TETRA TECH

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Project Number G01609

Ms. Maritza Montegross, RPM
NAVFAC MIDLANT, Northeast IPT
Building Z-144, 2nd Floor
Virginia Avenue
Norfolk, VA 23511

Reference: CLEAN Contract No. N62472-03-D-0057
Contract Task Order (CTO) No. 145

Subject: Final Record of Decision
Site 3 – Chlorinated Solvent Groundwater Plume
Naval Weapons Industrial Reserve Plant (NWIRP) Bedford, Massachusetts

Dear Ms. Montegross:

Tetra Tech is pleased to provide copies of the final Record of Decision for Site 3 at NWIRP Bedford, which was signed on September 29, 2010.

Please contact me at (978) 474-8449 or jim.ropp@tetratech.com should you have any questions.

Sincerely,

James Ropp
Project Manager

Enclosure – Final Site 3 ROD (2 hardcopies, 2 CDs)

c: V. Jurka, NAVFAC (w/ encl – email)
G. Lakner, NAVSEA (w/ encl. – email)
L. Williams, NAVSEA (w/ encl. – email)
M. Audet, EPA (w/ encl. – hardcopy, CD)
M. Moran, MassDEP (w/ encl. – hardcopy, CD)
D. Gallagher, MassDEP (w/ encl. – email)
T. Best, Hanscom AFB (w/ encl. – CD)
R. Miller, Tetra Tech (w/ encl. – email)
J. Trepanowski, Tetra Tech (w/o encl. – email)
G. Glenn, Tetra Tech (w/o encl. – email)
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Tetra Tech NUS, Inc.
55 Jonspin Road, Wilmington, MA 01887-1020
Tel 978.474.8400 Fax 978.474.8499 www.ttnus.com

SDMS DocID 469176

RECORD OF DECISION

SITE 3 - CHLORINATED SOLVENT GROUNDWATER PLUME

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

NAVFAC
Naval Facilities Engineering Command

SEPTEMBER 2010

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

Site 3 is the Chlorinated Solvent Groundwater Plume at the Naval Weapons Industrial Reserve Plant (NWIRP) Bedford, Massachusetts, United States Environmental Protection Agency (USEPA) ID number MA6170023570. NWIRP Bedford is shown on Figure 1.

1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the selected remedy for Site 3, which was chosen by the Navy and USEPA in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record for the site. The Massachusetts Department of Environmental Protection (MassDEP) statement regarding the selected remedy is presented in Appendix A.

FIGURE 1-1. NWIRP BEDFORD LOCATION MAP

1.3 ASSESSMENT OF SITE

The selected remedial action is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. A CERCLA action is required because concentrations of chlorinated solvents in groundwater would pose unacceptable risks to human health if site groundwater were to be used as a drinking water source.

1.4 DESCRIPTION OF SELECTED REMEDY

The major components of the selected remedy for Site 3 include the following:

- In-situ enhanced bioremediation of the source area
- Continued operation of the existing groundwater pump-and-treat system by the property line for plume capture and control
- Monitored natural attenuation (MNA)/long-term monitoring (LTM)
- Land use controls (LUCs)
- Five-year reviews

The selected remedy eliminates potential unacceptable human health risks associated with using site groundwater as a drinking water supply by reducing site-wide contaminant concentrations to drinking water standards. No unacceptable risks associated with site soil, sediment, or surface water were identified. No unacceptable risks associated with air are anticipated although LUCs will be implemented to prevent on-site building occupancy until further evaluations for potential vapor intrusion hazards are

conducted after source area remediation efforts have reduced contaminant concentrations. The remediation at Site 3 will not adversely impact the current use and reasonably anticipated future use of the site as an industrial facility. The selected remedy is expected to achieve substantial long-term risk reduction and allow the property to be used for the reasonable anticipated future land use, which is non-residential.

This ROD documents the final remedial action for Site 3 and does not include or adversely impact any other sites at NWIRP Bedford. The fringe of the Site 3 solvent plume overlaps with NWIRP Bedford's Site 4 benzene, toluene, ethylbenzene, and xylenes (BTEX) plume and the respective contaminants are co-mingled in that area. Remedial actions at Site 3 will be conducted in a manner that will not adversely impact the ongoing remedial action at Site 4. Groundwater contaminants in the overlapping area of Sites 3 and 4 are to be addressed through the same remedial action: MNA.

Implementation of the Site 3 remedy will allow for continued industrial use of the site, which is consistent with current use and the overall cleanup strategy for NWIRP Bedford of restoring sites to be consistent with the likely industrial property redevelopment and with the groundwater classification.

1.5 Statutory Determinations

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, satisfies the statutory requirements of CERCLA §121 and the regulatory requirements of the NCP, is cost-effective, and utilizes permanent solutions to the maximum extent practicable. This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, and/or volume of hazardous substances, pollutants, and contaminants as a principal element through treatment).

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years of initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment. Five-year reviews will be continued until site conditions are suitable for unlimited exposure and unrestricted use.

1.6 ROD Data Certification Checklist

The locations in Section 2.0, Decision Summary, of the information required to be included in the ROD are summarized in Table 1-1. Additional information can be found in the Administrative Record file for NWIRP Bedford.

Table 1-1. ROD Data Certification Checklist

Data	Location in ROD
Chemicals of concern (COCs) and their respective concentrations	Section 2.5.2 and Appendix B
Baseline risk represented by the COCs	Section 2.7
Cleanup levels established for COCs and the basis for these levels	Section 2.7 and 2.8
How source materials constituting principal threats are addressed	Section 2.11
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the risk assessment	Section 2.6
Potential land and groundwater uses that will be available at the site as a result of the selected remedy	Section 2.12.3
Estimated capital, operating and maintenance (O&M), and total net present worth (NPW) costs; discount rate; and number of years over which the remedy costs are projected	Appendix C
Key factors that led to the selection of the remedy	Section 2.12.1

1.7 AUTHORIZING SIGNATURES

David W. Anderson for

22 Sept 2010

Thomas W. Klima
Director, Installations and Equipment Office
Naval Sea Systems Command
U.S. Department of the Navy

Date

J T Owens II

9/29/10

James T. Owens III
Director, Office of Site Remediation and Restoration
U.S. Environmental Protection Agency, Region 1

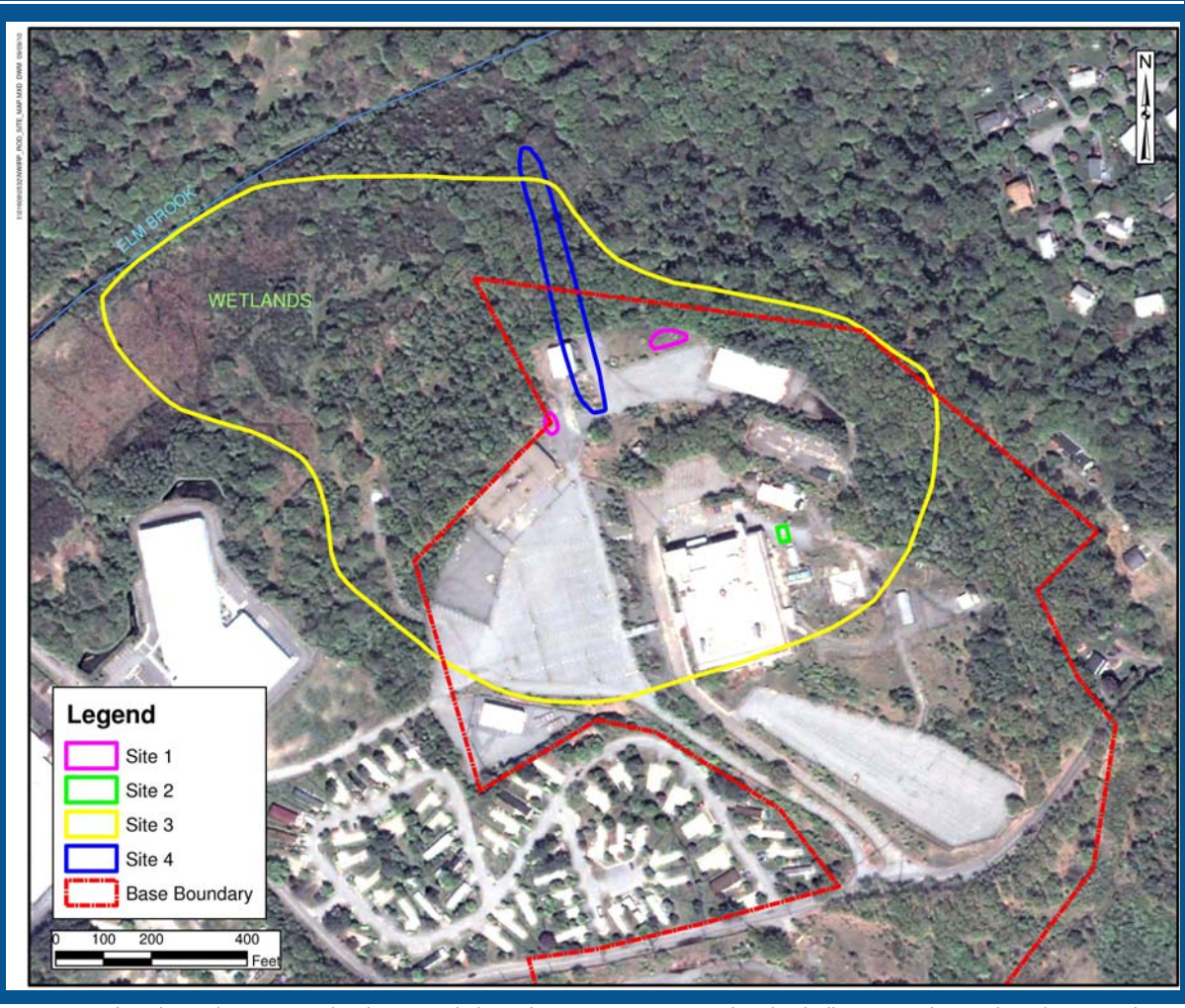
Date

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

NWIRP Bedford, USEPA ID number MA6170023570, is a 46-acre facility located in the Town of Bedford, Middlesex County, Massachusetts. NWIRP Bedford is owned by the Navy and was historically operated by the Raytheon Company of Waltham, Massachusetts. The mission of NWIRP Bedford was to design, fabricate, and test prototype weapons equipment such as missile guidance and control systems. Activities at NWIRP Bedford were historically conducted in two main structures: the Components Laboratory north of Hartwell Road, and the Flight Test Facility to the south. Raytheon conducted its operations at NWIRP Bedford from the mid-1950s through December 2000. The facility has remained vacant since that time except for the Navy's operation of a groundwater pump-and-treat system as an interim remedial action for Site 3 from 1997 to the present. Site 3, the Chlorinated Solvent Groundwater Plume, comprises the area in the northern portion of NWIRP Bedford where elevated chlorinated volatile organic compound (CVOC) concentrations were detected in groundwater (see Figure 2-1). The predominant Site 3 COC is trichloroethene (TCE).

FIGURE 2-1. NWIRP BEDFORD SITE MAP



Note: The Site 3 plume extent in Figure 2-1 is based on 2002-2006 TCE data in shallow groundwater (1 µg/L contour).

Site 3 consists of a subsurface source area of CVOCs in soil and groundwater and a plume of dissolved-phase CVOCs in groundwater extending primarily northwest to a wetland area on private property. The

source area is located atop Hartwells Hill under the paved shipping and receiving (loading dock) area associated with the Components Laboratory building.

NWIRP Bedford is an inactive facility, and environmental investigations and remediation at the base are funded under the Environmental Restoration, Navy (ER,N) program. The Navy is conducting its Installation Restoration (IR) Program (i.e., environmental investigation and remediation program) at NWIRP Bedford in accordance with a Federal Facility Agreement (FFA) between the Navy and USEPA (USEPA, 1999a). The FFA became effective in September 1999 and established the Navy as the lead agency for the investigation and specified cleanup of designated sites within the NWIRP Bedford property, with USEPA providing oversight. The MassDEP is not party to the FFA; however, in accordance with CERCLA and the NCP, MassDEP has participated in discussions and strategy sessions, as well as provided oversight and guidance through their review of the Navy's IR Program documents. The status of the other sites at NWIRP Bedford is summarized in Section 2.4

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Table 2-1 provides brief summaries of previous investigations at Site 3. Results of these investigations indicated that elevated concentrations of CVOCs are present in groundwater. The nature and extent of groundwater contamination is presented in Section 2.5.2.

TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION

INVESTIGATION	DATE	ACTIVITIES
Initial Assessment Study (IAS)	1986	Under the IR Program, the Navy began evaluating the environmental conditions at NWIRP Bedford with the IAS which recommended the implementation of a groundwater and surface water monitoring program.
Phase I Remedial Investigation (RI) and Supplemental Investigation	1990	The facility-wide Phase I RI evaluated underground storage tanks (USTs), leach fields, drywells, and waste storage areas as locations of potential sources of environmental contamination. The Navy collected over 400 soil samples, 23 groundwater samples, and 4 surface water samples across NWIRP Bedford. **Chlorinated solvents** were detected in groundwater at concentrations that exceeded federal and state drinking water standards. A supplemental investigation was conducted to address concerns about the origin and migration of the volatile organic compounds (VOCs) detected in groundwater. It included a **facility inspection and records review**, three additional rounds of groundwater monitoring, and a soil gas survey. The soil gas survey was conducted with a total of 38 sample locations on a 100-foot sampling grid in three areas of the facility. Elevated VOC concentrations were detected in several areas including northwest of the Facilities Storage Building and the north central area around the Components Laboratory. These areas would be identified as part of Site 3 in the Phase II RI.
Draft Phase II RI	1993-1997	The Phase II RI further characterized the sources of VOCs on Navy property, including what was now designated as the Site 3 chlorinated solvent plume and the Site 4 BTEX plume. The Phase II RI also characterized the off-property extent of the Site 3 and Site 4 VOC plumes in groundwater.
Short Term Measure (STM) Design and Implementation	1993-1995	To prevent the migration of CVOCs from Site 3 to Elm Brook and the associated wetlands, the Navy implemented the STM, later called the Immediate Response Action in accordance with state environmental restoration terminology, and now called the Interim Remedial Action (IRA). The IRA is comprised of a groundwater pump-and-treat system that has been operating since March 1997 to prevent the migration of groundwater contamination to the off-property wetland area.
Immediate Response Action (IRA) Monitoring and Evaluation	1996-present	Several studies were completed for the IRA. The February 1999 and February 2000 IRA monitoring reports included a detailed analysis of the **hydraulic capture** of the CVOC plume, the impact to surrounding groundwater quality, and the overall effectiveness of the IRA system. These reports concluded that the IRA system was effective at capturing a significant portion of the shallow CVOC plume, and that groundwater concentrations of CVOCs in downgradient wells were showing declining trends. The Navy has been conducting quarterly or semi-annual

TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION		
INVESTIGATION	**DATE**	**ACTIVITIES**
		groundwater monitoring of over 40 wells on- and off-Navy property since system start-up in 1997. Monitoring wells are located in the shallow overburden, deep overburden, and bedrock groundwater zones.
Final Phase II RI and Site 3 Supplemental Investigation	2000	The Phase II RI further detailed the previous RI activities and presented the results of a **Human Health Risk Assessment** (HHRA) and an **Ecological Risk Assessment** (ERA) for NWIRP Bedford. The investigations included over 100 surface and subsurface soil samples, 28 sediment samples, 12 surface water samples, 66 groundwater samples, 8 benthic macroinvertebrate samples, and soil vapor surveys in 7 areas across the facility. A supplemental investigation was conducted that included seven downgradient groundwater samples as well as four soil samples, two groundwater samples, and two soil vapor samples in the vicinity of/under the Components Laboratory. The results of the supplemental investigation indicated that the Site 3 source area is located in the shipping and receiving area associated with the Components Laboratory, but that the source is not beneath the Components Laboratory building itself.
Results for the Characterization of the Site 3 Pilot Study Area	2002	This subsurface investigation of the Site 3 source area included a **geophysical survey**, monitoring well installations, hydraulic conductivity testing, and groundwater sampling. Nine soil samples and 16 groundwater samples were collected. The results of the investigation were used to help plan for and design a source area treatment pilot study and to provide a baseline data set for the pilot study.
Site 3 Pilot Study Work Plan	2003	This document presented the **rationale** for the selection of an in-situ thermal treatment technology for the source area pilot study.
Summary of Sampling and Analysis Results for Components Laboratory Investigation	2004	Based on the **additional subsurface investigations** underneath and adjacent to the Components Laboratory, it was **concluded** that the Site 3 CVOC plume was not the result of contaminant releases from past practices within the Component Laboratory Building itself. Eleven soil samples, five soil gas samples, and two groundwater samples were collected during this investigation.
Closeout Report for Site 3 Thermal Treatment Pilot Test	2005	The Closeout Report presented the results of the Electrical Resistance Heating (ERH) pilot study and concluded that full-scale application of ERH may be capable of achieving a **95 percent or greater** reduction of total CVOCs in the source area. Twenty subsurface soil samples were collected prior to the test and multiple rounds of groundwater samples were collected from 17 wells was before, during, and after the application of the thermal treatment technology.
Modeling Report for Site 3	2007	The purpose of the revised, three-dimensional **groundwater computer model** was to help evaluate the remedial alternatives being developed in the Site 3 FS.
Source Area Investigation Report	2010	A supplemental subsurface soil and groundwater sampling program further delineated the extent of the Site 3 source area to assist in the evaluation of remedial alternatives and to provide data to be used during the Remedial Design phase. Eight samples were collected from the deep overburden groundwater in the source area. Eleven soil borings in the source area were also installed to depths of up to 75 feet and had continuous 2-foot soil screening samples, 13 confirmatory soil samples, and 15 dye tests to search for potential dense, non-aqueous phase liquid (DNAPL). **No DNAPL** was found during this or any previous investigation, indicating that DNAPL is either not present or is not present in appreciable quantities that can be located and targeted for treatment or removal.
Feasibility Study (FS)	2010	The FS identified Remedial Action Objectives (RAOs), screened potential remedial technologies, and developed and evaluated remedial alternatives based on the available information from previous investigations. The final FS presented **five remedial alternatives** to address CVOC contamination in Site 3 groundwater.

There have been no cited violations under federal or state environmental law or any past or pending enforcement actions pertaining to the cleanup of Site 3.

2.3 COMMUNITY PARTICIPATION

The Navy performs public participation activities in accordance with CERCLA and the NCP throughout the site cleanup process at NWIRP Bedford. The Navy prepared a **Community Relations Plan** in 1992 that outlined a program to address community concerns and keep citizens informed about and involved in remediation activities. During the site's history, the Navy has kept the community and other interested parties apprised of Site 3 activities through informational meetings, fact sheets, press releases, and contact with local officials. Since March 1996, the Navy also has periodically met to discuss the status and progress of the IR Program with the Restoration Advisory Board (RAB). Representatives from the Navy, USEPA, MassDEP, and local government and community have attended the RAB meetings.

The Navy has developed an Administrative Record that is available for public review at the Naval Facility Engineering Command (NAVFAC) office in Norfolk, Virginia. A local Information Repository with a copy of the Administrative Record also has been established at the Bedford Free Public Library reference desk, 7 Mudge Way, Bedford, Massachusetts (http://www.bedfordlibrary.net/). The Administrative Record contains the documents and other relevant information that was relied on in the remedy selection process for Site 3. The Administrative Record has been made available on CD since December 2004 (updated in March 2010).

In accordance with Sections 113 and 117 of CERCLA, the Navy held a 30-day public comment period from July 15 to August 13, 2010, for the Site 3 Proposed Plan. A public meeting to present the Proposed Plan and answer questions was held on July 21, 2010, at the Bedford Town Hall. A public hearing was held immediately thereafter to solicit public comments for the record. A transcript of the oral comments received during the public hearing is presented in Appendix D. Public notices announcing the meeting and the availability of documents were published in the local Bedford Minuteman and Lexington Minuteman newspapers. No written comments were received during the 30-day comment period.

2.4 SCOPE AND ROLE OF OPERABLE UNIT

Site 3 is part of a comprehensive environmental investigation and cleanup program currently being performed at NWIRP Bedford under CERCLA authority pursuant to the FFA dated September 14, 1999. As outlined in the FFA, the following CERCLA Operable Units have been undergoing study and cleanup:

- Site 1 – Old Incinerator Ash Disposal Area
- Site 2 – Components Laboratory Fuel Tank
- Site 3 – Chlorinated Solvent Groundwater Plume
- Site 4 – BTEX Plume

Site 3 is the subject of this ROD. The remaining sites are progressing through the CERCLA cleanup process independently from Site 3. Separate RODs for Site 1 and Site 2 were completed in 2000 and documented that no further action was required for those sites. The Site 4 ROD was signed in 2009 with a selected remedy of excavation of source area soil followed by MNA of residual COCs in groundwater. Site 4 is currently in the remedial design stage. The annual Site Management Plan (SMP) for NWIRP Bedford includes detailed schedules for CERCLA activities and is available for public review as part of the Administrative Record.

Investigations at Site 3 indicated the presence of groundwater contamination from past facility operations that would pose an unacceptable human health risk if site groundwater were to be used as a drinking water source. Therefore, the Navy has implemented a groundwater extraction and treatment system at the facility property line as an interim remedial action. The remedy documented in this ROD will achieve RAOs for Site 3, as listed in Section 2.8. Implementation of this remedy will be consistent with the site's groundwater classification, will mitigate the identified unacceptable risks, and will allow for continued industrial use of the site, which is consistent with current and reasonably anticipated future property use and the overall cleanup strategy for NWIRP Bedford of restoring sites to support property transfer.

The selected remedy will mitigate potential threats and present the final response action for Site 3. The Site 3 ROD is one component of the Superfund program at NWIRP Bedford and, as such, has proceeded on an independent track to enable the Navy to expedite site closure and eventual property transfer. The proposed remedy for Site 3 is not expected to have an adverse impact on the strategy or progress for the remaining operable unit (Site 4) at NWIRP Bedford. The fringe of the Site 3 solvent plume overlaps with the Site 4 BTEX plume and the respective COCs are co-mingled in that area. Remedial actions at Site 3 will be conducted in a manner that will not adversely impact the remedial action at Site 4. Dissolved-phase COCs in groundwater in the overlapping area of Sites 3 and 4 are being addressed through the same remedial action, MNA.

2.5 SITE CHARACTERISTICS

Figures 2-2 and 2-3 present the Site 3 conceptual site model (CSM) for the source area and downgradient areas, respectively. The CSM identifies contaminant sources, contaminant release mechanisms, and transport routes. The extent of the Site 3 plume in deep overburden groundwater is presented in Figure 2-4. The evaluated contaminant exposure pathways and potential human and ecological receptors under current and potential future land use scenarios are presented in Section 2.7.

FIGURE 2-2. CONCEPTUAL SITE MODEL – SOURCE AREA

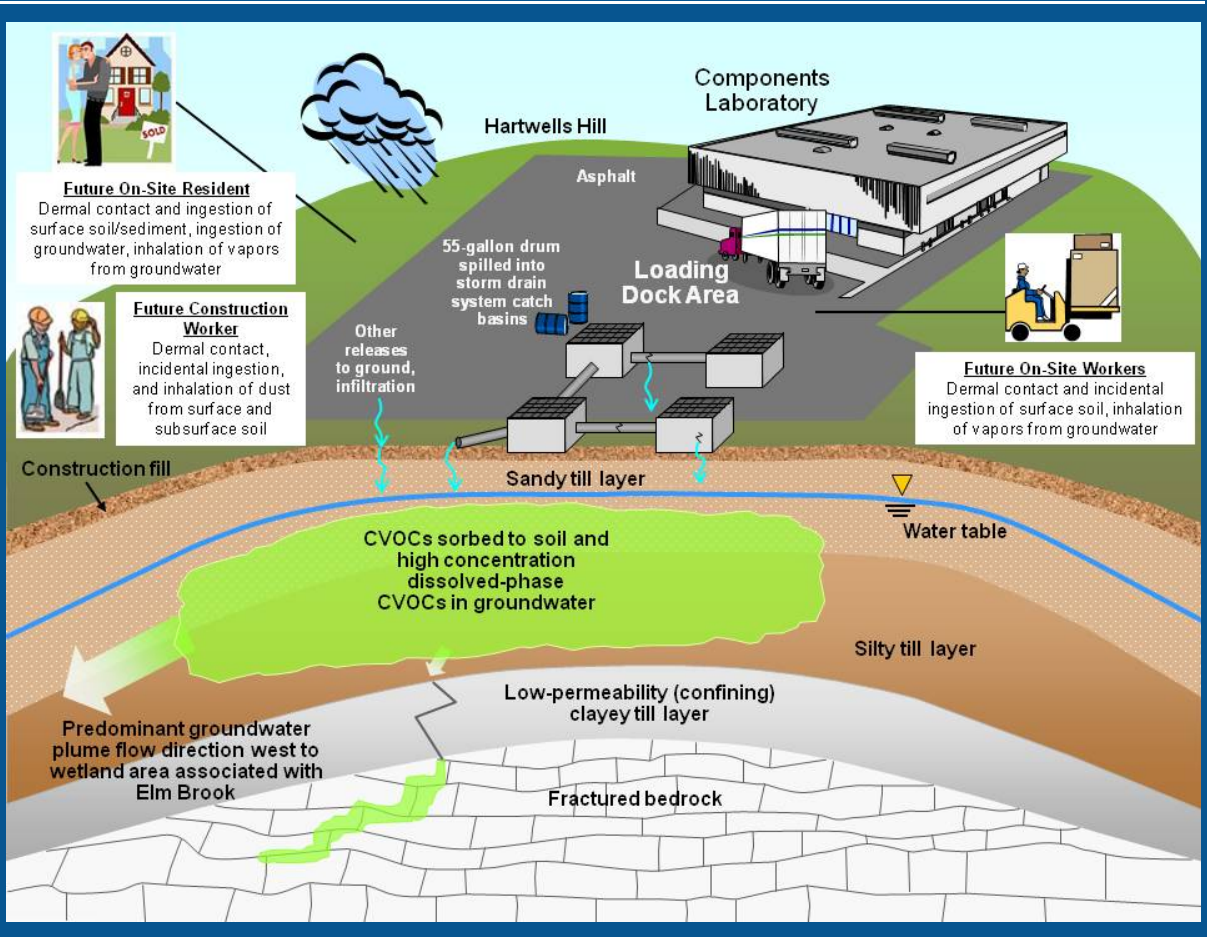


FIGURE 2-3. CONCEPTUAL SITE MODEL – DOWNGRADIENT AREAS

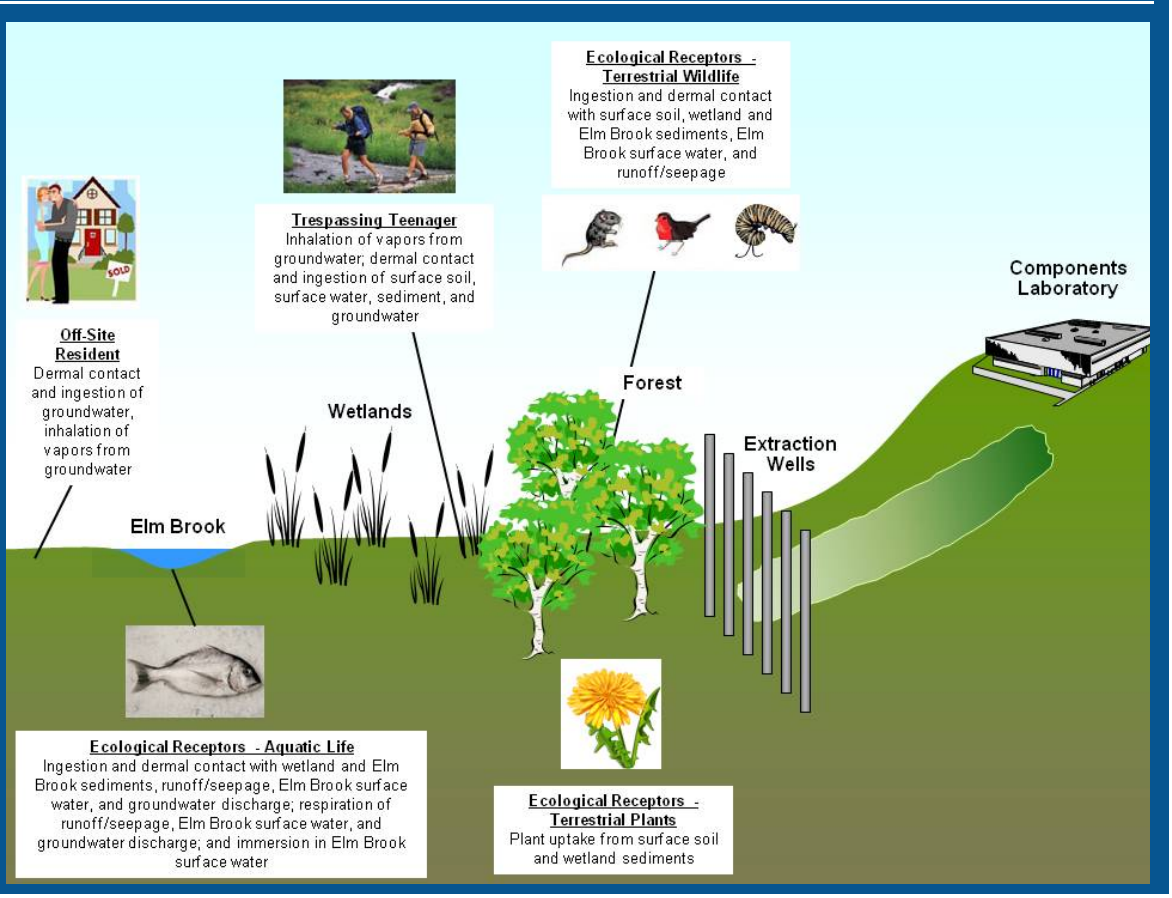


FIGURE 2-4. TRICHLOROETHENE CONCENTRATIONS IN DEEP OVERBURDEN GROUNDWATER (2002-2006 DATA)

2.5.1 Physical Characteristics

The Site 3 source area is beneath the paved, shipping and receiving area on the north side of the Components Laboratory atop of Hartwells Hill (see Section 2.5.2). The topography of the source area is relatively flat with a gentle slope to the north, away from the Components Laboratory. A steep hillside abuts the loading dock area to the north, east, and west. Four storm water catch basins are present within the loading dock area. The **peak elevation** of Hartwells Hill is approximately 205 feet above mean sea level (msl). The Site 3 plume extends from the top of Hartwells Hill primarily northwest towards an off-property wetland area and Elm Brook, which borders NWIRP Bedford to the north and west (Figure 2-4). These wetlands represent the local topographical low, with elevations ranging from approximately 110 to 114 feet above msl. Elm Brook has its headwaters located 4 miles upstream of the site and converges with the Shawsheen River approximately 1 mile downstream (northeast) of the site.

The geology of Site 3 can be divided into two distinct regimes: (1) imported fill underlain by fine-grained glacial till deposits beneath, and along the flanks of Hartwells Hill, and (2) the lacustrine and outwash deposits beneath the low-lying wetlands associated with Elm Brook. The transition between the lacustrine/outwash and till/moraine deposits occurs along the lower flanks of Hartwells Hill. The Site 3 IRA groundwater extraction system which prevents the groundwater plume from migrating to the off-property wetlands is located at the base of the western edge of Hartwells Hill in this transition zone.

The surface topography of Hartwells Hill is sloped most steeply on the northwestern and southeastern sides, and less steeply on the eastern and southwestern sides, forming a nearly classic drumlin shape with the long axis oriented in the northwest-southeast direction. The glacial deposits on Hartwells Hill consist of sandy till underlain by silty till and then a dense clayey till on top of bedrock. The glacial deposits mantle the bedrock topography on both the hill and flat areas. The sandy till is generally thin in lowland areas and thicker (up to 73 feet) and more variable on the hill. The silty till ranges in thickness from 4 to 75 feet, with the thickest part of the unit on the western slope of the hill. The clayey till is absent on the flanks of the hill in some locations and ranges in thickness up to 96 feet beneath the hill. Each “till” contains a compact, heterogeneous mixture of particle sizes ranging from clay to gravel. The terms “sandy”, “silty” and “clayey” refer to the predominant particle size from the geologic boring logs. Sand and gravel fill, placed during construction of NWIRP Bedford, is found overlying the sandy till at thicknesses up to 26 feet on the crest of the hill.

To the northwest of Hartwells Hill, in the low-lying area of Elm Brook and associated wetlands, seven geologic units are encountered at various well locations overlying bedrock. These units are as follows, in order of descending depth, peat/loam, lacustrine sand, lacustrine silt/clay, glacial outwash sand/gravel, sandy till, silty till, and clayey till. The organic peat and loam ranges in thickness from 0 to 4 feet and is generally thicker near the brook and thinner towards the hill. The peat is limited to the wetlands area, but the loam is encountered in undisturbed areas closer to Hartwells Hill. The lacustrine sand is encountered below the peat and loam and at the surface when the organic layer is absent. The sand is 24 feet thick near the brook, and thins to 10 feet or less along the flanks of the hill. To the northeast of Hartwells Hill is also a low-lying area with the same general geologic material as the northwestern side of the hill (i.e., lacustrine silts and sands), but the organic peat and loam layer that is associated with the brook is absent.

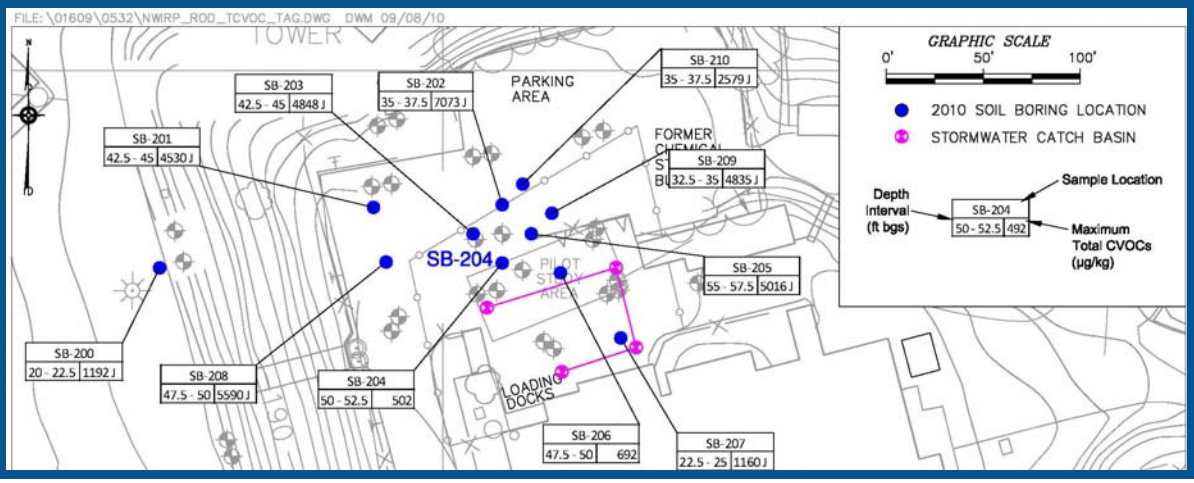
Precipitation falling on top of Hartwells Hill infiltrates through the unsaturated zone and recharges the underlying shallow groundwater. At the top of the hill, the principle water-bearing unit in the vicinity of Site 3 is the sandy till. The depth to the water table beneath the top of the hill at the Site 3 source area is typically between 20 to 25 feet below ground surface (bgs). Groundwater generally moves laterally and vertically away from the hill, although flow from the highest elevation, by the northern end of the Components Laboratory, shows a strong westerly component of flow. Due to the topography, pavement, storm water system, and low-permeability soils, the amount of recharge in the Site 3 source area is probably low.

2.5.2 Nature and Extent and Fate and Transport of Contamination

During the RI and related investigations, samples of site soil, sediment, surface water, and groundwater were collected to determine the nature and extent of contamination. The greatest CVOC concentrations in soil and groundwater were detected in the Components Laboratory Shipping and Receiving area, which is identified as the primary source area of the CVOC plume. In 1976, approximately 55 gallons of **Axothene** (which contains 1,1,1-trichloroethane [TCA]) were reported to have spilled from a ruptured storage drum on the northern side of the Components Laboratory. The spilled solvent reportedly emptied into a nearby storm drain, where it entered the ground at the storm drain discharge in a grassy area on the northwestern portion of Hartwells Hill. Although there are **no other documented releases** of chlorinated solvents, it is likely that additional similar releases have occurred at the Components Laboratory loading dock, or from other support buildings in the northern portion of NWIRP Bedford (e.g., Facility Storage Building – see Figure 2-1), during the use, storage, and handling of solvents in this area. The Site 3 plume is believed to be the result of various relatively small random releases and not from a deliberate practice of waste disposal. The predominant contaminant at Site 3 is TCE, as it is present at some of the highest concentrations in soil and groundwater and is one of the main contributors to the identified site risks to human health. In addition to 1,1,1-TCA and TCE, other chlorinated solvents detected in groundwater in the vicinity of the Components Laboratory and Facility Storage Building include tetrachloroethene (PCE), cis-1,2-dichloroethene (DCE), 1,1-DCE, 1,2-dichloroethane (DCA), 1,1-DCA, and vinyl chloride (VC).

The Site 3 source area includes the high concentrations of dissolved-phase CVOCs in groundwater as well as some CVOCs sorbed to subsurface saturated soil. Based on the result of the 2010 Source Area Investigation, **elevated CVOC concentrations** have been detected throughout the compact, saturated, sandy and silty till units in the Components Laboratory shipping and receiving area, generally from 30 to 50 feet bgs and extending to 60 feet bgs in some areas. The highest CVOC concentrations in soil and groundwater were found in an approximately 6,700 square-foot area in the northwest portion of the shipping and receiving area. Based on that lateral extent and depth interval which comprises the primary source area, the estimated volume of contaminated soil below the groundwater table is approximately **7,447 cubic yards (CY)**. No DNAPL has been identified during any of the investigations at the site, although it was initially suspected to be present based on the elevated CVOC concentrations detected in source area soil and groundwater. Therefore, DNAPL is either not present at Site 3, or is not present in an appreciable amount that can be located and targeted for direct removal. Figure 2-5 shows the maximum total CVOC concentrations from the confirmatory soil data collected during the 2010 Source Area Investigation. The additional soil screening data from the same sampling event had a maximum total CVOC concentration of 28,431 micrograms per kilogram (µg/kg) (in sampling location SB-205 at a depth of 47.5 to 50 feet bgs).

FIGURE 2-5. EXTENT OF TOTAL CVOCS IN SOIL



Past releases of CVOCs migrated down through the sandy till and stopped in the underlying silty till layer (due to a reduction in hydraulic conductivity) before reaching the bottom clayey till layer. Residual contamination that may have been present in the unsaturated (vadose) zone above the groundwater table has dissipated through volatilization or diffusion and is no longer a source of dissolved-phase contamination. The vadose zone currently does not appear to be contaminated. The CVOC plume in groundwater primarily migrates through unconsolidated (overburden soil) deposits; however, lower concentrations of CVOCs are also present in the bedrock groundwater.

The dissolved-phase plume consists of dissolved CVOCs in dynamic equilibrium with pore-water concentrations in low-permeability matrices and contaminants sorbed to aquifer solids. The dissolved-phase overburden plume migrates according to the groundwater flow regime and ultimately discharges from shallow groundwater into Elm Brook at trace to low concentrations where no unacceptable risks were identified. The available groundwater data from initial site characterization and subsequent sampling/monitoring events indicate that CVOC concentrations in groundwater in the wetland area are decreasing.

2.6 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

NWIRP Bedford was an active research facility from the mid-1950s until Raytheon's departure in December 2000. Since that time, the facility has remained vacant and inactive except for the Navy's operation of the IRA system. NWIRP Bedford is a vacant/inactive industrial area that is fenced and gated by the Navy to control access. Despite the current physical access controls, trespassing by teenagers and adults has been observed and some vandalism has occurred.

Land uses surrounding NWIRP Bedford are both industrial and residential in nature. NWIRP Bedford is abutted to the west and north by undeveloped woodland and wetland areas. A residential area and additional wooded wetlands are located to the east and northeast. Other properties abutting NWIRP Bedford include Raytheon Missile Systems Division facilities to the west, and Hanscom Field (formerly Hanscom Air Force Base) to the south. The Town of Bedford zoning for the majority of the NWIRP Bedford property is for use as an industrial park. The area north of the Components Laboratory and the off-property wetland area are zoned for residential use.

Reuse plans for the facility are currently being prepared under the direction of the Naval Sea Systems Command (NAVSEA) and will likely involve property transfer because the Navy considers the property to be excess. The reasonably foreseeable future use of Site 3, NWIRP Bedford, and surrounding areas is expected to be similar to the current use pattern (i.e., industrial use on the NWIRP property and a mix of commercial/industrial and residential uses in the surrounding areas). Further residential development of the portion of Site 3 on non-Navy property is unlikely due to the presence of the wetlands.

Groundwater at NWIRP Bedford and the Site 3 area is not currently used as a drinking water supply; however, groundwater in this area is classified under MassDEP drinking water regulations as "Zone II" and "Zone III". Zone II refers to a portion of an aquifer that would contribute to a drinking water well under the most severe pumping and recharge conditions and that is bounded by the groundwater divides that result from pumping the well and by contact of the aquifer with less permeable materials such as till or bedrock. Zone III refers to the land beyond the Zone II area from which surface water and groundwater drain into Zone II.

The NWIRP Bedford property on Hartwells Hill is within the Zone II area and the wetland area associated with Elm Brook is in the Zone III area. This Zone III area, which contains the western portion of the Site 3 plume, is associated with the Hartwell Road municipal water supply wellfield, located less than a half-mile northwest of NWIRP Bedford (Figure 1-1). The wellfield has been inactive since 1984 due to the detection of various contaminants in those wells, including CVOC concentrations in excess of drinking water standards. The source of the wellfield CVOC contamination has not been identified. Although the town wellfield is inactive, it has not been officially abandoned under MassDEP regulations, and the Town of Bedford has contingency plans to reactivate the wells at some time in the future. The Navy's investigations indicate that the Site 3 **plume does not extend beyond Elm Brook** to the town wellfield

and **other CVOC plumes** not related to NWIRP Bedford are known to be present in the area. However, the Navy's 2007 groundwater computer model indicated that if no further cleanup action were to be taken at Site 3, then the Site 3 plume could eventually be drawn past Elm Brook to the wellfield if it were to be reactivated. The extent of the Site 3 plume does not reach private wells located in the residential neighborhood to the northeast of NWIRP Bedford (these private wells are unlikely to be used for drinking water because the residences are connected to the **municipal public water supply**.

In 1997, the Town of Bedford adopted a bylaw to establish an Aquifer Protection District (APD) to secure its membership into, and subsequent purchases of drinking water from, the Massachusetts Water Resource Authority (MWRA). An APD is an area designated by a municipality for the protection of groundwater as a source of municipal supply. The state views an APD as a potential drinking water source area. In 1998, MassDEP determined that groundwater underlying NWIRP Bedford is of "high use and value". The Groundwater Use and Value Determination (GUVD) conducted by MassDEP is presented in Appendix E.

2.7 SUMMARY OF SITE RISKS

The baseline risk assessment was performed to estimate what risks the site poses if no action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. A baseline human health and ecological risk assessment was conducted for the whole of NWIRP Bedford during the Phase II RI, as finalized in 2000. In 2001, a baseline HHRA addendum was conducted to account for the change in groundwater classification per the APD and GUVD. The 2001 addendum evaluated an **additional exposure pathway** specific to Site 3: on-site residential use of Site 3 groundwater for drinking water. The overall baseline risk assessment conducted during both studies evaluated several current and reasonably expected future exposure scenarios. The 2001 assessment provides the basis for taking action at Site 3, and identifies the compounds and exposure pathway that need to be addressed by the selected remedy. Changes to the Site 3 plume have occurred since 2001 as a result of the 2003 source area treatment, the continued operation of the IRA system, and natural attenuation mechanisms; therefore, the groundwater data used in the 2000 and 2001 do not represent current conditions. In 2010, supplemental risk evaluation for Site 3 was prepared as part of the FS using May 2010 USEPA Regional Screening Levels (RSLs) and February 2010 groundwater data from the Site 3 source area. The results of the 2010 evaluation further support the basis for taking action at Site 3.

2.7.1 Summary of Human Health Risk

The quantitative HHRA was conducted using chemical concentrations detected in surface soil, subsurface soil, groundwater, surface water, and sediment samples (see Table 2-2). Key steps in the risk assessment process included identification of chemicals of potential concern (COPCs), exposure assessment, toxicity assessment, and risk characterization. Tables summarizing data used in the HHRA and associated results are presented in Appendix B. Tables B-1 through B-4 pertain to the 2000 HHRA, Tables B-5 through B-16 pertain to the 2001 HHRA addendum, and Tables B-17 and B-18 pertain to the 2010 risk evaluation (screening).

Identification of COPCs

Tables B-1 and B-5 present the exposure point concentrations (EPCs) for the COPCs identified in environmental media at NWIRP Bedford. EPCs are the concentrations used in the risk assessment to estimate exposure and risk from each COPC. For each COPC, the table includes the range of detected concentrations, the number of times the chemical was detected in samples collected at the site, the EPC, and how the EPC was derived.

Exposure Assessment

During the exposure assessment, current and potential future exposure pathways through which humans might come into contact with the chemicals identified in the previous step were evaluated. The results of the exposure assessment for Site 3 were used to refine the CSM (Figure 2-2), which identifies potential contaminant sources, contaminant release mechanisms, transport routes, and receptors under current and future land use scenarios. Potential exposure routes for surface and subsurface soil include dermal contact, ingestion, and inhalation of soil-derived dust. Potential exposure routes for surface water include dermal contact and ingestion. Potential exposure routes for sediment include dermal contact and ingestion. Potential exposure routes for groundwater include ingestion of drinking water, inhalation of volatile compounds in indoor air and while showering. Exposure via inhalation while showering was expressed quantitatively by assuming that the risks from inhalation are equal to those from ingestion of groundwater. Inhalation of VOCs in indoor air were only qualitatively evaluated. The 2000 HHRA considered receptor exposure to soil, surface water, sediment, and groundwater under industrial land use (on-site workers, construction workers, and trespassing teenagers) and off-site (off Navy property) residential land use. The 2000 HHRA also considered future **on-site residential exposure to surface soil and drainage area sediment**. The 2001 HHRA Addendum considered future hypothetical on-site residential land use as an additional receptor for groundwater. Inhalation of VOCs while showering were only evaluated in the 2001 HHRA. Current and hypothetical future exposure pathways at Site 3 are summarized in Table 2-2.

TABLE 2-2. RECEPTORS AND EXPOSURE ROUTES EVALUATED IN HHRAS

RECEPTORS	EXPOSURE ROUTES
2000 HHRA	
On-Site Workers (future land use)	• Dermal contact (on-site surface soil) • Ingestion (on-site surface soil) • Inhalation of volatile compounds in indoor air (on-site groundwater)[a]
Construction Workers (future land use)	• Dermal contact (on-site surface and subsurface soil) • Ingestion (on-site surface and subsurface soil) • Inhalation of soil-derived dust (on-site surface and subsurface soil)[a]
Trespassing Teenagers (current and future land use)	• Dermal contact (on-site/off-site surface soil, surface water, sediment, off-site groundwater)[a] • Ingestion (on-site/off-site surface soil, surface water, sediment, off-site groundwater)[a] • Inhalation of volatile compounds in indoor air (off-site groundwater)[a]
Off-Site Residents (current and future land use)	• Dermal contact (off-site groundwater)[a] • Ingestion (off-site groundwater) • Inhalation of volatile compounds in indoor air (off-site groundwater)[a] • Inhalation of volatile compounds while showering (off-site groundwater)[a]
On-Site Residents[b] (future land use)	• Dermal contact (on-site surface soil and sediment) • Ingestion (on-site surface soil and sediment)
2001 HHRA ADDENDUM	
On-Site Residents (hypothetical future land use)	• Ingestion (on-site groundwater) • Inhalation of volatile compounds while showering (on-site groundwater)

(a) Qualitative evaluation
(b) Did not evaluate exposure to subsurface soil.

The 2000 risk assessment evaluated the indoor air (vapor intrusion) pathway qualitatively rather than quantitatively. Therefore, because CVOC concentrations in groundwater exceed USEPA screening levels for potential vapor intrusion, the selected remedy includes an interim LUC to address the vapor intrusion pathway.

Toxicity Assessment

Toxicity assessment involves identifying the types of adverse health effects caused by exposure to site COCs and determining the relationship between the magnitude of exposure and the severity of adverse effects (i.e., the dose-response relationship) for each COPC. Based on the quantitative dose-response relationships determined, toxicity values for both cancer (cancer slope factor [CSF]) and non-cancer (reference dose [RfD]) effects were derived and used to estimate the potential for adverse effects.

Tables B-2 and B-6 provide carcinogenic risk information relevant for the evaluated exposure pathways during the 2000 and 2001 risk assessments, respectively. Tables B-3 and B-7 provide the respective non-carcinogenic hazard information.

Risk Characterization

During the risk characterization, the outputs of the exposure and toxicity assessments are combined to characterize the baseline risk (cancer risks and non-cancer hazards) at the site if no action were taken to address the contamination. Potential cancer risks and non-cancer hazards were calculated based on reasonable maximum exposure (RME) and central tendency case (CTC) assumptions during the 2000 HHRA and based only on RME assumptions during the 2001 HHRA Addendum. The RME scenario assumes the maximum level of exposure that could reasonably be expected to occur, and the CTC scenario assumes a median or average level of human exposure.

Cancer risks are characterized as the incremental increase in the probability that an individual will develop cancer during his or her lifetime due to site-specific exposure. The term "incremental" implies the risk due to environmental chemical exposure above the background cancer risk experienced by all individuals in the course of daily life. Cancer risks are expressed as a probability (e.g., one in a million, or $1x10^{-6}$) of an individual developing cancer over a lifetime, above background cancer risk, as a result of exposure. Excess lifetime cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where: risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (in mg/kg-day)
SF = slope factor (in mg/kg-day^{-1})

USEPA's generally acceptable risk range for site-related exposures is 1×10^{-4} to 1×10^{-6}.

Table B-4 presents the RME cancer risk estimates from the 2000 risk assessment for the receptors and routes of exposure developed by taking into account various conservative assumptions about the frequency and duration of exposure for each receptor and also about the toxicity of the COPCs. Table B-10 presents the incremental cancer risks from the 2001 assessment for the on-site residential use of groundwater scenario, which is the resultant exposure pathway of concern for Site 3. Carcinogenic risks for all exposure routes range from 1.1×10^{-7} for the construction worker to 3×10^{-2} for the future resident. Only the hypothetical future residential exposure scenario exceeds USEPA's acceptable risk range of 1×10^{-6} to 1×10^{-4}. The primary cancer risk drivers were identified as 1,1-DCE, 1,2-DCA, PCE, TCE, and VC.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., a lifetime) to an RfD derived for a similar exposure period. An RfD represents a level to which an individual may be exposed that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic non-carcinogenic effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all chemicals that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may be reasonably exposed. An HI less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-carcinogenic effects from

all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health. The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI} / \text{RfD}$$

where: CDI = chronic daily intake
RfD = reference dose

CDIs and RFDs are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or short-term).

Table B-4 presents the RME non-cancer HQ from the 2000 risk assessment for the receptors and routes of exposure. Table B-11 presents the non-cancer Hazard Index from the 2001 assessment for the on-site residential use of groundwater scenario. Total HIs for all exposure routes range from 0.01 under the site worker scenario to 100 under the hypothetical future on-site resident scenario. The magnitude of the on-site residential HI, which exceeds the USEPA acceptable level of 1, is the result of assumed exposure via the use of on-site groundwater as a drinking water supply. Much of the predicted excess non-cancer risk was associated with exposure to 1,1-DCE, TCE, PCE, and cis-1,2-DCE in groundwater. HI calculated for several chemicals impacting the liver and blood systems (i.e., the liver/blood system is the primary target organ) exceed 1, indicating a potential for adverse non-carcinogenic health impacts under the conditions established in this assessment.

Based on the results of the HHRA, RME carcinogenic and non-carcinogenic risks associated with groundwater were identified that require a response action for hypothetical future on-site residents. The RME receptor is the highest exposure that is reasonably expected to occur at a site. Exposure assumptions (e.g., body weight, exposure duration) typically adopt a median or 95th percentile value of the exposure variable. The risk assessment uses assumptions that have associated uncertainties. The effect of using numerous assumptions that overestimate potential exposure and toxicity is to ensure adequate protection of human health. In addition, natural attenuation processes and the 2003 ERH pilot study conducted in part of the source area have reduced the COC concentrations at Site 3. Therefore, the 2000 and 2001 risk assessments presented herein likely overestimate the current risks associated with Site 3. In 2010, an additional risk evaluation was performed to provide an updated evaluation of the hypothetical future on-site residential RME scenario (groundwater ingestion) using current risk assessment assumptions and recent (post pilot-study) groundwater data from the Site 3 source area (Table B-17). Because the 2010 data set was focused on the newer source area wells, the exposure point concentration was higher than would be calculated from the set of wells which was used for the 2000 and 2001 assessments. However, the calculated risks from the 2010 evaluation (Table B-18) were similar to the 2001 assessment results with an estimated cancer risk of 3.5×10^{-2} and an estimated non-cancer HQ of 71.

2.7.2 Summary of Ecological Risk

As part of the Phase II RI, the ERA evaluated potential risks to ecological receptors that may occur in the presence of chemical stressors (i.e., COPCs) in environmental media at NWIRP Bedford. The ERA included three steps: (1) Problem Formulation, (2) Risk Analysis, and (3) Risk Characterization. The COPCs used in the ERA are presented in Table B-19.

The NWIRP Bedford facility and abutting area were characterized to include habitat types of stream and wooded swamp, marsh, white pine-oak-red maple forest, upland scrub-shrub land, residential land, and industrial areas. Receptor exposures to surface soils, wetland sediments, runoff/seepage, Elm Brook surface water and sediment, and groundwater discharge to Elm Brook were evaluated. The ecological receptor groups evaluated included terrestrial vertebrates (e.g., small mammals and birds), terrestrial invertebrates (e.g., earthworms), terrestrial plants (e.g., ruderal growth vegetation such as weeds and early successional species), and aquatic life (fish and benthic invertebrates associated with Elm Brook). The ecological exposure pathways evaluated included direct contact with and/or ingestion of surface soil

by terrestrial invertebrates, direct contact with surface soil by terrestrial plants, wildlife ingestion of food items potentially contaminated as a result of accumulation of constituents from surface soil, incidental ingestion of surface soil by wildlife, and direct contact, ingestion, and/or respiration of aquatic media (wetland, sediment, surface water, runoff/seepage, and groundwater discharge) by aquatic life. The exposure pathways used in the ERA are presented in Table B-20.

COPCs were identified for each medium being evaluated. Of the contaminants associated with Site 3, 1,2-DCA, TCE, and PCE were selected as COPCs for surface soil. None of these CVOCs was selected as a COPC in runoff/seepage, wetland sediment, Elm Brook sediment or surface water, or groundwater discharge. The ERA concluded that there is a very low potential for ecological risks at NWIRP Bedford; therefore, no unacceptable ecological risks were identified for Site 3.

Similar to the HHRA, the ERA used assumptions that have associated uncertainties, which influence the results and conclusions of the risk assessment. Some of the assumptions may underestimate potential risk, some have an unknown effect on potential risk, while some assumptions tend to over-estimate potential risk. Also, COC concentrations have been decreasing since the risk assessment was completed (e.g., through operation of the IRA system); therefore, the ERA is an over-estimate of the actual current ecological risks associated with Site 3.

2.7.3 Basis for Action

Unacceptable human health risks were identified for exposure to 1,1-DCE, 1,2-DCA, cis-1,2-DCE, PCE, TCE, and VC in Site 3 groundwater, including non-cancer hazards and cancer risk for a hypothetical future on-site residential scenario. Although the reasonably anticipated future land use scenario for NWIRP Bedford property is industrial, the identified residential risks associated with Site 3 groundwater warrant mitigation due to the Town of Bedford's APD and the state's GUVD. Therefore, the response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

2.8 REMEDIAL ACTION OBJECTIVES

RAOs are medium-specific goals that define the objective of conducting remedial actions to protect human health and the environment. RAOs specify the COCs, potential exposure routes and receptors, and acceptable concentrations (i.e., cleanup levels) for a site and provide a general description of what the cleanup will accomplish. RAOs typically serve as the design basis for the remedial alternatives described in Section 2.9.

The RAOs for Site 3 are as follows:

- Mitigate the identified unacceptable risks to human health associated with the use of Site 3 groundwater as a drinking water supply by reducing the concentrations of 1,1-DCE, 1,1-DCA, 1,2-DCA, cis-1,2-DCE, 1,1,2-TCA, PCE, TCE, and VC in groundwater to cleanup levels.

- Prevent the use of on-site groundwater for human consumption until groundwater cleanup levels have been achieved on site.

- Prevent the migration of 1,1-DCE, 1,1-DCA, 1,2-DCA, cis-1,2-DCE, 1,1,2-TCA, PCE, TCE, and VC in groundwater at concentrations greater than cleanup levels.

The cleanup levels for Site 3 groundwater were selected as the more stringent standards of the federal and state drinking water Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs), as shown in Table 2-3.

TABLE 2-3. PRELIMINARY REMEDIATION GOALS

CHEMICAL OF CONCERN	DRINKING WATER STANDARDS (µg/L)			CLEANUP LEVEL (µg/L)
	USEPA MCL	USEPA NON ZERO MCLG	STATE MCL	
1,1-Dichloroethene	7	7	7	**7**
1,1-Dichloroethane	--	--	70 (a)	**70**
1,2-Dichloroethane	5	--	5	**5**
cis-1,2-Dichloroethene	70	70	70	**70**
1,1,2-Trichloroethane	5	3	5	**3**
Tetrachloroethene	5	--	5	**5**
Trichloroethene	5	--	5	**5**
Vinyl chloride	2	--	2	**2**

(a) Value is based on the Massachusetts Office of Research and Standards Guideline for drinking water (not a State MCL).
Sources: USEPA Drinking Water Regulations (USEPA 816-F-02-013 July 2002).
Massachusetts Drinking Water Standards (310 CMR 22.00).

Other COPCs identified in the HHRA (Appendix B) do not require cleanup goals because they were not identified as risk drivers (i.e., because of their low risks, the other COPCs were not designated as COCs warranting cleanup).

2.9 DESCRIPTION OF ALTERNATIVES

To address COCs and the associated human health risks in groundwater, a **screening of General Response Actions, remedial technologies, and process options** was conducted as part of the FS. The technologies and process options retained from the detailed screening were assembled into five remedial alternatives for Site 3. Consistent with the NCP, the No Action alternative was evaluated as a baseline for comparison with other alternatives during the comparative analysis. Table 2-4 summarizes the major components and provides estimated costs for each of the remedial alternatives developed for Site 3.

TABLE 2-4. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED

ALTERNATIVE	COMPONENTS	DETAILS	COST	TIME TO CLEANUP
No Further Action (Alternative 1)	None	No further actions would be taken. The IRA system would be deactivated.	**Capital**: $0 **O&M**: $0 **Total 30-Year NPW**: $0	150 + years
Excavation of the Source Area, Downgradient Groundwater Extraction and Treatment, MNA, and LUCs (Alternative 2)	Excavation and off-site disposal of source area soil	Excavation of approximately **7,447 CY** of saturated source area soil. Overlaying vadose zone soil (approximately 4,963 CY) may be used as backfill. Source area saturated soil would be disposed of at an off-site facility licensed to accept this soil.	**Capital**: $4,972,000 **O&M**: $7,212,000 **Total 30-Year NPW**: $12,184,000	Source Area 3 years On-Property Plume 80+ years Off- Property Plume 7 years
	Continued operation of IRA system	The downgradient portion of the plume would continue to be captured and controlled by the IRA system. It was assumed that an additional set of extraction wells will be installed to capture the northern lobe of the plume. The need for this will be determined based on long-term monitoring data trends.		

TABLE 2-4. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED				
ALTERNATIVE	**COMPONENTS**	**DETAILS**	**COST**	**TIME TO CLEANUP**
	MNA	Long-term monitoring (LTM) of CVOCs in groundwater and MNA assessments would be performed to verify that the overall plume is attenuating at an acceptable rate.		
	LUCs	Interim LUCs would be implemented to (1) prevent the use of site groundwater, (2) prevent occupancy of site structures, (3) prevent residential development of the site; and (4) ensure continued maintenance of remediation systems.		
	Five-Year Reviews	Five-year reviews would be conducted by the Navy, USEPA, and MassDEP until site conditions were restored to allow for unrestricted use and unlimited exposure.		
In-Situ Thermal Treatment of the Source Area, Downgradient Groundwater Extraction and Treatment, MNA, and LUCs (Alternative 3)	Thermal treatment of the source area	The source area would be treated in-place using ERH or a comparable thermal treatment technology. CVOC vapors would be captured using a soil vapor extraction (SVE) system and treated ex situ prior to discharge.	**Capital**: $4,918,000 **O&M**: $7,212,000 **Total 30-Year NPW**: $12,130,000	Source Area 3 years On-Property Plume 80+ years Off- Property Plume 7 years
	Continued operation of IRA system	Same as for Alternative 2.		
	MNA	Same as for Alternative 2.		
	LUCs	Same as for Alternative 2.		
	Five-Year Reviews	Same as for Alternative 2.		
In-Situ Enhanced Bioremediation of the Source Area, Downgradient Groundwater Extraction and Treatment, MNA, and LUCs (Alternative 4)	Enhanced bioremediation of the source area	The source area will be treated in place through the application of nutrients and other amendments into the overburden aquifer to enhance the biodegradation of contaminants. An additional treatment zone will be implemented downgradient of the source area as a polishing step. A pilot test may be conducted to determine some design parameters.	**Capital**: $1,929,000 **O&M**: $7,212,000 **Total 30-Year NPW**: $9,141,000	Source Area 10 years On-Property Plume 80+ years Off- Property Plume 7 years
	Continued operation of IRA system	Same as for Alternative 2.		
	MNA	Same as for Alternative 2.		
	LUCs	Same as for Alternative 2.		
	Five-Year Reviews	Same as for Alternative 2.		
Groundwater Extraction and Treatment, MNA, and LUCs (Alternative 5)	Extraction and treatment of groundwater in the source area	Contaminated groundwater from the source area would be extracted via pumping wells and treated ex-situ at the IRA treatment plant.	**Capital**: $469,000 **O&M**: $7,726,000 **Total 30-Year NPW**: $8,195,000	Source Area 80+ years On-Property Plume 80+ years Off- Property Plume 7 years
	Continued operation of IRA system	Same as for Alternative 2.		
	MNA	Same as for Alternative 2.		
	LUCs	Same as for Alternative 2.		
	Five-Year Reviews	Same as for Alternative 2.		

The timeframe to cleanup for Alternatives 2 through 5 is listed as "80+ years" for the on-property area based on the results of the 2007 modeling report which evaluated several cleanup options. The model, which was run for an 80-year time period, showed that some COCs in groundwater are expected to remain at concentrations above MCLs on Navy property due, in part, to the low permeability soils on Hartwells Hill. Cleanup of the off-property area is predicted to be faster (7 years) due to the higher permeability in the wetland area soils and the continued operation of the IRA system.

2.10 COMPARATIVE ANALYSIS OF ALTERNATIVES

Table 2-5 and subsequent text in this section summarize the comparison of the remedial alternatives with respect to the **nine CERCLA evaluation criteria** outlined in the NCP at 40 Code of Federal Regulations (CFR) 300.430(e)(9)(iii) and categorized as threshold, primary balancing, and modifying criteria. Further information on the detailed comparison of remedial alternatives is presented in the Site 3 FS.

TABLE 2-5. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Alternative No. Summary Description	1 No Further Action	2 Excavation of Source Area, Downgradient Extraction and Treatment, LUCs, and MNA	3 Thermal Treatment of Source Area, Downgradient Extraction and Treatment, LUCs, and MNA	4 Enhanced Bioremediation of Source Area, Downgradient Extraction and Treatment, LUCs, and MNA	5 Extraction and Treatment, LUCs, and MNA
Overall Protection of Human Health and Environment	⊘	●	●	●	O
Compliance with ARARs Chemical-specific Location-specific Action-specific	⊘ N/A N/A	● ● ●	● ● ●	● ● ●	● ● ●
Long-Term Effectiveness and Permanence	⊘	O	O	O	⊘
Reduction of Mobility, Toxicity, and Volume of Contaminants through Treatment	⊘	O	●	●	O
Short-Term Effectiveness	⊘	O	●	●	O
Implementability	●	O	O	O	O
Cost	●	⊘	⊘	O	O
State Acceptance	⊘	●	●	●	●
Community Acceptance	⊘	●	●	●	●

● = Good O = Average ⊘ = Poor
ARARs = Applicable or Relevant and Appropriate Requirements

Threshold Criteria

Overall Protection of Human Health and the Environment. The No Action alternative would not achieve the RAOs and therefore does not protect human health and the environment. It will not be considered further in this ROD. For the Site 3 source area, Alternative 3 would be the most protective of human health and the environment with respect to the identified site risks because it would provide the most intensive, rapid treatment. Alternative 4 would have a similar level of protectiveness by achieving COC treatment/destruction in situ, but using a slower remediation process. Alternative 2 also would be similarly protective as Alternative 3, although it would involve moving the contamination to another location (off-site disposal) rather than focusing on COC destruction/treatment. Alternative 5 would be less protective as it is expected to have a diminishing rate of COC recovery from the source area over time

due to the heterogeneous, low-permeability site soil. For the on-property and off-property dissolved-phase plume areas, Alternatives 2 through 5 would be equally protective of human health and the environment. Each would limit COC migration from high-concentration areas, prevent COC migration to off-property areas where groundwater is classified as Zone II, and address interim risks through LUCs that prevent human exposure to COCs in groundwater.

Compliance with ARARs. ARARs include any federal or state standards, requirements, criteria, or limitations determined to be legally applicable or relevant and appropriate to the site or remedial action. Alternatives 2 through 5 would be conducted in compliance with chemical-, location-, and action-specific ARARs. Alternatives 3 and 4 include provisions to directly reduce (treat) COC concentrations in source area groundwater in accordance with chemical-specific ARARs. Alternative 2 would be intended to achieve chemical-specific ARARs in the source area more indirectly by removing soil with the highest COC concentrations that are contributing to groundwater contamination. Alternative 5 would extract or contain contaminated groundwater from the source area. For the dissolved-phase plume outside of the source area, Alternatives 2 through 5 would be equally compliant for achieving ARARs.

Primary Balancing Criteria

Long-Term Effectiveness and Permanence. Alternatives 2 and 3 would be the most effective in the long-term and permanent because they would mitigate source area COC concentrations through excavation or treatment. Alternative 4 would have similar long-term effectiveness, although in-situ bioremediation can be more difficult to directly control because it relies on biological processes rather than strictly mechanical removal. However, the Navy will look to optimize the bioremediation system over time, and additional applications can be performed as needed to achieve cleanup levels. Excavation under Alternative 2 is not expected to be a cost-effective means for removing source area contamination because a localized pocket of DNAPL-impacted soil has not been found. It is expected that Alternative 5 would be increasingly less effective over time for recovering COCs from the source area due to the nature of pump-and-treat applications in heterogeneous low-permeability soils. Alternative 5 could be designed to dewater the source area as a containment measure for COCs in that area.

For the on-property and off-property dissolved phase plume areas, Alternatives 2 through 5 would be nearly equally effective and permanent in the long-term for addressing those areas. The more rapid source area removal under Alternatives 2 and 3 would aid in the physical attenuation of the downgradient plume. Alternative 4 would take longer to achieve cleanup levels in the source area than Alternatives 2 or 3; however, the substrate applications for bioremediation may promote subsurface conditions that are also supportive of biological attenuation processes in the downgradient areas. Further, Alternative 4 will include an additional treatment zone in between the source area and the IRA extraction wells which will help to expedite the plume cleanup in that area. Although **80 or more years** will be required to reach cleanup levels in some portions of the on-property Site 3 plume, it is expected that the IRA system could be shut down sooner and more site redevelopment options would be available if Alternative 2, 3, or 4 were to be selected as compared to Alternative 5. Under Alternative 5, continual operation of the groundwater extraction and treatment system would be required for the foreseeable future (indefinitely).

The long-term effectiveness of Alternatives 2 through 5 carries some additional uncertainty in that they rely in part on MNA and LUCs for protectiveness, and the ability of MNA and LUCs to succeed for 80 or more years is based on models and projections with inherent uncertainties. The long-term effectiveness will be verified over time through the monitoring program and 5-year reviews.

Reduction in Toxicity, Mobility, or Volume Through Treatment. Alternatives 3 and 4 provide the greatest degree of source area COC treatment and reduction of COC toxicity, mobility, or volume. Alternative 3 would reduce the toxicity and volume of COCs through in-situ destruction and/or treatment of the recovered soil vapors. The mobility of COCs would increase during the heating process; therefore, the SVE component of the thermal treatment system would need to be appropriately designed and monitored to ensure recovery of the COC vapors. Alternative 4 will break down COCs in the source area through biodegradation. The short-term partitioning of CVOCs into the applied substrate oil would further reduce COC migration from the source area. Incomplete biodegradation of DCE into VC would result in

an increase in toxicity; however, system performance will be monitored and adjusted as needed to achieve the degradation of VC. Alternative 5 would treat COCs extracted from the source area using carbon filtration, and the captured COCs would eventually be destroyed by the carbon regeneration process. Under Alternative 2, no treatment is specified, although excavated materials may be partially treated to meet land disposal requirements prior to landfilling.

For the on-property and off-property dissolved phase plume areas, Alternatives 2 through 5 would be nearly equally effective for reducing the toxicity, mobility, and volume of COCs through treatment. COCs captured via the IRA system would be treated using carbon filtration and MNA would treat the residual groundwater plume. However, Alternative 4 includes an additional treatment zone to be implemented in between the source area and the IRA extraction wells which will further reduce the toxicity, mobility, and volume of COCs in that area of the plume.

Short-Term Effectiveness. Alternatives 3 and 4 would be the most effective in the short term. Alternative 3 would be effective because it includes a relatively rapid source area remediation time frame, and there would be low risks posed to site workers or the community. However, additional health and safety procedures would be required to protect remediation workers from exposure to volatilized COCs, from the high voltage power used, and from the high temperatures generated below ground. Although Alternative 4 would take longer to achieve cleanup levels in the source area, the overall site cleanup time frame would be the same, and there would be lower risks to site workers and the community because the only above-ground components would be the substrate application wells. The extraction and treatment system under Alternative 5 may need to be run indefinitely in order to control the plume. Alternative 2 would be effective for achieving cleanup levels in the source area in a similar time frame to Alternative 3 but would present greater physical and chemical risks to remediation workers and the community due to the excavation and ex-situ handling and transportation of source area soil.

For the on-property and off-property dissolved phase plume areas, Alternatives 2 through 5 would have nearly equivalent short-term effectiveness because similar remedial components are specified. However, under Alternative 4, the efforts to enhance bioremediation in situ may also promote subsurface conditions downgradient of the treatment zones that are more conducive to biological attenuation processes, thereby augmenting the overall MNA program for the residual plume.

Implementability. For addressing the source area, Alternative 5 would be the easiest to construct because it represents a relatively small modification to the current IRA system; however, operational complications are expected due to the low permeability of the source area soils. Alternatives 3 and 4 would be the next most implementable for the source area because the required equipment and services are available, although fewer vendors may be available for thermal treatment. Alternative 2 would be the most difficult to implement due to the specialized deep-excavation techniques that would be required. Complications for excavation are the most significant because of the excavation depth (50 feet or greater), significant saturated thickness to be excavated (30 feet), and presence of utilities and structures near the excavation. Greater engineering design and controls would be required to perform the excavation under Alternative 2 than the source area remedies under Alternatives 3, 4, and 5. Under Alternative 4, the application and distribution of nutrients/substrate throughout the source area would be complicated by the tight soils in that area; however, various design options are available that could be explored as part of a pilot test prior to full-scale implementation. For the on-property and off-property dissolved phase plume areas, Alternatives 2 through 5 would be equally implementable.

Cost. O&M costs for Alternatives 2 through 5 are nearly identical to each other; therefore, the primary difference in costs is related to the source area remedy. Of the implementable options, Alternative 5 would be the least expensive because it requires only a relatively small change to the existing IRA system. Alternatives 2 and 3 have approximately equivalent costs and would be the most expensive. Alternative 4 is less expensive than Alternatives 2 and 3 because source area COC concentrations would be reduced by augmenting the **biodegradation processes that are already at work**.

Modifying Criteria

State Acceptance. State involvement has been solicited throughout the CERCLA process. MassDEP's statement on the selected remedy is presented in Appendix A.

Community Acceptance. The community has expressed support for the selected remedy. No written comments were received during the formal public comment period on the Proposed Plan. The questions raised at the public meeting on July 21, 2010 included inquiries for informational purposes and expressed the Town's desire to restore groundwater quality in this area so that the Town can reactivate the Hartwell Road Wellfield to supplement the Town's drinking water supply. The comments raised at the public hearing on July 21, 2010 were supportive of the Proposed Plan.

2.11 PRINCIPAL THREAT WASTE

The NCP at 40 CFR 300.430(a)(1)(iii)(A) establishes an expectation that treatment will be used to address the principal threats posed at a site wherever practicable. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or that would present a significant risk to human health or the environment should exposure occur. A source material is a material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or acts as a source for direct exposure. Principal threat wastes are not present at Site 3 because the contamination primarily consists of dissolved-phase CVOCs in groundwater that are not highly toxic (unacceptable risks are associated with long-term exposure) and are not highly mobile (due to the site-specific hydrogeological conditions). A current receptor of concern is not present. If the property zoning were to be changed and site redeveloped for residential use, then the exposure pathway of concern can be prevented through a LUC that prohibits installation of a drinking water supply well.

2.12 SELECTED REMEDY

2.12.1 Rationale for Selected Remedy

The selected remedy for Site 3 is in-situ enhanced bioremediation in the source area, downgradient groundwater extraction and treatment, MNA, and LUCs. This remedy was selected because it provides the best balance of tradeoffs with respect to the nine evaluation criteria, allows for continued industrial use of the site, and addresses the town and state groundwater classifications. The remedy will meet the RAOs by reducing COC concentrations through bioremediation and MNA, preventing the migration of COCs through continued operation of the IRA system, and preventing the use of groundwater from the on- and off-site Site 3 plume area as a drinking water source through LUCs. The LUCs also will address potential property use and vapor intrusion concerns within the Site 3 area.

The principal factors in the selection of this remedy included the following:

- Degradation processes are already working to break down TCE, which is the primary COC at Site 3. Accelerating the biodegradation process is a cost-effective option for remediating the source area while still completing the overall plume remediation within the same time frame as alternatives with more intensive source area cleanup technologies.

- Bioremediation will have greater technical and economic flexibility to allow for system optimizations over time in response to the O&M process and the observed COC trends from the monitoring program. Optimizations could include changes to the application rates, dosage amounts, substrate types, application methods, number of applications, number of application points, or other remedy details. The ultimate purpose of the optimization will be to complete the cleanup in the most cost effective and timely manner possible. Compared to Alternatives 2 and 3 which expend the high capital costs upfront, the lower capital cost of Alternative 4 will be spread out over multiple nutrient/substrate applications, which will allow for more flexibility to incorporate system optimizations over time.

- Enhancing bioremediation in and around the source area will promote subsurface conditions that are beneficial for MNA of the downgradient plume area.

- Continued operation of the IRA system until the source area and on-property plume area have been sufficiently mitigated will protect off-property resources (e.g., groundwater, wetlands, Elm Brook) and aid in the restoration of the off-property plume area.

- Implementation of LUCs will immediately address the exposure pathway of concern (consumption of site groundwater).

- The remedy is consistent with current and reasonably anticipated future site uses (industrial) and groundwater classifications (potential drinking water source area).

2.12.2 Description of Selected Remedy

The selected remedy includes the following components, described below:

- In-situ enhanced bioremediation of the source area
- Downgradient groundwater extraction and ex-situ treatment
- MNA/LTM
- LUCs
- Five-Year Reviews

In-Situ Enhanced Bioremediation of the Source Area

Anaerobic reductive dechlorination (ARD) is the primary biological degradation process by which CVOCs are transformed to innocuous compounds such as carbon dioxide, ethene, ethane, and chloride. In the presence of a suitable electron donor (e.g., hydrogen), the appropriate microbial consortia, and favorable geochemical conditions, a hydrogen atom can replace a chlorine atom on a chlorinated ethene molecule. This rigorously studied microbial process occurs under anaerobic conditions. Hydrogen is typically generated when organic carbon is fermented. This organic carbon supply can come from natural organic carbon, anthropogenic carbon such as hydrocarbon contaminants (e.g., benzene, toluene), or applied/injected carbon substrates. In the presence of hydrogen, CVOCs such as TCE can be reduced to DCE. DCE is then reduced to VC, which, in turn, can be reduced to ethene and ethane, or via mineralization, to carbon dioxide, water, and chloride.

ARD will be promoted as the primary biological degradation process to treat the Site 3 COCs. Previous investigation included a **Screening Assessment** for natural attenuation that indicated that biological degradation of CVOCs was a primary cause of significant reductions in concentrations along the plume axis and that the degree and consistency of the degradation was variable due to a limited source of biologically available carbon. Therefore, with sufficient electron donor addition, in-situ bioremediation is anticipated to be successful at this site. The electron donor will be provided through the application of a carbon (nutrient) substrate into the subsurface source area in the Components Laboratory loading dock area.

Various carbon substrates are available for use. Carbon substrates fall into two general categories: soluble and slow-release electron donors:

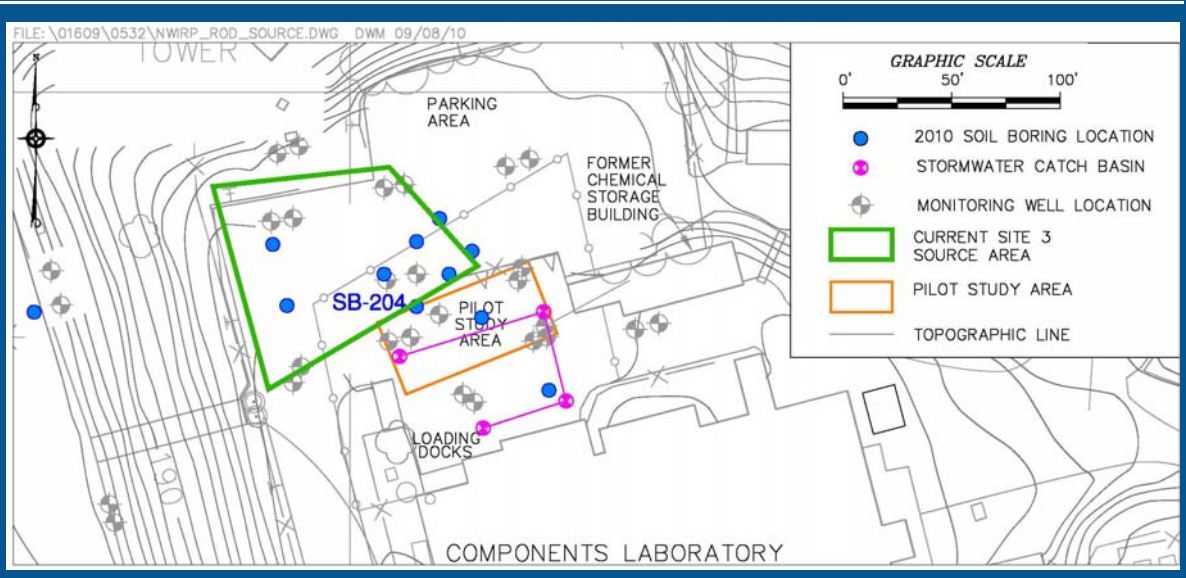
- Soluble electron donor substrates include lactate, ethanol, and other short-chain hydrocarbons. These materials dissolve in water and are typically used quickly by the microorganisms. An advantage of soluble electron donors is that delivery and distribution are more easily achieved in a heterogeneous environment and the application from a given point can cover a larger area than with slow release electron donors. These two advantages are expected to be helpful at this site due to its varied geologic environment. The disadvantage of soluble electron donors is that they are generally consumed within three to six months.

- Slow release electron donors include hydrogen releasing compounds, vegetable oil, and chitin. These compounds slowly release fatty acids into the groundwater which in turn are metabolized and utilized by microbes for ARD. Many of these substrates persist for months or years before being exhausted. Emulsified vegetable oils are available commercially that have been engineered to exhibit enhanced transport properties while slowly releasing carbon. An added benefit of these oils is that they can preferentially partition CVOCs from the dissolved phase into the oil.

In the FS, it was assumed that an emulsified vegetable oil would be used; however, the specific type of substrate to be used will be further evaluated during the remedial design phase. If necessary, a pilot test can be performed to aid in determination of the electron donor(s) application strategy, optimum electron donor substrate type(s) and dosage(s), the achievable substrate distribution in the various soil matrices in the source area, and whether bioaugmentation (i.e., microbe additions) or other water quality adjustments are warranted.

Full-scale implementation will include the application of the electron donor substrate throughout the 6,700 square-foot source area (Figure 2-6) from the top of the groundwater table (approximately 20 feet bgs) to a depth of approximately 50 feet bgs. Substrate application may be achieved through a series of new and existing injection wells situated in a grid layout across the source area (e.g., FS assumed a total of 64 injection wells), or as a series of treatment zones through which source area groundwater would flow. The pilot test can also further evaluate such substrate application methods, volumes, and rates. As a polishing step to follow the direct source area treatment, an additional treatment zone will be implemented downgradient in the lower parking lot west of the Components Laboratory.

FIGURE 2-6. SOURCE AREA TREATMENT AREA



The existing monitoring well network will be augmented with additional nested groundwater wells installed in the treatment zone to monitor the effectiveness of bioremediation over time (e.g., FS assumed 15 wells in the source area). Sampling results will be used to evaluate the effectiveness of the substrate application process in creating reducing conditions in the overburden aquifer and for reducing CVOC concentrations. The analytical list will include Site 3 COCs (1,1-DCE, 1,1-DCA, 1,2-DCA, cis-1,2-DCE, 1,1,2-TCA, PCE, TCE, and VC) and their biodegradation byproducts and end-products (e.g., ferrous iron, sulfide, nitrite, nitrogen, oxygen, carbon dioxide, ethane, ethane, and methane), electron acceptors (e.g., sulfate, nitrate, ferric iron), and other water quality parameters and biogeochemical indicators (e.g., hydrogen, oxidation/reduction potential, chloride, pH, temperature, specific conductance). The results

will aid in the design of subsequent substrate injections, as deemed necessary, to further promote in-situ bioremediation. It is anticipated that multiple substrate injections will be conducted to achieve the desired COC mass reduction in the source area. The FS assumed three rounds of substrate applications. The scope of the remedial action (e.g., number and location of substrate applications) can be expanded as necessary to meet cleanup goals.

Downgradient Groundwater Extraction and Ex-Situ Treatment

The downgradient portion of the plume will continue to be controlled by the IRA system. This pump-and-treat system, which was originally installed as an interim measure, will become part of the overall remedial action for Site 3. The groundwater pump-and-treat system will continue to be operated until the Navy, with EPA concurrence, determines it is no longer necessary for the control of plume migration in accordance with the RAOs.

The current IRA system consists of a total of 23 extraction wells constructed at depths varying from 12 to 28 feet bgs, with extracted groundwater sent to a **treatment plant** located on NWIRP Bedford property. The treatment plant was designed for a flow rate up to approximately 30 gallons per minute (gpm) and includes pretreatment to adjust pH and to remove solids and then removal of CVOCs using liquid-phase granular activated carbon (GAC). The treated effluent is discharged to the ground on the side of Hartwells Hill, upgradient of the wetlands and Elm Brook. This treated water seeps into the ground and back into the overburden aquifer with no observable flow reaching the boundary of the bordering vegetated wetlands.

The 2007 groundwater model predicted that the northern lobe of the plume by the Antenna Range Building may continue to expand; however, no plume expansion has been observed based on the monitoring data collected since that time. Therefore, as a contingency measure, if future monitoring data indicate that the northern lobe of the plume is expanding, then the Navy, with EPA concurrence, will evaluate whether additional extraction wells are warranted for that area. Based on the 2007 model, this may include a line of seven extraction wells completed to the base of the sandy till layer north of the Antenna Range Building and pumping at a combined rate of 2.3 gpm. The groundwater treatment plant is currently operating at an average flow rate of 11 to 12 gpm; therefore, the additional 2.3 gpm from the northern lobe of the plume can be accommodated.

The current IRA monitoring program includes semi-annual sampling of up to 46 wells to evaluate the extent of the plume over time and the ability of the extraction wells to capture the plume. A similar LTM program will be implemented to monitor the selected remedy. The number and locations of monitoring wells will be determined during the remedial design phase. Monitoring wells will be sampled and analyzed for the target COCs, and groundwater elevations will be recorded. These data will permit evaluation of reductions in COC concentrations in groundwater and the extent of the capture zone for the extraction well system. Treatment system monitoring will also continue to be conducted to track performance through the treatment process and to verify that the discharge limits are being achieved. Discharge limits are presented in Appendix F.

Monitored Natural Attenuation

MNA will be implemented in accordance with the Office of Solid Waste and Emergency Response (OSWER) Directive titled Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (USEPA, 1999b) and other MNA guidance documents (see Appendix F). Under natural attenuation, naturally occurring processes in soil and groundwater act without human intervention to reduce the mass, toxicity, volume, or concentration of COCs. When implementing MNA, periodic monitoring and technical evaluations are performed to ensure that COC concentrations are decreasing at an acceptable rate.

The scope of the MNA monitoring program (e.g., sampling frequency, number of locations, list of analytes) will be determined during the remedial design phase and can be adjusted over time based on the observed data trends. Semi-annual sampling of the existing overburden and bedrock groundwater

monitoring well network will be conducted for 2 years (four events), and based on those results, the Navy, with the concurrence of EPA, may decide that a less frequent sampling program (e.g., annual) could be used and the monitoring well network could be further optimized. The FS assumed that the monitoring program would utilize a well network similar to the current IRA monitoring program with any additional monitoring wells installed as needed to provide sufficient coverage. Parameters to be analyzed in groundwater include:

- The Site 3 COCs, to document reductions in contaminant concentrations.
- Dissolved oxygen, carbon dioxide, hydrogen, methane, ethane, and ethene
- Nitrate and nitrite, total and ferrous iron, sulfate and sulfide, chloride, alkalinity, and dissolved organic carbon.
- Temperature, pH, oxidation/reduction potential, and conductivity.

The monitoring program may also include evaluations of the off-property wetland soils and plant species to assess the role that specific plant communities and soil characteristics play in degrading the CVOCs in the off-site dissolved phase plume.

Land Use Controls

As part of the selected remedy, the Navy will implement LUCs (institutional controls) to prevent exposure to COCs in groundwater and to protect human health during the interim time period until remedial actions have achieved RAOs across the site. LUCs implemented as part of this remedial alternative will:

- Prevent use of Site 3 groundwater as a drinking water supply until COC concentrations in groundwater achieve cleanup levels.

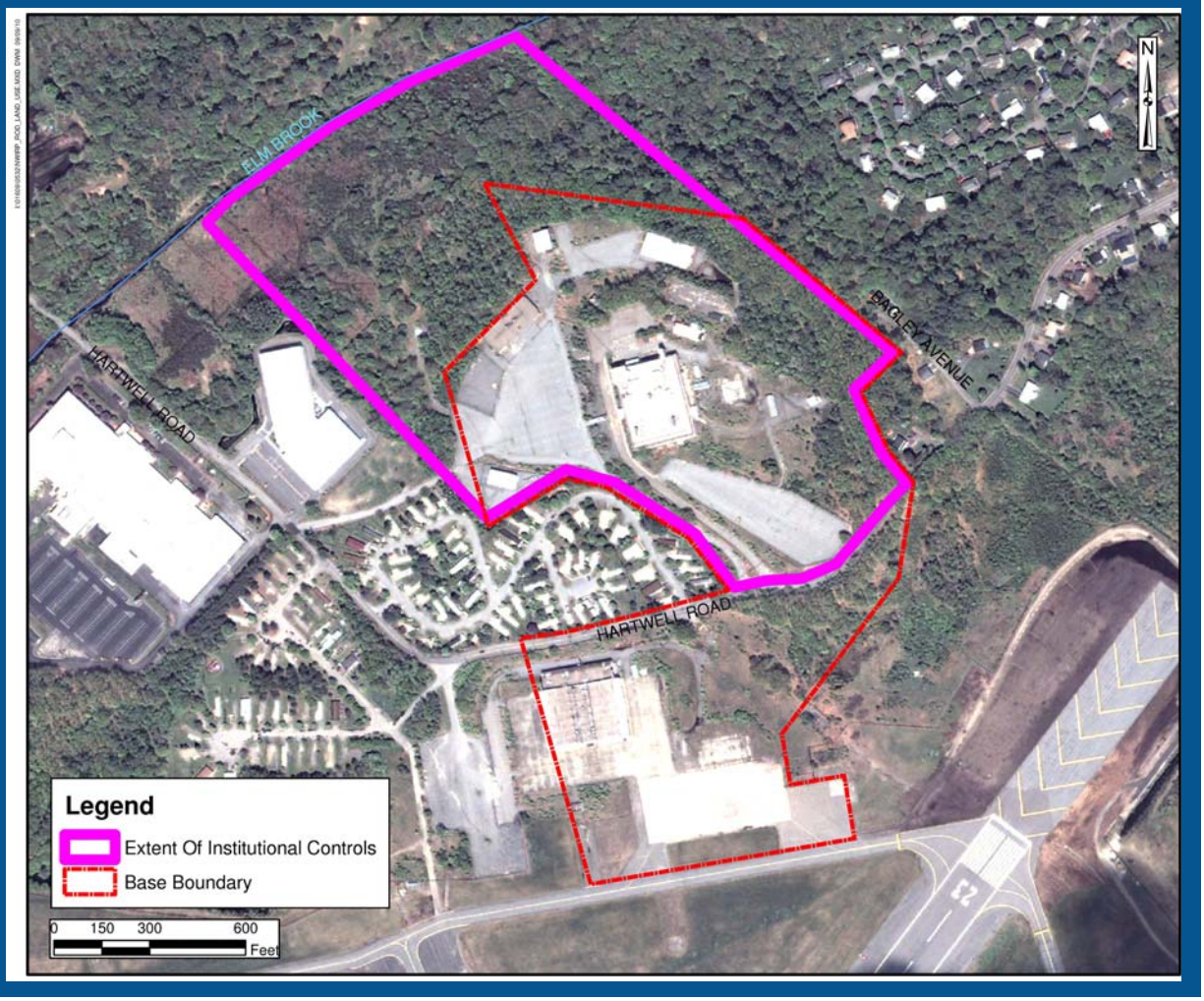
- Prevent occupancy of current and future Site 3 structures until COC concentrations allow for industrial use of the property.

- Prevent residential development of the Site 3 area until COC concentrations allow for unlimited use and unrestricted exposure.

- Maintain the integrity of the current or future remedial and monitoring systems, such as extraction and treatment wells, monitoring wells, and in-situ enhanced bioremediation.

The Navy will maintain these LUCs at Site 3 until the concentrations of hazardous substances have been reduced to levels that allow for unlimited exposure and unrestricted use, as determined through the long-term monitoring program and five-year reviews. Figure 2-7 shows the extent of the LUCs, which cover the lateral extent of the Site 3 plume in shallow overburden, deep overburden, and bedrock groundwater. This LUC area includes a portion of Hartwells Hill on Navy property as well as a portion of the area between Hartwells Hill and Elm Brook which is non-Navy property. For the portion of Site 3 not on Navy property, the Navy will continue to coordinate with the Town of Bedford Board of Health under an existing agreement to implement the municipal Code of Health Regulations which controls the installation (permitting) and use of private water wells (Appendix G). Currently, the non-Navy property is not developed, has no private groundwater wells and includes delineated wetlands. The Navy also has coordinated with the Town to ensure that the Navy will be notified of any proposal to develop for residential use any of the privately owned Site 3 property. In this instance, the Navy would then confer with the USEPA and MassDEP to determine what further actions may be necessary, if any, to protect human health at that time.

FIGURE 2-7. LAND USE CONTROL BOUNDARY



Within 90 days of ROD signature, the Navy shall prepare and submit to USEPA for review and approval, and to MassDEP for comment, a LUC Remedial Design. The Navy will be responsible for implementing, inspecting, maintaining, reporting, and enforcing the LUCs described in the ROD in accordance with the approved LUC Remedial Design. LUCs will be developed in accordance with the Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions, per the letter dated January 16, 2004 from Alex A. Beehler, Assistant Deputy Under Secretary of Defense (Environment, Safety and Occupational Health), and the requirements of the NWIRP Bedford FFA. Should any LUC component of the selected remedy fail, the Navy will ensure that appropriate actions are taken to re-establish the selected remedy's protectiveness. The Navy may transfer various operational responsibilities for these actions to other parties through contracts, agreements, and/or deed restrictions; however, the Navy acknowledges its ultimate responsibility under CERCLA for remedy integrity, including for the performance of any transferred operational responsibilities.

Five-Year Reviews

Five-year reviews will be conducted by the Navy, in conjunction with USEPA and MassDEP, until Site 3 groundwater conditions are restored such that the site is suitable for unrestricted use and unlimited exposure in accordance with CERCLA. During such reviews, the Navy, USEPA, and state will review site

conditions and monitoring data to determine whether the continued implementation of the remedy is appropriate.

2.12.3 Expected Outcomes of Selected Remedy

The primary expected outcome of the selected remedy is that the Site 3 COC concentrations in groundwater will be consistent with the groundwater classification and will no longer present an unacceptable risk to humans via hypothetical future residential use of groundwater as a drinking water source. The site poses no unacceptable ecological risks. LUCs will be immediately effective for addressing the human exposure pathway of concern until site cleanup is complete. LUCs will also mitigate potential land use and vapor intrusion risks until site cleanup is complete or a future risk assessment demonstrates that there are no unacceptable residential use or vapor intrusion risks.

Within approximately 10 years of remedy implementation, enhanced bioremediation is expected to decrease COC concentrations in the source area such that MNA can reduce the residual concentrations to cleanup levels, along with the remaining on-property plume area. The source area remediation will directly aid in the attenuation of the downgradient plume. Although achieving cleanup levels in the on-property plume area is predicted to require an extended timeframe due to the nature and extent of the plume and site hydrogeological conditions, the Navy will seek to optimize the remedial action over time in response to observed data trends to expedite the site cleanup. In the off-site plume area, it is expected that cleanup levels will be achieved in a much shorter time frame (7 years) because COC concentrations in that area have already been decreasing toward cleanup levels since operation of the IRA system began in 1997. The time frames to achieve site cleanup are estimates based on the currently available information and will be further evaluated as part of the LTM program and 5-year review process.

Groundwater at Site 3 is considered a potential source of drinking water, based on the results of MassDEP's GUVD (see Section 2.6 and Appendix E). This finding indicates that groundwater beneath the site has high value as a future drinking water supply and therefore drinking water standards, consistent with the GUVD, must be attained in site groundwater. Upon achieving groundwater cleanup levels, the site will be suitable for unlimited use and unrestricted exposure. Complete site cleanup will be determined by two consecutive rounds of groundwater monitoring with COC concentrations meeting cleanup levels in all wells sampled as part of the long-term monitoring program.

Table 2-6 describes how the selected remedy mitigates risk and achieves RAOs for Site 3.

TABLE 2-6. HOW SELECTED REMEDY MITIGATES RISK AND ACHIEVES RAOS

RISK	RAO	COMMENTS
Ingestion of on-site groundwater as a drinking water source	Reduce COC concentrations to mitigate risks associated with using groundwater as a drinking water supply	Enhanced bioremediation in the source area and MNA in the downgradient plume will reduce COC concentrations to acceptable levels over time.
	Prevent the use of on-site groundwater for human consumption until remediation goals have been achieved	LUCs will prevent the use of on-site groundwater as a drinking water source until groundwater COC concentrations are reduced to cleanup goals.
	Prevent the migration of elevated COC concentrations in groundwater	The groundwater extraction system will prevent the migration of COCs to off-property areas west of NWIRP Bedford. The plume is already stable or decreasing in the other directions.

2.13 STATUTORY DETERMINATIONS

In accordance with the NCP, the selected remedy meets the following statutory determinations:

- **Protection of Human Health and the Environment** – The selected remedy will be protective of human health and the environment through the reduction of COC concentrations in site groundwater to achieve cleanup levels. LUCs will be protective of human health during the interim time until site

cleanup by preventing the future use of site groundwater as a drinking water supply. Site conditions do not pose unacceptable risks to ecological receptors or to human receptors under current site use.

- **Compliance with ARARs** – The selected remedy will comply with all identified federal and state ARARs, as presented in Appendix F.

- **Cost-Effectiveness** – The selected remedy is a cost-effective means to achieve site remediation. The costs are proportional to the overall effectiveness during the remediation time frame. Detailed costs for the selected remedy are presented in Appendix C. The capital cost of the source area remedy will be spread out over the various substrate applications, which will allow for more flexibility to incorporate system optimizations over time.

- **Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable** – The selected remedy will be an effective and permanent means of reducing COC concentrations in the source area through treatment. Multiple substrate injections or other system optimizations will be conducted to ensure successful biodegradation. As demonstrated through monitoring and modeling of the existing IRA system, groundwater extraction and treatment will be effective for capturing and treating much of the downgradient plume.

- **Preference for Treatment Which Permanently and Significantly Reduces the Toxicity, Mobility, or Volume of the Hazardous Substances as a Principle Element** – The selected remedy includes a focus on source area treatment to break down COCs, thereby reducing the toxicity, mobility, and volume of the source contamination. Implementing bioremediation in the source area may also augment natural attenuation processes in downgradient areas by promoting conditions for reductive dechlorination. Groundwater extraction at the property line includes ex-situ treatment prior to discharge.

- **Five-Year Review Requirement** – The Navy, in conjunction with USEPA and MassDEP, will conduct a review within 5 years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. Five-year reviews will be continued until site conditions are remediated to levels that allow for unlimited use and unrestricted exposure.

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

CERCLA Section 117(b) requires an explanation of significant changes from the remedy presented in the Proposed Plan that was published for public comment. Comments received during the public hearing on July 21, 2010 were supportive of the Proposed Plan and no written comments were received during the 30-day comment period. Therefore, no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate. The comments supporting the Proposed Plan during the public hearing are presented in Section 3.0.

3.0 RESPONSIVENESS SUMMARY

3.1 STAKEHOLDER COMMENTS AND LEAD AGENCY RESPONSES

Participants in the public meeting and public hearing held on July 21, 2010 included RAB members, Town of Bedford representatives, and representatives from the Navy, EPA, and MassDEP. Informal questions raised during the public meeting were generally for informational purposes and expressed the Town's desire to have groundwater quality restored in this area so that the Town can reactivate the Hartwell Road Wellfield for purposes of supplementing the Town's drinking water supply. The formal comments raised at the public hearing (Appendix D) were supportive of the Navy's Proposed Plan (no response necessary). No written comments were received during the 30-day public comment period on the Proposed Plan.

3.2 TECHNICAL AND LEGAL ISSUES

No technical or legal issues associated with the Site 3 ROD were identified.

Administrative Record Reference Table

DETAILED ADMINISTRATIVE RECORD REFERENCE TABLE

ITEM	REFERENCE PHRASE IN ROD	LOCATION IN ROD	LOCATION OF INFORMATION IN ADMINISTRATIVE RECORD
1	**chlorinated solvents**	Table 2-1	Dames & Moore, 1990a. Technical Memorandum, Remedial Investigation Findings, Naval Weapons Industrial Reserve Plant, Bedford, Massachusetts. Pages 19 to 20.
2	**facility inspection and records review**	Table 2-1	Dames & Moore, 1990b. Supplemental Investigation, Site Assessment and Soil Gas Survey Remedial Investigation Findings. Pages 4 to 13.
3	**hydraulic capture**	Table 2-1	Tetra Tech, 1999. IRA Monitoring Report. Pages 8-1 to 8-2. Tetra Tech, 2000c. February 2000 Quarterly Monitoring Report. Page 4-1.
4	**Areas of Concern**	Table 2-1	USEPA, 1999. Federal Facility Agreement for Naval Weapons Industrial Reserve Plant National Priorities List Site. Appendix B.
5	**source area**	Table 2-1	Tetra Tech, 2000a. Supplemental Investigation Report for Site 3. Page 4-1.
6	**Human Health Risk Assessment**	Table 2-1	Tetra Tech, 2000b. Final Remedial Investigation, Phase II Report, NWIRP Bedford. September. Pages 5-1 to 5-125.
7	**Ecological Risk Assessment**	Table 2-1	Tetra Tech, 2000b. Pages 6-1 to 6-92.
8	**geophysical survey**	Table 2-1	Tetra Tech, 2002. Results for the Characterization of the Site 3 Pilot Study Area. Page 102, Figure 1.
9	**rationale**	Table 2-1	Tetra Tech, 2003. Site 3 Pilot Study Work Plan, NWIRP Bedford, Massachusetts. Pages 3-1 to 3-2.
10	**additional subsurface investigations**	Table 2-1	ENSR, 2004. Work Plan Addendum for the Additional Investigation to Support Feasibility Study Evaluation of Site 3. Pages 1 to 2, Figure 1.
11	**concluded**	Table 2-1	Tetra Tech, 2008. Summary of Sampling and Analysis Results for Components Laboratory Investigation. Page 7.
12	**ERH pilot study**	Table 2-1	Tetra Tech, 2005. Draft Final Feasibility Study, Site 3. NWIRP Bedford, Massachusetts. Pages 5-37 to 5-43.
13	**95% or greater**	Table 2-1	Tetra Tech EC, 2008. Closeout Report for Site 3 Thermal Treatment Pilot Test, NWIRP, Bedford, MA. Page 4-21.
14	**groundwater computer model**	Table 2-1	Tetra Tech, 2007a. Modeling Report for Site - 03, Naval Weapons Industrial Reserve Plant, Bedford, Massachusetts. Figures 5-1 to 5-33.
15	**No DNAPL**	Table 2-1	Tetra Tech, 2010a. Feasibility Study for Site 3 – Chlorinated Solvent Groundwater Plume, Naval Weapons Industrial Reserve Plant Bedford, Massachusetts. Appendix E.
16	**five remedial alternatives**	Table 2-1	Tetra Tech, 2010a. Section 5.1.
17	**Community Relations Plan**	Section 2.3	Halliburton NUS, 1992. Community Relations Plan for Naval Weapons Industrial Reserve Plant Bedford. Page 1-3.
18	**peak elevation**	Section 2.5.1	Tetra Tech, 2000b. Page 3-1.
19	**Axothene**	Section 2.5.2	Tetra Tech, 2000b. Pages ES-12 and 4-160.
20	**no other documented releases**	Section 2.5.2	Tetra Tech, 2000b. Section 4.5.6.

ITEM	REFERENCE PHRASE IN ROD	LOCATION IN ROD	LOCATION OF INFORMATION IN ADMINISTRATIVE RECORD
21	**elevated CVOC concentrations**	Section 2.5.2	Tetra Tech, 2010a. Appendix E.
22	**7,447 CY**	Section 2.5.2	Tetra Tech, 2010a. Page 5-6.
23	**Plume does not extend beyond Elm Brook**	Section 2.6	Tetra Tech, 2010a. Section 2.4.5. Tetra Tech, 2009. March 2009 Semi-Annual Monitoring Report for Immediate Response Action. Naval Weapons Industrial Reserve Plant Bedford, Massachusetts. August. Tetra Tech, 2010b. September 2009 Semi-Annual Monitoring Report for Immediate Response Action. Naval Weapons Industrial Reserve Plant Bedford, Massachusetts. February.
24	**other CVOC plumes**	Section 2.6	Tetra Tech 2000b. Page 1-26.
25	**municipal public water supply**	Section 2.6	Tetra Tech 2000b. Pages ES-17 and 2-2.
26	**additional exposure pathway**	Section 2.7	Tetra Tech, 2010a. Page 2-26.
27	**on-site residential exposure to surface soil and drainage area sediment**	Table 2-2	Tetra Tech, 2000b. Part 2, Section 5.5 and Appendix N.
28	**screening of General Response Actions, remedial technologies, and process options**	Section 2.9	Tetra Tech, 2010a. Section 4.0.
29	**Total 30-Year NPW**	Section 2.9	Tetra Tech, 2010a. Appendix B.
30	**12,410 CY**	Section 2.9	Tetra Tech, 2010a. Section 5.3.1.
31	**Nine CERCLA evaluation criteria**	Section 2.10	Tetra Tech, 2010a. Section 6.0.
32	**80 or more years**	Section 2.10	Tetra Tech, 2010a. Appendix A.
33	**biodegradation processes which are already at work**	Section 2.10	Tetra Tech, 2010a. Section 2.4.6.
34	**Screening Assessment**	Section 2.12.2	Tetra Tech, 1999. Section 6.4.
35	**treatment plant**	Section 2.10	Tetra Tech, 2010a. Pages 5-8 and 5-9.

ADDITIONAL REFERENCES

USEPA, 1999a. Federal Facility Agreement for Naval Weapons Industrial Reserve Plant National Priorities List Site.

USEPA, 1999b. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites, OSWER Directive 9200.4-17P.

Appendix A

MassDEP Statement

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

IAN A. BOWLES
Secretary

LAURIE BURT
Commissioner

September 29, 2010

Mr. James T. Owens, Director
Office of Site Remediation and Restoration
U.S. Environmental Protection Agency Region 1
5 Post Office Square, Suite 100 (OSRR07-2)
Boston, MA 02109-3912

Re: Record of Decision Site 3
Naval Weapons Industrial Plant
Bedford, MA

Dear Mr. Owens:

The Massachusetts Department of Environmental Protection (MassDEP) has reviewed the *Record of Decision for Site 3*, for the Naval Reserve Plant in Bedford, Massachusetts. The Record of Decision (ROD) summarizes the results from the investigations and the selected remedy. The selected remedy is enhanced bioremediation of the source area and down gradient groundwater extraction by ex-situ treatment with monitored natural attenuation. This remediation will address the unacceptable risks to human health and the environment at Site 3.

MassDEP concurs with the selected remedy as it will be protective of public health and the environment by addressing the long term cleanup goals. If you have any questions or comments, please contact Mike Moran, Project Manager (617-348-4039), or Anne Malewicz, Federal Facilities Section Chief (617-292-5659).

Sincerely,

Janine Commerford
Assistant Commissioner

cc: Matthew Audet, U.S. EPA Region1
Maritza Montegross, NAVFAC MIDPLANT
James Ropp, Tetra Tech, NUS
RAB Members

This information is available in alternate format. Call Donald M. Gomes, ADA Coordinator at 617-556-1057. TDD# 1-866-539-7622 or 1-617-574-6868.

MassDEP on the World Wide Web: http://www.mass.gov/dep
Printed on Recycled Paper

Appendix B

Human Health and Ecological Risk Tables

TABLE B-1
SUMMARY OF CHEMICALS OF POTENTIAL CONCERN
USED IN THE 2000 HUMAN HEALTH RISK ASSESSMENT

Exposure Point [3]	Chemicals of Potential Concern	Conc. Detected Min	Conc. Detected Max	Units	Frequency of Detection	Exposure Point Conc.	Units	Statistical Measure
Soil								
Surface Soil	Arsenic	4.3	8.1	ppm	11/11	6.51	ppm	95% UCL
	Beryllium	0.34	0.58	ppm	11/11	0.48	ppm	95% UCL
	Silver	1.3	119	ppm	3/8	44.43	ppm	95% UCL
	Total B(a)P-TE	64.8	856.9	ppb	11/11	471.27	ppb	95% UCL
	Total cPAH	516	4,730	ppb	9/11	2,777.68	ppb	95% UCL
Subsurface	Beryllium	0.20	0.84	ppm	19/19	0.54	ppm	95% UCL
Soil	Total B(a)P-TE	404.4	2,753.3	ppb	18/18	844.19	ppb	95% UCL
	Total cPAH	2,013	21,920	ppb	6/18	5,412.55	ppb	95% UCL
Groundwater								
Private Wells	Aluminum	207	76,000	ppb	37/37	76,000	ppb	Max
& Hartwell	Arsenic	1.6	114	ppb	21/37	114	ppb	Max
Road	Beryllium	1.0	3.6	ppb	6/37	3.6	ppb	Max
Municipal	Cadmium	2.35	11.2	ppb	8/37	11.2	ppb	Max
Wells	Lead	1.6	50.6	ppb	22/36	50.6	ppb	Max
(measured)	Manganese	31.9	6,590	ppb	37/37	6,590	ppb	Max
	Nickel	13.8	131	ppb	22/37	131	ppb	Max
	Vanadium	6.3	222	ppb	22/37	222	ppb	Max
	4-Chloroaniline	7.5	7.5	ppb	1/36	7.5	ppb	Max
	2-Methylnaphthalene	8.0	1,300	ppb	3/37	1,300	ppb	Max
	Naphthalene	1.5	2,500	ppb	5/37	2,500	ppb	Max
Private Wells	1,1-Dichloroethane	-	-	-	-	2.71	ppb	Peak
(modeled)	1,2-Dichloroethane	-	-	-	-	2.38	ppb	Peak
	1,1-Dichloroethene	-	-	-	-	5.11	ppb	Peak
	1,2-Dichloroethene (total)	-	-	-	-	2.41	ppb	Peak
	Trichloroethene	-	-	-	-	4.30	ppb	Peak
Hartwell Road	Benzene	-	-	-	-	0.1	ppb	Peak
Municipal	1,1-Dichloroethane	-	-	-	-	1.14	ppb	Peak
Wells	1,2-Dichloroethane	-	-	-	-	2.11	ppb	Peak
(modeled)	1,1-Dichloroethene	-	-	-	-	0.46	ppb	Peak
	1,2-Dichloroethene (total)	-	-	-	-	14.1	ppb	Peak
	Tetrachloroethene	-	-	-	-	0.06	ppb	Peak
	1,1,1-Trichloroethane	-	-	-	-	0.05	ppb	Peak
	Trichloroethene	-	-	-	-	3.0	ppb	Peak
On-site	2-Butanone (MEK)	5.0[1]	470[1]	ppb	-	470	ppb	Max[2]
	2-Methylnaphthalene	8.0[1]	1,300[1]	ppb	-	1,300	ppb	Max[2]
	Acetone	7.0[1]	510[1]	ppb	-	510	ppb	Max[2]
	Benzene	1.0[1]	2,090[1]	ppb	-	2,090	ppb	Max[2]
	Ethylbenzene	2.0[1]	3,497[1]	ppb	-	3,497	ppb	Max[2]
	Methyl-tert-Butyl Ether	1.0[1]	37[1]	ppb	-	37	ppb	Max[2]
	Naphthalene	79.0[1]	600[1]	ppb	-	600	ppb	Max[2]
	Toluene	4.0[1]	22,367[1]	ppb	-	22,367	ppb	Max[2]
	Xylene (Total)	5.0[1]	18,533[1]	ppb	-	18,533	ppb	Max[2]

Notes:
Highlighted rows indicate the specific Site 3 chemicals of concern (COCs). The other chemicals of potential concern (COPCs) listed in this table were either determined to be not part of the Site 3 plume or were not risk-drivers identified as COCs requiring a remedial action.

(1) Notes: Average concentrations by monitoring wells from May 1998 to June 2000 were used. One-half the detection limit was used for non-detect values except where the compound was never detected in a specific well.
(2) The EPCs represent the highest average concentration among all wells.
(3) The vapor intrusion pathway was qualitatively assessed in the 2001 HHRA Addendum.

B(a)P-TE: Benzo(a)pyrene toxic equivalents
cPAH: Carcinogenic polycyclic aromatic hydrocarbons
ppm: parts per million (mg/kg or mg/L)
ppb: parts per billion (μg/kg or μg/L)
95% UCL: 95% Upper Confidence Limit
Max: Maximum concentration
Peak: Modeled concentrations under the most severe pumping conditions

TABLE B-2
POTENTIAL CARCINOGENIC TOXICITY DATA SUMMARY
FROM THE 2000 HUMAN HEALTH RISK ASSESSMENT

Chemical of Potential Concern	Oral Cancer Slope Factor (mg/kg)/day	Reference (Last Verified)	Weight of Evidence/ Cancer Guideline Description
Acetone	NA	IRIS (6/2001)	D
Aluminum	ND	NA	ND
Arsenic	1.50E+00	IRIS (2/96)	A
Beryllium	4.30E+00	IRIS (2/96)	B2
Lead	ND	NA	B2
Manganese	ND	NA	D
Silver	ND	NA	D
2-Butanone	NA	IRIS (6/01)	D
2-methylnaphthalene	NA	IRIS (6/01)	NA
Methyl tert-Butyl Ether	NA	IRIS (6/01)	NA
Naphthalene	ND	IRIS (2/96) IRIS (6/01)	D C
Total B(A)P-TE	7.30E+00	IRIS (2/96)	B2
Total cPAH	ND	NA	D
Benzene	2.90E-02 5.50E-02	IRIS (2/96) IRIS (6/01)	A
1,1,1-Trichloroethane	ND	NA	D
1,1-Dichloroethane	ND	NA	C
1,2-Dichloroethane	9.10E-02	IRIS (2/96)	B2
1,1-Dichloroethene	6.00E-01	IRIS (2/96)	C
1,2-Dichloroethene (total)	ND	NA	ND
Ethylbenzene	NA	IRIS (6/01)	D
Tetrachloroethene	5.20E-02	SHRTSC (10/93)	B2
Trichloroethene	1.10E-02	SHRTSC (10/93)	B2
Toluene	NA	IRIS (6/01)	D
Xylene	NA	IRIS (6/01)	D

Notes:
Highlighted rows indicate the specific Site 3 chemicals of concern (COCs). The other chemicals of potential concern (COPCs) listed in this table were either determined to be not part of the Site 3 plume or were not risk-drivers identified as COCs requiring a remedial action.
mg/kg: milligram per kilogram
cPAH: Carcinogenic polycyclic aromatic hydrocarbons
B(a)P-TE: Benzo(a)pyrene toxic equivalents
NA: Not available
ND: Not determined

IRIS: Integrated Risk Information System, an online computer database of toxicological information (EPA, 1996)
SHRTSC: U.S. EPA Superfund Health Risk Technical Support Center

A: Human carcinogen
B2: Probable human carcinogen – Indicates sufficient evidence in animals or no evidence in humans
C: Possible human carcinogen
D: Not classifiable as a human carcinogen

TABLE B-3
POTENTIAL NON-CARCINOGENIC TOXICITY DATA SUMMARY
FROM THE 2000 HUMAN HEALTH RISK ASSESSMENT

Chemical of Potential Concern	Oral Dose-Response Value (mg/kg-day)	Target Organ/ Critical Effect at LOAEL	EPA Confidence Level	Reference (Last Verified)
Acetone	1.00E-01	Increased liver & kidney weights, nephrotoxicity	Low	IRIS (6/01)
Aluminum	ND	NA	NA	NA
Arsenic	3.00E-04	Hyperpigmentation, keratosis; vascular complications	Medium	IRIS (2/96)
Beryllium	5.00E-03	No adverse effects observed	Low	IRIS (2/96)
Lead	NA	NA	NA	NA
Manganese	4.70E-02 (a)	CNS effects	Medium	IRIS (2/96)
Manganese	1.40E-01 (b)	CNS Effects	Medium	IRIS (2/96)
Silver	5.00E-03	Argyria	Low	IRIS (2/96)
2-Butanone	6.00E-01	Decreased fetal birth weight	Low	IRIS (6/01)
2-methylnaphthalene	2.00E-02	NA	NA	NCEA (1995)
Naphthalene	4.00E-02 2.00E-02	Decreased body weight Decreased mean terminal body weight	NA Low	NCEA (1995) IRIS (6/01)
Total B(a)P-TE	NA	NA	NA	NA
Total cPAH	3.00E-02 (c)	Kidney effects	Low	IRIS (2/96)
Benzene	3.00E-04	Blood effects	Medium	NCEA (1995)
1,1,1-Trichloroethane	2.00E-02	CNS effects	Medium-Low	NCEA (1996)
1,1-Dichloroethane	1.00E-01	No adverse effects observed	NA	HEAST (1995)
1,2-Dichloroethane	3.00E-02	Changes in organ weights	Low	NCEA (1993)
1,1-Dichloroethene	9.00E-03	Hepatic lesions	Medium	IRIS (2/96)
1,2-Dichloroethene (total)	9.00E-03	Hepatic lesions	ND	HEAST (1995)
Ethylbenzene	1.00E-01	Liver and kidney toxicity	Low	IRIS (2/96)
Tetrachloroethene	1.00E-02	Liver toxicity	Medium	IRIS (2/96)
Trichloroethene	6.00E-03	Liver toxicity	Low	NCEA (1996)
Toluene	2.00E-01	Changes in liver and kidney weights	Medium	IRIS (2/96 & 6/01)
Xylenes	2.00E+00	Hyperactivity; decreased body weight; increased mortality	Medium	IRIS (2/96 & 6/01)

Notes:
Highlighted rows indicate the specific Site 3 chemicals of concern (COCs). The other chemicals of potential concern (COPCs) listed in this table were either determined to be not part of the Site 3 plume or were not risk-drivers identified as COCs requiring a remedial action.
mg/kg: milligram per kilogram
CNS: Central nervous system
cPAH: Carcinogenic polycyclic aromatic hydrocarbons
B(a)P-TE: Benzo(a)pyrene toxic equivalents
ND: Not determined
NA: Not available

HEAST: Health Effects Assessment Summary Tables, published annually by the U.S. EPA (1995)
IRIS: Integrated Risk Information System, an online computer database of toxicological information (EPA, 2000)
LOAEL: Lowest observed adverse effects level
NCEA: National Center for Environmental Assessment

(a): Used for all exposures except dietary
(b): Used for dietary exposure only
(c): Due to structural similarities, the dose response value for pyrene is assigned to this compound

TABLE B-4
SUMMARY OF 2000 HUMAN HEALTH RISK ASSESSMENT RESULTS
REASONABLE MAXIMUM EXPOSURE (RME) SCENARIOS

Scenario Evaluated [3]	Media	Total Carcinogenic Risk (statistical chance)	Total Non-Carcinogenic Risk (Hazard Index)
Current & Future Site Workers			
Ingestion/ Dermal Contact	Surface Soil – Area D	2.88E-06	1.08E-02
	Surface Soil – Area F	1.19E-06	7.89E-03
Current & Future Site Worker Total – Area D		***2.9E-06***	***1.1E-03***
Current & Future Site Worker Total – Area F		***1.2E-06***	***7.9E-03***
Current Trespassing Teenager			
Ingestion/ Dermal Contact	Surface Soil – Area D	1.31E-06	2.40E-02
	Surface Soil – Area F	5.40E-07	1.97E-02
Ingestion//Dermal Contact	Surface Water	No COPCs identified	1.66E-04
Current Trespassing Teenager Total – Area D		***2.1E-06***	***5.6E-02***
Current Trespassing Teenager Total – Area F		***1.4E-06***	***5.2E-02***
Construction Worker			
Ingestion/ Dermal Contact	Surface Soil – Area D	2.14E-07	1.96E-02
	Surface Soil – Area F	8.83E-08	1.47E-02
	Subsurface Soil – Area D	2.90E-08	7.96E-03
	Subsurface Soil – Area F	1.99E-08	9.71E-03
Construction Worker Total – Area D		***2.4E-07***	***2.8E-02***
Construction Worker Total – Area F		***1.1E-07***	***2.4E-02***
Future Trespassing Teenager			
Ingestion/ Dermal Contact	Surface Soil – Area D	1.31E-08	2.40E-02
	Surface Soil – Area F	5.40E-07	1.97E-02
	Groundwater (private wells)	2.77E-05	1.49E+00
Future Trespassing Teenager Total – Area D		***2.98E-05***	***1.54E+00 (1)***
Future Trespassing Teenager Total – Area F		***2.90E-05***	***1.54E+00 (1)***
Ingestion/ Dermal Contact	Surface Soil – Area D	1.31E-08	2.40E-02
	Surface Soil – Area F	5.40E-07	1.97E-02
Ingestion	Groundwater (municipal wells)	2.33E-05	1.50E+00
Future Trespassing Teenager Total – Area D		***2.54E-05***	***1.56E+00 (1)***
Future Trespassing Teenager Total – Area F		***2.46E-05***	***1.56E+00 (1)***

Scenario Evaluated [3]	Media	Total Carcinogenic Risk (statistical chance)	Total Non-Carcinogenic Risk (Hazard Index)
Off-site Resident			
Ingestion/Dermal Contact	Groundwater from private wells (total)	2.09E-04	1.87E+00
	Groundwater from municipal wells (total)	1.75E-04	1.89E+00
Off-site Resident Total		***3.84E-04 (2)***	***3.76E+00 (1)***
On-site Resident[4]			
Ingestion/Dermal Contact	Surface Soil/Sediment – Area D	2.98E-05	4.3E-01
	Surface Soil/Sediment – Area E	1.63E-05	3.7E-01
	Surface Soil/Sediment – Area F	3.55E-05	4.9E-01

Notes:
Area D = Facility Storage Building Area
Area E = Transportation Building Area
Area F = Components Laboratory Area

(1) The target organ-specific hazard indices are all less than one, indicating that there are no non-carcinogenic adverse health effects anticipated for this receptor.

(2) The carcinogenic risks are due to the presence of arsenic in groundwater; however, the presence of arsenic has not been attributed to Site 3. The Phase II RI concluded that detections of metals at concentrations above MCLs are not widespread and do not appear to follow a particular pattern; therefore, the metals detected in groundwater are most likely naturally occurring or were associated with sediments entrained in the samples rather than from historical waste handling practices at NWIRP Bedford. Furthermore, the arithmetic mean concentration of total arsenic (7.56 µg/L) at NWIRP Bedford does not exceed the MCL for drinking water (10 µg/L). Therefore, arsenic was not identified as a Site 3 COC.

(3) The vapor intrusion pathway was qualitatively assessed in the 2001 HHRA Addendum.

(4) Future on-site resident evaluation did not include subsurface soil.

TABLE B-5
EXPOSURE POINT CONCENTRATIONS
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

	Average Concentration by Monitoring Well (ug/L) (a)																						Exposure Point Concentration	
COPC	**GEI-107U**	**MW-13S**	**MW-15S**	**MW-18S**	**MW-19R**	**MW-19S**	**MW-21S**	**MW-26R**	**MW-30R**	**MW-39**	**MW-40**	**MW-41**	**MW-42**	**MW-43**	**MW-44**	**MW-45**	**MW-46**	**MW-47**	**PZ-1**	**PZ-2**	**PZ-3**	**PZ-4**	**(ug/L) (b)**	**COPC (d)**
1,1,1-Trichloroethane	ND	3730.0	ND	ND	ND	ND	1000.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**3730.0**	Yes
1,1,2-Trichloroethane	ND	58.0	ND	ND	ND	ND	6.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**58.0**	Yes
1,1-Dichloroethane	ND	124.0	ND	262.8	12.2	ND	78.3	ND	ND	1.0	ND	ND	ND	ND	ND	ND	17.0	1.0	ND	ND	ND	ND	**262.8**	Yes
1,1-Dichloroethene	ND	1733.8	ND	ND	7.5	0.9	628.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	22.0	ND	ND	ND	ND	ND	**1733.8**	Yes
1,2-Dichloroethane	9.6	39.0	7.3	146.0	5.3	ND	4.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.0	ND	ND	ND	ND	ND	**146.0**	Yes
4-Chloroaniline (c)	ND	ND	10.0	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**10.0**	Yes
Cis-1,2-Dichloroethene	17.8	335.4	8.3	264.3	12.9	1.9	511.0	ND	ND	4.0	ND	ND	ND	ND	ND	ND	81.0	3.0	ND	ND	ND	ND	**511.0**	Yes
Methylene Chloride	ND	39.6	ND	215.6	ND	ND	5.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**215.6**	Yes
Tetrachloroethene	ND	597.3	5.5	ND	ND	ND	237.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.0	ND	ND	ND	ND	ND	**597.3**	Yes
Trans-1,2-Dichloroethene	ND	96.3	ND	ND	ND	ND	15.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	**96.3**	Yes
Trichloroethene	6.8	8806.3	ND	97.0	11.8	2.9	2186.7	ND	2.5	5.0	ND	1.0	ND	ND	30.0	ND	180.0	5.0	1.4	1.7	1.6	1.8	**8806.3**	Yes
Vinyl Chloride	ND	30.3	ND	ND	ND	ND	15.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**30.3**	Yes

Notes:
COPC - Chemical of Potential Concern.
NA - Well not sampled. Therefore, no data is available.
ND - Compound was not detected in all sampling events.
RI - Remedial Investigation.
STM - Short-Term Measure.
(a) Averages were calculated using the arithmetic mean of results from data collected from February 1999 to February 2001. One-half the detection limit was used for non-detect values except where the compound was never detected in a specific well.
(b) The exposure point concentration represents the highest average concentration among all wells.
(c) Data for 4-Chloroaniline was obtained from the RI Phase II (April/May 1993) and RI STM (August 1993) sampling events.
(d) Column indicates if chemical is a COPC for this revised risk assessment.

TABLE B-6
DOSE-RESPONSE INFORMATION FOR CHEMICALS OF POTENTIAL CONCERN WITH POTENTIAL CARCINOGENIC EFFECTS
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

COPC	CAS Number	EPA Carcinogen Class	Oral CSF $(mg/kg\text{-}day)^{-1}$	Oral CSF Reference (Last Verified)	Oral CSF Study Animal	Oral CSF Study Method
1,1,1-Trichloroethane	71-55-6	D	NA	IRIS (6/2001)	NA	NA
1,1,2-Trichloroethane	79-00-5	C	5.70E-02	IRIS (6/2001)	MOUSE	ORAL:GAVAGE
1,1-Dichloroethane	75-34-3	C	NA	IRIS (6/2001)	NA	NA
1,1-Dichloroethene	75-35-4	C	6.00E-01	IRIS (6/2001)	RAT	ORAL:DRINKING WATER
1,2-Dichloroethane	107-06-2	B2	9.10E-02	IRIS (6/2001)	RAT	ORAL:GAVAGE
4-Chloroaniline	106-47-8	NA	NA	IRIS (6/2001)	NA	NA
Methylene chloride	75-09-2	B2	7.50E-03	IRIS (6/2001)	MOUSE	ORAL:DRINKING WATER
Tetrachloroethene	127-18-4	NA	5.20E-02	NCEA (e)	NA	NA
Trichloroethene	79-01-6	NA	1.10E-02	NCEA (e)	MOUSE	ORAL:GAVAGE
Vinyl chloride	75-01-4	A	7.20E-01	IRIS (6/2001)	RAT	ORAL:DIET
Cis-1,2-Dichloroethene	156-59-2	D	NA	IRIS (6/2001)	NA	NA
Trans-1,2-Dichloroethene	156-60-5	NA	NA	IRIS (6/2001)	NA	NA

Notes:
CAS - Chemical Abstracts Service.
COPC - Chemical of potential concern.
CSF - Cancer Slope Factor.
IRIS = Integrated Risk Information System, an online computer database of toxicological information (U.S. EPA, 2001).
HEAST = Health Effects Assessment Summary Tables, published annually by the U.S. EPA (1997).
NA = Not Available.
A - Known human carcinogen.
B2 - Probable human carcinogen.
C - Possible human carcinogen.
D - Not classifiable as to human carcinogenicity.
(a) Converted from an inhalation unit risk of 5.0×10^{-5} per $ug/m^3 * (70mg/20m^3) * 1000mg/ug$.
(b) Converted from an inhalation unit risk of 2.6×10^{-5} per $ug/m^3 * (70mg/20m^3) * 1000mg/ug$.
(c) Converted from an inhalation unit risk of 4.7×10^{-7} per $ug/m^3 * (70mg/20m^3) * 1000mg/ug$.
(d) Converted from an inhalation unit risk of 4.4×10^{-6} per $ug/m^3 * (70mg/20m^3) * 1000mg/ug$.
(e) As reported in the U.S. EPA Region 3 Risk Based Concentration (RBC) Table. May 8, 2001.

TABLE B-7
DOSE-RESPONSE INFORMATION FOR CHEMICALS OF POTENTIAL CONCERN WITH POTENTIAL NONCARCINOGENIC EFFECTS FROM CHRONIC EXPOSURE THROUGH THE ORAL ROUTE
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

COPC	CAS Number	Oral Dose-Response Value (mg/kg-day)	Reference (Last Verified) Type	EPA Confidence Level	Target Organ/ Critical Effect	Study Animal	Study Method
1,1,1-Trichloroethane	71-55-6	2.80E-01	NCEA (a)	NA	NA	NA	NA
1,1,2-Trichloroethane	79-00-5	4.00E-03	IRIS (6/2001)	MEDIUM	CLINICAL SERUM CHEMISTRY	MOUSE:SUBCHRONIC	ORAL:DRINKING WATER
1,1-Dichloroethane	75-34-3	1.00E-01	HEAST (1997)	NA	NONE OBSERVED	RAT	INHALATION:INTERMITTENT
1,1-Dichloroethene	75-35-4	9.00E-03	IRIS (6/2001)	MEDIUM	HEPATIC LESIONS	RAT	ORAL:DRINKING WATER
1,2-Dichloroethane	107-06-2	3.00E-02	NCEA (a)	NA	NA	NA	NA
4-Chloroaniline	106-47-8	4.00E-03	IRIS (6/2001)	LOW	NONNEOPLASTIC LESIONS OF SPLENIC CAPSULE	RAT	ORAL:DIET
Methylene chloride	75-09-2	6.00E-02	IRIS (6/2001)	MEDIUM	LIVER TOXICITY	RAT	ORAL:DRINKING WATER
Tetrachloroethene	127-18-4	1.00E-02	IRIS (6/2001)	MEDIUM	HEPATOTOXICITY, WEIGHT GAIN	MOUSE,RAT	ORAL:GAVAGE
Trichloroethene	79-01-6	6.00E-03	NCEA	LOW	INCREASED LIVER WEIGHTS	MOUSE	ORAL:DRINKING WATER
Vinyl chloride	75-01-4	3.00E-03	IRIS (6/2001)	MEDIUM	LIVER CELL POLYMORPHISM	RAT	ORAL:DIET
Cis-1,2-Dichloroethene	156-59-2	1.00E-02	HEAST (1997)	NA	DECREASED HEMATOCRIT AND HEMOGLOBIN	RAT	ORAL:GAVAGE
Trans-1,2-Dichloroethene	156-60-5	2.00E-02	IRIS (6/2001)	LOW	INDREASED SERUM ALKALINE PHOSPHATASE	MOUSE	ORAL:DRINKING WATER

Notes:
CAS - Chemical Abstracts Service.
COPC - Chemical of potential concern.
LOAEL - Lowest Observed Adverse Effects Level.
RfD - Reference Dose.
IRIS - Integrated Risk Information System, an on-line computer database of toxicological information (U.S. EPA, 2001).
HEAST - Health Effects Assessment Summary Tables, published annually by the U.S. EPA (1997).
NA - Not Available.
NCEA - National Center for Environmental Assessment.
(a) As reported in the U.S. EPA Region 3 Risk Based Concentration (RBC) Table. May 8, 2001.

TABLE B-8
SUMMARY OF POTENTIAL EXPOSURE ASSUMPTIONS FOR INGESTION PATHWAY
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

Parameter	Resident Adult	References
Parameters Used in the Drinking Water Pathway		
Exposure Frequency (days/365 days)	350	(a)
Exposure Duration (yr)	30	(a)
Water Ingestion Rate (l/day)	2	(a)
Body Weight (kg)	70	(a)

Notes:
(a) U.S. EPA, 1991. Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors.

TABLE B-9
ABSORPTION ADJUSTMENT FACTORS (AAFs) FOR CHRONIC EXPOSURE
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

	Exposure Route (Medium)	
	Oral	Water
COPC	**Carc.**	**Noncarc.**
1,1,1-Trichloroethane	NA	1
1,1,2-Trichloroethane	1	1
1,1-Dichloroethane	NA	1
1,1-Dichloroethene	1	1
1,2-Dichloroethane	1	1
4-Chloroaniline	NA	1
Methylene chloride	1	1
Tetrachloroethene	1	1
Trichloroethene	1	1
Vinyl chloride	1	1
Cis-1,2-Dichloroethene	1	1
Trans-1,2-Dichloroethene	1	1

Notes:
All Absorption Adjustment Factors are 1, which assumes complete absorption through the oral exposure pathway.
COPC - Chemical of potential concern.
Carc. - The value derived is for assessing the compound's carcinogenic potential.
Noncarc. - The value derived is for assessing the compound's noncarcinogenic potential.

TABLE B-10
TOTAL ESTIMATED INCREMENTAL CARCINOGENIC RISK
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

COPC	Exposure Pathway		Total
	Drinking Water	Inhalation while Showering (a)	
1,1,1-Trichloroethane	NA	NA	NC
1,1,2-Trichloroethane	3.88E-05	3.88E-05	7.76E-05
1,1-Dichloroethane	NA	NA	NC
1,1-Dichloroethene	1.22E-02	1.22E-02	2.44E-02
1,2-Dichloroethane	1.56E-04	1.56E-04	3.12E-04
4-Chloroaniline	NA	NA	NC
Methylene chloride	1.90E-05	1.90E-05	3.80E-05
Tetrachloroethene	3.65E-04	3.65E-04	7.29E-04
Trichloroethene	1.14E-03	1.14E-03	2.27E-03
Vinyl chloride	2.56E-04	2.56E-04	5.11E-04
Cis-1,2-Dichloroethene	NA	NA	NC
Trans-1,2-Dichloroethene	NA	NA	NC
TOTAL	1.42E-02	1.42E-02	2.84E-02

Notes:
NA - A risk estimation could not be made due to unavailable dose-response information.
NC - Not Calculated.
COPC - Chemical of potential concern.
(a) Inhalation exposure due to showering is estimated as equally to exposure from drinking water.

TABLE B-11
TOTAL ESTIMATED INCREMENTAL NONCARCINOGENIC HAZARD INDEX
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

	Exposure Pathway		
COPC	Drinking Water	Inhalation while Showering (a)	Total
1,1,1-Trichloroethane	3.65E-01	3.65E-01	7.30E-01
1,1,2-Trichloroethane	3.97E-01	3.97E-01	7.94E-01
1,1-Dichloroethane	7.20E-02	7.20E-02	1.44E-01
1,1-Dichloroethene	5.28E+00	5.28E+00	1.06E+01
1,2-Dichloroethane	1.33E-01	1.33E-01	2.67E-01
4-Chloroaniline	6.85E-02	6.85E-02	1.37E-01
Methylene chloride	9.85E-02	9.85E-02	1.97E-01
Tetrachloroethene	1.64E+00	1.64E+00	3.27E+00
Trichloroethene	4.02E+01	4.02E+01	8.04E+01
Vinyl chloride	2.76E-01	2.76E-01	5.53E-01
Cis-1,2-Dichloroethene	1.40E+00	1.40E+00	2.80E+00
Trans-1,2-Dichloroethene	1.32E-01	1.32E-01	2.64E-01
TOTAL	5.01E+01	5.01E+01	1.00E+02

Notes:
COPC - Chemical of potential concern.
(a) Inhalation exposure due to showering is estimated as equaling exposure from drinking water.

TABLE B-12
MAXIMUM CONTAMINANT LEVELS
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

Chemical	MCL (mg/L) (a)
1,1-Dichloroethene	7.00E-03
1,2-Dichloroethane	5.00E-03
Tetrachloroethene	5.00E-03
Trichloroethene	5.00E-03
Vinyl chloride	2.00E-03
Cis-1,2-Dichloroethene	7.00E-02

Notes:
(a) MCL - Maximum Contaminant Level. U.S. EPA. Drinking Water Standards and Health Advisories. EPA 822-B-00-001. Summer 2000.

TABLE B-13
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

Receptors Evaluated:	
Receptor 1:	Adult Resident

Assumptions for Carcinogenic Assessment Risk By Ingestion of Drinking Water		Assumed Value	Units	Calculated Value
Water Ingestion Rate	Adult Resident	2	(l/day)	
Body Weight	Adult Resident	70	(kg)	
Exposure Frequency	Adult Resident	350	(days)/365 (days) =	9.59E-01
Exposure Duration	Adult Resident	30	(yrs)/70(yrs) =	4.29E-01
Lifetime		70	(years)	

R.N.: 0

12-Jul-01

TABLE B-14
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

Carcinogenic Assessment
Risk By Ingestion of Drinking Water

Compound	Compound Concentration in Drinking Water (mg/l)	Oral - Water Absorption Adjustment Factor	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	ADDing Adult Resident (mg/kg-day)	Lifetime Average Daily Dose (mg/kg-day)	Excess Lifetime Cancer Risk
1,1,1-Trichloroethane	3.73E+00	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	5.80E-02	1	5.70E-02	6.81E-04	6.81E-04	3.88E-05
1,1-Dichloroethane	2.63E-01	NA	NA	NA	NA	NA
1,1-Dichloroethene	1.73E+00	1	6.00E-01	2.04E-02	2.04E-02	1.22E-02
1,2-Dichloroethane	1.46E-01	1	9.10E-02	1.71E-03	1.71E-03	1.56E-04
4-Chloroaniline	1.00E-02	NA	NA	NA	NA	NA
Methylene chloride	2.16E-01	1	7.50E-03	2.53E-03	2.53E-03	1.90E-05
Tetrachloroethene	5.97E-01	1	5.20E-02	7.01E-03	7.01E-03	3.65E-04
Trichloroethene	8.81E+00	1	1.10E-02	1.03E-01	1.03E-01	1.14E-03
Vinyl chloride	3.03E-02	1	7.20E-01	3.55E-04	3.55E-04	2.56E-04
Cis-1,2-Dichloroethene	5.11E-01	1	NA	6.00E-03	6.00E-03	NA
Trans-1,2-Dichloroethene	9.63E-02	1	NA	1.13E-03	1.13E-03	NA
					Total =	1.42E-02

R.N.: 0

TABLE B-15
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

Receptors Evaluated:	
Receptor 1:	Adult Resident

Assumptions for Noncarcinogenic Assessment Risk By Ingestion Of Drinking Water		Assumed Value	Units	Calculated Value
Water Ingestion Rate	Adult Resident	2	(l/day)	
Body Weight	Adult Resident	70	(kg)	
Exposure Frequency	Adult Resident	350	(days)/ 365(days) =	9.59E-01
Exposure Duration	Adult Resident	30	(yrs)/30(yrs) =	1.00E+00
Lifetime	Adult Resident	70	(years)	

R.N.: 0

12-Jul-01

TABLE B-16
2001 SITE 3 RISK ASSESSMENT ADDENDUM FOR GROUNDWATER
NWIRP BEDFORD, MASSACHUSETTS

Noncarcinogenic Assessment
Risk By Ingestion Of Drinking Water

Compound	Compound Concentration Drinking water (mg/l)	Oral - Water Absorption Adjustment Factor	Oral Reference Dose (mg/kg-day)	ADDing Adult Resident (mg/kg-day)	Chronic Average Daily Dose (mg/kg-day)	Hazard Index
1,1,1-Trichloroethane	3.73E+00	1	2.80E-01	1.02E-01	1.02E-01	3.65E-01
1,1,2-Trichloroethane	5.80E-02	1	4.00E-03	1.59E-03	1.59E-03	3.97E-01
1,1-Dichloroethane	2.63E-01	1	1.00E-01	7.20E-03	7.20E-03	7.20E-02
1,1-Dichloroethene	1.73E+00	1	9.00E-03	4.75E-02	4.75E-02	5.28E+00
1,2-Dichloroethane	1.46E-01	1	3.00E-02	4.00E-03	4.00E-03	1.33E-01
4-Chloroaniline	1.00E-02	1	4.00E-03	2.74E-04	2.74E-04	6.85E-02
Methylene chloride	2.16E-01	1	6.00E-02	5.91E-03	5.91E-03	9.85E-02
Tetrachloroethene	5.97E-01	1	1.00E-02	1.64E-02	1.64E-02	1.64E+00
Trichloroethene	8.81E+00	1	6.00E-03	2.41E-01	2.41E-01	4.02E+01
Vinyl chloride	3.03E-02	1	3.00E-03	8.29E-04	8.29E-04	2.76E-01
Cis-1,2-Dichloroethene	5.11E-01	1	1.00E-02	1.40E-02	1.40E-02	1.40E+00
Trans-1,2-Dichloroethene	9.63E-02	1	2.00E-02	2.64E-03	2.64E-03	1.32E-01
					Total =	5.01E+01

R.N.: 0

TABLE B-17

SUMMARY OF 2010 SOURCE AREA GROUNDWATER DATA
SITE 3
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

SAMPLE ID	BED-GW-MW49I-022210	BED-GW-MW50I-022210	BED-GW-MW52I-022310	BED-GW-MW53I-022210	BED-GW-MW55I-022310	BED-GW-MW55I-022310-D	BED-GW-MW55I-022310	BED-GW-MW56I-022210	BED-GW-MW57I-022210	BED-GW-MW58IR-022210
LOCATION ID	MW-49I	MW-50I	MW-52I	MW-53I	MW-55I	MW-55I	MW-55I	MW-56I	MW-57I	MW-58IR
SAMPLE DATE	02/22/10	02/22/10	02/23/10	02/22/10	02/23/10	02/23/10	02/23/10	02/22/10	02/22/10	02/22/10
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	ORIG	DUP	AVG	NORMAL	NORMAL	NORMAL
PARAMETER	NM	NM	NM	NM	NM	FD	FD	NM	NM	NM
VOLATILES (UG/L)										
1,1,1-TRICHLOROETHANE	10 U	2.5 U	**114**	**36**	**55**	**53**	**54**	1.3 U	**51**	0.50 U
1,1,2-TRICHLOROETHANE	**12 J**	2.5 U	25 U	**5.1 J**	25 U	25 U	25 U	1.3 U	5 U	0.50 U
1,1-DICHLOROETHANE	**538**	**3.6 J**	**639**	**212**	**512**	**489**	**500.5**	**10**	**220**	**2.3**
1,1-DICHLOROETHENE	**1320**	**53**	**3760**	**1510**	**585**	**571**	**578**	**87**	**1610**	**3.8**
1,2-DICHLOROETHANE	10 U	2.5 U	25 U	5 U	25 U	25 U	25 U	1.3 U	5 U	0.50 U
CIS-1,2-DICHLOROETHENE	**4920**	**2070**	**10500**	**1860**	**18500**	**18600**	**18550**	**1280**	**4900**	**18**
TETRACHLOROETHENE	**501**	2.5 U	**902**	**446**	**197**	**204**	**200.5**	**56**	**154**	**4.4**
TOTAL 1,2-DICHLOROETHENE	**4959**	**2078.5**	**10551**	**1877**	**18541**	**18654**	**18597.5**	**1284.3**	**4911**	**18**
TOTAL CHLORINATED VOCS	**18411**	**2149.3**	**33856**	**9775.1**	**21090**	**21221**	**21155.5**	**1814.2**	**7724.2**	**38.3**
TRANS-1,2-DICHLOROETHENE	**39**	**8.5**	**51**	**17**	**41 J**	**54**	**47.5 J**	**4.3**	**11**	0.50 U
TRICHLOROETHENE	**11000**	**9.7**	**17600**	**5620**	**1200**	**1250**	**1225**	**375**	**772**	**9.8**
VINYL CHLORIDE	**81**	**4.5 J**	**290**	**69**	25 U	25 U	25 U	**1.9 J**	**6.2 J**	0.50 U

U = not detected at the quantitation limit shown
J = estimated

TABLE B-18

SUMMARY OF RECEPTOR RISKS AND HAZARDS - GROUNDWATER - 2010 DATA
SITE 3
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Chemical	Incremental Lifetime Cancer Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
	Maximum Concentration[1] (ug/L)	EPA Regional Screening Level for Tap Water[2] (ug/L)	Estimated ILCR	Primary Target Organs	EPA Regional Screening Level for Tap Water (ug/L)	Estimated HQ
1,1,1-Trichloroethane	114	NA[3]	NA	Body Weight	9100	0.0
1,1,2-Trichloroethane	12	0.24	5.0E-05	Blood	150	0.1
1,1-Dichloroethane	639	2.4	2.7E-04	Central Nervous System	730	0.9
1,1-Dichloroethene	3760	NA	NA	Liver	340	11.1
1,2-Dichloroethane	0	0.15	0.0E+00	NA	640	0.0
4-Chloroaniline	0	0.34	0.0E+00	Spleen	150	0.0
cis-1,2-Dichloroethene	18600	NA	NA	Blood	370	50.3
Methylene chloride	0	4.8	0.0E+00	Liver	1100	0.0
Tetrachloroethene	902	0.11	8.2E-03	Liver	220	4.1
Trans-1,2-Dichloroethene	51	NA	NA	Blood	110	0.5
Trichloroethene	17600	2	8.8E-03	Liver	NA	NA
Vinyl chloride	290	0.016	1.8E-02	Liver	72	4.0
		Total Cancer Risk	3.5E-02		**Total Hazard Index (HI)**	70.9

1 Maximum detected concentrations were reported for source area monitoring wells MW-52I, MW-49I, and MW-55I.

2 USEPA Regional Screening Levels (RSLs) for tap water (USEPA, May 2010). RSLs for carcinogenic effects represent the IE-06 cancer risk level. RSLs for noncarcinogenic effects represent a Hazard Index of 1.

3 NA - Not applicable. The USEPA has not established a cancer slope factor (CSF) or noncarcinogenic reference dose (RfD) for this chemical.

TABLE B-19
SUMMARY OF CHEMICALS OF POTENTIAL CONCERN
USED IN THE 2000 ECOLOGICAL RISK ASSESSMENT

Exposure Medium	Chemical of Potential Concern	Frequency of Detection	Minimum Conc.	Maximum Conc.	Units	Maximum Exposure Point Conc.	Units	Statistical Measure
Riparian Forest Areas								
Runoff/ Seepage	Aluminum	3/4/4	299	2,480	ppb	2,135	ppb	95% UCL
	Cadmium	2/4/4	6.3	19.1	ppb	17	ppb	95% UCL
	Copper	4/4/4	12.1	55.2	ppb	55	ppb	95% UCL
	Iron	4/4/4	174	2,980	ppb	2,980	ppb	Maximum
	Lead	3/4/4	8.2	51.9	ppb	45	ppb	95% UCL
	Zinc	4/4/4	42.5	176	ppb	164	ppb	95% UCL
	Bis(2-ehtylhexyl)phthalate	2/2/4	4	4	ppm	4	ppb	Maximum
Wetland Sediment	Aluminum	6/6/6	6,765	14,050	ppm	10,941	ppm	95% UCL
	Arsenic	6/6/6	4.2	38.6	ppm	37	ppm	95% UCL
	Cadmium	4/5/5	1.9	8.7	ppm	7.2	ppm	95% UCL
	Copper	6/6/6	14.3	44.2	ppm	33	ppm	95% UCL
	Iron	6/6/6	9,120	54,700	ppm	35,193	ppm	95% UCL
	Lead	6/6/6	19.3	121.1	ppm	82	ppm	95% UCL
	Selenium	4/6/6	2.5	5.2	ppm	4.4	ppm	95% UCL
	Silver	1/2/2	3.9	3.9	ppm	3.9	ppm	Maximum
	Total PAHs	5/5/5	135	23,783	ppm	16.2	ppm	95% UCL
Surface Soil	Arsenic	24/24/24	2.9	42.1	ppm	10.04	ppm	95%UCL
	Silver	4/17/17	0.91	119	ppm	20.20	ppm	95% UCL
	Alpha Chlordane	1/1/1	0.0025	0.0025	ppm	0.0025	ppm	Maximum
	Bis(2-ehtylhexyl)phthalate	5/24/24	0.07	12	ppm	1.636	ppm	95% UCL
	Total PAHs	24/24/24	1.51	25.1	ppm	7.35	ppm	95% UCL
	1,2-dichloroethene (total)	5/24/24	0.002	0.032	ppm	0.009	ppm	95% UCL
	Tetrachloroethene	4/24/24	0.001	0.036	ppm	0.009	ppm	95% UCL
	Trichloroethene	8/24/24	0.002	0.055	ppm	0.013	ppm	95% UCL
Elm Brook								
Surface Water	Iron	3/3/3	247	2,830	ppb	2,830	ppb	Maximum
Sediment	Aluminum	6/6/6	2,790	5,930	ppm	4,587	ppm	95%UCL
	Arsenic	6/6/6	3.9	47.4	ppm	36	ppm	95% UCL
	Total PAHs	6/6/6	1.62	17.34	ppm	12.29	ppm	95% UCL
	1,2-dichloroethene (total)	1/6/6	0.21	0.21	ppb	0.11	ppb	95% UCL
Groundwater Discharge	Aluminum	4/4/4	1,810	9,030	ppb	8,670	ppb	95% UCL
	Chromium	3/4/4	33.6	97	ppb	93	ppb	95% UCL
	Copper	2/4/4	61.3	85.4	ppb	85	ppb	Maximum
	Iron	4/4/4	4,130	25,300	ppb	25,238	ppb	95% UCL
	Lead	3/4/4	16.9	48.6	ppb	46	ppb	95% UCL
	Zinc	3/4/4	18.7	213	ppb	183	ppb	95% UCL

Notes:
ppm: parts per million (mg/kg or mg/L)
ppb: parts per billion (μg/kg or μg/L)
95% UCL: 95% Upper Confidence Limit
PAHs: Polycyclic aromatic hydrocarbons
Frequency of Detection: Number of detects/ number used to calculate statistics/ number of sampling points

TABLE B-20
SUMMARY OF POTENTIAL EXPOSURE PATHWAYS USED IN THE 2000 ECOLOGICAL RISK ASSESSMENT

Exposure Medium	Potential Receptor	Sensitive Environment (Y/N)	Sensitive Species (Y/N)	Exposure Routes Evaluated	Assessment Endpoints	Measurement Endpoints	Findings
Riparian Forest							
Surface Soil	- Terrestrial Wildlife - Terrestrial Plants	No	No	- Ingestion - Dermal Absorption - Plant Uptake	Protection and maintenance of upland terrestrial biota and habitats.	- Comparison to soil benchmark values - Modeling & evaluation of potential adverse effects - Qualitative evaluation (field walkovers, habitat characterization, and observation)	Minimal potential for ecological risks
Wetland Sediments	- Terrestrial Wildlife - Wetland Plants - Aquatic Life	No	No	- Ingestion - Dermal Absorption - Plant Uptake	Protection and maintenance of the riparian forested wetland biota and habitats	- Comparison of wetland sediment concentrations to sediment quality criteria or benchmark values - Modeling and evaluation of potential adverse effects - Qualitative evaluation (through field walkovers, habitat characterization, and observation)	Minimal potential for ecological risks
Runoff/ Seepage	- Aquatic Life - Terrestrial Wildlife	No	No	- Ingestion, dermal absorption & respiration for aquatic life - Ingestion & dermal absorption for terrestrial wildlife	Protection and maintenance of upland terrestrial and wetland biota and habitats.	- Comparison of runoff/seepage concentrations to water quality criteria or benchmark values - Modeling and evaluation of potential adverse effects - Qualitative evaluation (field walkovers, habitat characterization, and observation)	Minimal potential for ecological risks
Elm Brook							
Sediment	- Terrestrial Wildlife - Wetland Plants - Aquatic Life	No	No	- Ingestion - Dermal Absorption - Plant Uptake	Protection and maintenance of Elm Brook biota and habitats.	- Comparison of sediment concentrations to sediment quality criteria or benchmark values - Modeling of potential adverse effects - Qualitative evaluation of upland conditions through field walkovers, habitat characterization, and observation - Evaluation of macroinvertebrate study	Minimal potential for ecological risks
Surface Water	- Aquatic Life - Terrestrial Wildlife	No	No	- Ingestion, dermal absorption & respiration/ immersion for aquatic life - Ingestion & dermal absorption for terrestrial wildlife	Protection and maintenance of Elm Brook biota and habitats.	- Comparison of surface water concentrations to water quality criteria or benchmark values - Modeling of potential adverse effects - Qualitative evaluation of upland conditions through field walkovers, habitat characterization, and observation - Evaluation of macroinvertebrate study	Minimal potential for ecological risks
Groundwater Discharge	- Aquatic Life	No	No	- Ingestion - Dermal Absorption - Respiration	Protection and maintenance of Elm Brook biota and habitats.	- Comparison of groundwater concentrations to water quality criteria or benchmark values	Minimal potential for ecological risks

Appendix C
Cost Estimate

TABLE C-1
ESTIMATED COSTS FOR IN-SITU ENHANCED BIOREMEDIATION (SOURCE AREA AND DOWNGRADIENT POLISHING)
SITE 3
NWIRP BEDFORD, MASSACHUSETTS

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans including Permits	400	hr			$37.00		$0	$0	$14,800	$0	$14,800
1.2 Completion Report	200	hr			$37.00		$0	$0	$7,400	$0	$7,400
2 FIELD SUPPORT											
2.1 Site Support Facilities (trailers, phone, electric, etc.)	3	mo		$220.00	$360.00		$0	$660	$1,080	$0	$1,740
2.2 Survey Support	5	day	$1,025.00				$5,125	$0	$0	$0	$5,125
2.3 Decontamination Services	3	mo		$220.00		$328.00	$0	$660	$0	$984	$1,644
3 PILOT TEST AND WELLS											
3.1 Pilot Test	1	ls	$30,000.00				$30,000	$0	$0	$0	$30,000
3.2 Source Area Well Installation (15 wells to 50 ft deep	750	lf	$70.00				$52,500	$0	$0	$0	$52,500
3.3 Lower Parking Lot Well Installation (10 wells, 30 ft deep	300	lf	$50.00				$15,000	$0	$0	$0	$15,000
4 FIRST ROUND OF INJECTIONS											
4.1 Injection Rig	24	day	$2,650.00				$63,600	$0	$0	$0	$63,600
4.2 Emulsified Oil	66,000	lb		$2.44			$0	$161,040	$0	$0	$161,040
4.3 Water	37,700	gal		$0.32			$0	$12,064	$0	$0	$12,064
4.4 Site Superintendent	5	week			$1,285.00		$0	$0	$6,425	$0	$6,425
4.5 Site Health & Safety and QA/QC	5	week			$730.00		$0	$0	$3,650	$0	$3,650
4.6 Field Activity Report	25	hr			$37.00		$0	$0	$925	$0	$925
4.7 Monitoring (3 events, 10 wells, COCs+geochem analyses	3	EA	$10,000.00		$7,000.00	$3,000.00	$30,000	$0	$21,000	$9,000	$60,000
5 SECOND ROUND OF INJECTIONS											
5.1 Injection Rig	17	day	$2,650.00				$45,050	$0	$0	$0	$45,050
5.2 Emulsified Oil	44,000	lb		$2.44			$0	$107,360	$0	$0	$107,360
5.3 Water	22,000	gal		$0.32			$0	$7,040	$0	$0	$7,040
5.4 Site Superintendent	4	week			$1,285.00		$0	$0	$5,140	$0	$5,140
5.5 Site Health & Safety and QA/QC	4	week			$730.00		$0	$0	$2,920	$0	$2,920
5.6 Field Activity Report	25	hr			$37.00		$0	$0	$925	$0	$925
5.7 Monitoring (3 events, 10 wells, COCs+geochem analyses	3	EA	$10,000.00		$7,000.00	$3,000.00	$30,000	$0	$21,000	$9,000	$60,000
6 THIRD ROUND OF INJECTIONS											
6.1 Injection Rig	11	day	$2,650.00				$29,150	$0	$0	$0	$29,150
6.2 Emulsified Oil	22,000	lb		$2.44			$0	$53,680	$0	$0	$53,680
6.3 Water	13,200	gal		$0.32			$0	$4,224	$0	$0	$4,224
6.4 Site Superintendent	3	week			$1,285.00		$0	$0	$3,855	$0	$3,855
6.5 Site Health & Safety and QA/QC	3	week			$730.00		$0	$0	$2,190	$0	$2,190
6.6 Field Activity Report	25	hr			$37.00		$0	$0	$925	$0	$925
6.7 Monitoring (3 events, 10 wells, COCs+geochem analyses	3	EA	$10,000.00		$7,000.00	$3,000.00	$30,000	$0	$21,000	$9,000	$60,000
Subtotal							**$330,425**	**$346,728**	**$113,235**	**$27,984**	**$818,372**
Overhead on Labor Cost @ 30%									$33,971		$33,971
G & A on Labor Cost @ 10%									$11,324		$11,324
G & A on Material Cost @ 10%								$34,673			$34,673
G & A on Equipment Cost @ 10%										$2,798	$2,798
G & A on Subcontract Cost @ 10%							$33,043				$33,043
Tax on Materials and Equipment Cost @ 6%										$1,749	$23,420
Total Direct Cost							$363,468	$403,071	$158,529	$32,531	$957,599
Indirects on Total Direct Cost @ 15%											$143,640
Profit on Total Direct Cost @ 10%											$95,760
Subtotal											$1,196,999
							$21,671				
Health & Safety Monitoring @ 1%											$11,970
Total Field Cost											$1,208,969
Contingency on Total Field Costs @ 20%											$241,794
Engineering on Total Field Cost @ 5%											$60,448
TOTAL CAPITAL COST											**$1,511,211**

TABLE C-2
ESTIMATED COSTS FOR PUMP-AND-TREAT AS MIGRATION CONTROL IN THE ON-SITE AREA
SITE 3
NWIRP BEDFORD, MA

Technology:	Pump and Treat System - On-Site Dissolved-Phase Plume Area (IRA system + 7 new wells)				
Site:	NWIRP Bedford, Site 3				
Location:	Bedford, MA	Prepared By: KMC		Checked by:	JJK/KW/EMM/DM/JR
Phase:	Feasibility Study (-30% to +50%)	Orig. Date: 10/3/00		Revision Date:	6/25/10 (JR)
Base Year:	2010				

Work Statement:

Continue operation of the existing IRA system. Add 7 extraction wells to capture the portion of plume migrating to the north/northwest (a potential cost). Monitor effectiveness using existing groundwater monitoring well network. Include treatment plant upgrades. Does not include potential easement costs.

DESCRIPTION		QTY	UNIT	UNIT TOTAL	TOTAL	NOTES
CAPITAL COSTS						
Monitoring, Sampling, Testing & Analysis						
	Install/Develop New Wells	7	EA	$ 5,300	$ 37,100	[a]
	Sampling	7	EA	$ 1,100	$ 7,700	[f]
	Analysis	7	EA	$ 200	$ 1,400	[f]
	SUBTOTAL				**$ 46,200**	
Site Work						
	Construction	1	LS	12,700	$ 12,700	[f]
	Clearing & Grubbing	0.5	acre	$ 2,100	$ 1,050	[b]
	SUBTOTAL				**$ 13,750**	
Purchase/Set-up Extraction Well System (Pumps and Connections, etc.)						
	Pumps	7	EA	$ 5,300	$ 37,100	[g]
	Connect Piping	1	LS	$ 8,500	$ 8,500	[g]
	Sampling Ports and Flow Meters	7	EA	$ 1,100	$ 7,700	[a]
	SUBTOTAL				**$ 53,300**	
Treatment System[1]						
	Perform Jar Tests	1	LS	$ 5,300	$ 5,300	[c]
	Upgrade Existing Treat. Sys./Manual	1	LS	$ 100,000	$ 100,000	[c]
	Piping Stands/Accessories	1	LS	$ 10,600	$ 10,600	[c]
	SUBTOTAL				**$ 115,900**	
Offsite Treatment/Disposal of Drill Cuttings						
	Waste Characterization	1	EA	$ 600	$ 600	[d]
	Transport & Disposal (non-haz)	7	drums	$ 90	$ 630	[d]
	SUBTOTAL				**$ 1,230**	
CUMULATIVE SUBTOTAL					**$ 230,380**	
Contingency		20%			$ 46,076	
CUMULATIVE SUBTOTAL					**$ 276,456**	
Project Management and Design						USEPA, 2000
	Project Management	8%			$ 22,116	
	Remedial Design	15%			$ 41,468	
	Construction Management	10%			$ 27,646	
	SUBTOTAL				**$ 91,230**	
TOTAL CAPITAL COSTS					**$ 367,686**	
ANNUAL OPERATION AND MAINTENANCE COSTS						
Site Monitoring[2]						
	Groundwater Sampling-Winter	50	EA	$ 1,000	$ 50,000	[g]
	Groundwater Analysis-Winter	60	EA	$ 200	$ 12,000	[g]
	Groundwater Reporting-Winter	1	LS	$ 15,000	$ 15,000	[g]
	Groundwater Sampling-Summer	40	EA	$ 1,000	$ 40,000	[g]
	Groundwater Analysis-Summer	48	EA	$ 200	$ 9,600	[g]
	Groundwater Reporting-Summer	1	LS	$ 15,000	$ 15,000	[g]
	SUBTOTAL				**$ 141,600**	

TABLE C-2
ESTIMATED COSTS FOR PUMP-AND-TREAT AS MIGRATION CONTROL IN THE ON-SITE AREA
SITE 3
NWIRP BEDFORD, MA

DESCRIPTION		QTY	UNIT	UNIT TOTAL	TOTAL	NOTES
Well and Pump Maintenance						
	Repairs	1	LS	$ 10,000	$ 10,000	[h]
	SUBTOTAL				**$ 10,000**	
Pump and Treat System						
	Operations Labor	200	hours	$ 85	$ 17,000	[f]
	Equipment Repair	3	LS	$ 9,000	$ 27,000	[f]
	Utilities	12	months	$ 2,000	$ 24,000	[f]
	Carbon changeout/disposal	2	per event	$ 3,000	$ 6,000	[f, i]
	SUBTOTAL				**$ 74,000**	
CUMULATIVE ANNUAL O&M SUBTOTAL					**$ 225,600**	
Contingency		10%			$ 22,560	
CUMULATIVE ANNUAL O&M SUBTOTAL					**$ 248,160**	
Project Management and Design						
	Project Management	5%			$ 12,408	
	Technical Support	10%			$ 24,816	
	SUBTOTAL				**$ 37,224**	
TOTAL ANNUAL O&M COSTS					**$ 285,384**	
Calculated 30 Year O&M Net Present Value		**3%**			**$ 5,761,462**	3% federal interest rate for discounting constant dollar flows
PERIODIC COSTS						
Extraction Well Replacement[3]			event		$ 130,000	[h]
Pump Replacement[4]			event		$ 105,000	[h]
Treatment System Replacement[5]			event		$ 250,000	[h]
Five-Year Reviews			event		$ 50,000	[e]
	SUBTOTAL				**$ 535,000**	
Calculated 30 Year Net Present Value		**3%**			**$ 941,321**	3% federal interest rate for discounting constant dollar flows
TOTAL COST (CAPITAL, ANNUAL O&M, PERIODIC -- 30 YEARS)					**$ 7,070,469**	

Notes:
(1) General estimate for improvements to facility. Data required to improve accuracy of estimate.
(2) Sampling and analysis costs assume that 50 wells will be monitored in the winter and 40 wells will be monitored in the summer (+QA/QC).
(3) 26 total wells, every 10 years.
(4) 26 total pumps, every 5 years.
(5) Treatment System Replacement, every 25 years.

Cost References:
[a] Prior project experience (KC, Bedford Site 4 FS)
[b] Project experience (JK, Dover)
[c] Cost estimate generated for Site 3 FS (KC).
[d] Prior project experience at Site 3 (JR)
[e] Professional judgment based on projected costs for 5-year reviews at other CERCLA sites (SG)
[f] Prior project experience (AM, Bedford Site 4 FS)
[g] Estimate based on past Site 3 sampling costs.
[h] Engineering judgment or calculation (DM)
[i] Engineering judgment or calculation

TABLE C-3
ESTIMATED COSTS FOR MONITORED NATURAL ATTENUATION
SITE 3
NWIRP BEDFORD, MASSACHUSETTS

Technology:	Monitored Natural Attenuation		
Site:	NWIRP Bedford, Site 3	Prepared By: JJK	Checked by: KMC / DM / JR
Location:	Bedford, MA	Orig. Date: 10/17/00	Rev. Date: 6/25/10 (JR)
Phase:	Feasibility Study (-30% to +50%)		
Base Year:	2010		

Work Statement:
The natural attenuation of the COCs will be monitored via periodic groundwater sampling (add on to monitoring program for the IRA system, Table B-2).

DESCRIPTION		QTY	UNIT	UNIT COST	TOTAL	NOTES
CAPITAL COSTS						
Work Plan						
	Sampling and Analysis Plan	1	LS	$ 20,000	$20,000	
	TOTAL				**$20,000**	
O&M COSTS						
Well Maintenance						
	Repairs	1	LS	$ 3,500	$3,500	
	SUBTOTAL				**$3,500**	
Contingency		20%			$700	
CUMULATIVE SUBTOTAL					**$4,200**	
TOTAL PRESENT VALUE O&M COST OVER 30 YEARS					**$84,792**	
PERIODIC COSTS						
Site Monitoring (add-on to LTM program for IRA operation)						
Year 1 -- Semiannually[1]						
	Labor and Equipment[2]	2	Each	$10,000	$20,000	
	Laboratory Analysis[3]	2	Each	$15,000	$30,000	
	Monitoring Reports[4]	2	Each	$5,000	$10,000	
	SUBTOTAL				**$60,000**	
	Contingency		10%		**$6,000**	
	CUMULATIVE SUBTOTAL				**$66,000**	
	Project Management		5%		**$3,300**	
	Technical Support		10%		**$6,600**	
		SUBTOTAL			**$9,900**	
	CUMULATIVE SUBTOTAL				**$75,900**	

TABLE C-3
ESTIMATED COSTS FOR MONITORED NATURAL ATTENUATION
SITE 3
NWIRP BEDFORD, MASSACHUSETTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Year 2 -- Semiannually	2	event	$75,900		
Years 3-8 -- Annually	1	event	$38,115		
Years 9-30 -- Biannually	1	event	$38,115		
Calculated 30 Year Net Present Value	3%			**$ 890,045**	3% federal interest rate for discounting constant dollar flows
TOTAL COST (CAPITAL, ANNUAL O&M, PERIODIC -- 30 YEARS				**$ 974,836**	

Notes:
1. Assume 50 existing wells.
2. Assume 2 rounds per year.
3. Assume 50 wells + 10 QA/QC each round
4. Assume 1 report each year (years 1-8) and 1 per event for years 9-30.

TABLE C-4
ESTIMATED COSTS FOR INSTITUTIONAL CONTROLS
SITE 3
NWIRP BEDFORD, MASSACHUSETTS

Technology:	Institutional Controls				
Site:	NWIRP Bedford, Site 3				
Location:	Bedford, MA	Prepared By: JJK		Checked by:	JR
Phase:	Feasibility Study (-30% to +50%)	Orig. Date: 10/25/2000		Rev. Date:	6/25/10 (JR)
Base Year:	2010				

Work Statement:
Institutional controls enacted to prevent exposure to COCs (prohibiting groundwater usage, controlling use of buildings/structures).

DESCRIPTION		QTY	UNIT	UNIT TOTAL	TOTAL	NOTES
CAPITAL COSTS						
Institutional Control Plan		1	LS	$10,000	$10,000	
Groundwater Use Restriction		1	LS	$10,000	$10,000	
Site Information Database		1	LS	$10,000	$10,000	
	SUBTOTAL				**$30,000**	
OPERATION AND MAINTENANCE (O&M) COSTS						
Inspections and Reporting		1	LS	$2,000	$2,000	
	SUBTOTAL				**$2,000**	
PERIODIC COSTS						
no additional costs (5-year review costs included with other remedies)						
COST SUMMARY (30-YEAR NET PRESENT WORTH)						
	Capital Costs		$30,000			
	30-Year Present Worth		$39,201			
	30-Year Net Present Worth		**$69,201**			

Year	Annual O&M	Periodic Costs	Subtotal
1	$2,000	$0	$2,000
2	$2,000	$0	$2,000
3	$2,000	$0	$2,000
4	$2,000	$0	$2,000
5	$2,000	$0	$2,000
6	$2,000	$0	$2,000
7	$2,000	$0	$2,000
8	$2,000	$0	$2,000
9	$2,000	$0	$2,000
10	$2,000	$0	$2,000
11	$2,000	$0	$2,000
12	$2,000	$0	$2,000
13	$2,000	$0	$2,000
14	$2,000	$0	$2,000
15	$2,000	$0	$2,000
16	$2,000	$0	$2,000
17	$2,000	$0	$2,000
18	$2,000	$0	$2,000
19	$2,000	$0	$2,000
20	$2,000	$0	$2,000
21	$2,000	$0	$2,000
22	$2,000	$0	$2,000
23	$2,000	$0	$2,000
24	$2,000	$0	$2,000
25	$2,000	$0	$2,000
26	$2,000	$0	$2,000
27	$2,000	$0	$2,000
28	$2,000	$0	$2,000
29	$2,000	$0	$2,000
30	$2,000	$0	$2,000
		Total =	$60,000
		30-Year Discount Rate =	3.0%
		Present Worth =	$39,201

Appendix D

Public Hearing Transcript

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT

SITE 3 - CHLORINATED SOLVENT GROUNDWATER PLUME

PUBLIC HEARING

Wednesday, July 21, 2010
Bedford Town Hall
10 Mudge Way
Bedford, MA
7:20 p.m.

Leavitt Reporting, Inc.

119 Broad Street
Weymouth, MA 02188
www.leavittreporting.com

Tel. 781-335-6791
Fax: 781-335-7911
leavittreporting@comcast.net

Hearings ◆ Conferences ◆ Legal Proceedings

P R O C E E D I N G S

MR. ROPP: Thank you again for coming. This starts the official public hearing for the Navy Proposed Plan for Site 3.

Site 3 is the chlorinated solvent groundwater plume at the Naval Weapons Industrial Reserve Plant in Bedford.

The Navy's cleanup plan consists of source area treatment using enhanced bioremediation, continued downgradient plume control using groundwater extraction and treatment system, monitored natural attenuation of the remaining groundwater plume, land use controls, and five-year reviews.

The Navy issued the Proposed Plan last week, July 14th, and that starts a 30-day public comment period.

The purpose of this hearing tonight is to receive formal public comments, verbal comments, for the record, and that will become part of the official site Record of Decision.

Since this is a Hearing, we're not going to be answering questions at this point. We just

want to take your comments, your concerns, down for the record and that will be put into a transcript which will go into the Record of Decision.

That said, I'd like to invite anyone to raise a hand and you can state your comment, question, concern, or your approval of the plan.

And we will take those comments, the Navy and EPA and State will go over those, consider them closely, and that could affect the overall outcome of the decision.

So we welcome your comments. Would anyone like to go first?

MR. COREY: My name is Don Corey. I'm the Community Co-Chair of the RAB Committee. Just for the record, the town lost its Hartwell well field just about 30 years ago from chlorinated solvent contamination.

Since the RAB was formed and I became the Community Co-Chair, it is a shorter interval but it has also been a long, agonizing process where we've seen two or three successive Navy project managers, EPA representatives, DEP representatives from Massachusetts, and individuals representing the

contractor.

However, I'm pleased to see that we've gotten to the point tonight where we have a proposed Record of Decision for the last site, Site 3, here at the Navy.

I'm a former LSP so I've had some professional experience. And based on the presentation, this seems like a very reasonable approach and I have no objections and look forward to the process coming to completion. Thank you.

MR. ROPP: Thank you. Anyone else?

MS. BRUNKHORST: My name is Beatrice Brunkhorst. I'm from the Bedford Board of Health and I would just like to state, as was stated already, that the overall goal here is to get to drinking water quality for any water that is going off site of the contaminated site, and that this is the overall goal and I think everything you presented tonight looks toward reaching that goal.

MR. ROPP: Thank you. Anyone else? Okay. If everyone's set -- Go ahead, Anne.

MS. MALEWICZ: Just lastly, State of Massachusetts. We just want to make sure that the

community's voices are heard in this Record of Decision and we are also as sensitive as they are regarding the Hartwell wells.

And please be assured that we will make sure that the monitoring includes the five-year review, checking in with the community, making sure what the status is with the wells.

And also, we are pleased with the Navy moving forward at this point to finding a remedy for this particular site and we'll be working with the EPA on this.

So we thank the community, especially the RAB Chair, for all his dedication over the years. Thank you.

MR. ROPP: Thank you. If everyone's all set then, I'll just remind you that we have copies of the Proposed Plan here and at the library along with other documents for the site.

The public comment period goes through August 13th, and the Plan tells you how you can submit written comments. At this point we'll consider the hearing closed. Thank you very much.

(Whereupon at 7:26 p.m. the hearing adjourned.)

C E R T I F I C A T E

I hereby certify that the foregoing 6 pages contain a full, true and correct transcription of all my stenographic notes to the best of my ability taken in the above-captioned matter held at the Bedford Town Hall on Wednesday, July 21, 2010, commencing at 7:20 p.m.

Linda J. Modano 8/5/10

Linda J. Modano, Registered Professional Reporter

My commission expires June 2, 2011

Appendix E

Groundwater Use and Value Determination by MassDEP

GROUNDWATER USE AND VALUE DETERMINATION
Naval Weapons Industrial Reserve Plant, Bedford, Massachusetts
October 1998

Pursuant to the Memorandum of Agreement between the EPA and the DEP concerning Ground Water Use and Value Determinations, and consistent with the Environmental Protection Agency's (EPA) 1996 Final Ground Water Use and Value Determination Guidance, the Department has developed a "Use and Value Determination" of the groundwater impacted by the Naval Weapons Industrial Reserve Plant (NWIRP) Superfund Site (the "Site"). The purpose of the Use and Value Determination is to identify whether the aquifer related to the Site is of "High, Medium," or "Low" use and value. In the development of its Determination, the Department has applied the criteria for groundwater classification as promulgated in the Massachusetts Contingency Plan (MCP). The classification contained in the MCP considers criteria similar to those recommended in the Use and Value Guidance. **The Department's determination for this Site is high use and value.** This determination is explained in more detail below.

The NWIRP Site occupies approximately 46 acres in the town of Bedford. NWIRP is part of a larger industrial complex located immediately north of Hanscom Air Force Base, which is also a Superfund Site. NWIRP and the Raytheon Missile Systems Division (RMSD), also located within the industrial complex, are operated by Raytheon Co. NWIRP's mission began in 1952 when a missile and radar development laboratory was built. Then known as the Naval Industrial Research Aircraft Plant (NIRAP), the laboratory provided facilities for research and development of radar, missile guidance systems, and related equipment. Flight test facilities were added on the southern portion of the site in 1959. Between 1959 and 1977, the Navy obtained about 43 additional acres from the Air Force. Buildings constructed during the past 25 years include large facility storage and government buildings near the northern property boundary, an Antenna Range Building, air conditioning and incineration facilities, and the Advanced Medium Range Air to Air Missile Development (AMRAD) Building. NWIRP currently is used for advanced technology research in weapons systems development. These activities include the design, fabrication, and testing of prototype equipment such as missile guidance and control systems. There are two primary operating areas at NWIRP: the Components Laboratory and the Flight Test Facility. Approximately 21 other buildings house various support activities related to the work at these two centers. Wastes generated at NWIRP include various volatile organic compounds (VOCs), photographic fixer, waste oil and coolants, lacquer thinner, unspecified solvents and thinners, Stoddard solvent, waste paint, and chromic, sulfuric, nitric, hydrochloric, and phosphoric acids. In 1986, the Navy initiated a study to determine potential contaminant sources at NWIRP. Contaminants in soil and groundwater include petroleum compounds, primarily BTEX, and chlorinated solvents, primarily trichloroethylene. Operation of groundwater collection system began in 1997 to treat and contain contamination in the groundwater migrating from the northwest area of NWIRP. Extraction of groundwater is intended to prevent VOC contamination from potentially migrating north toward Elm Brook.

The groundwater beneath and around the area of the HAFB site is classified as GW-1 under the MCP. Groundwater is classified as GW-1 because it is currently used for, or considered to be a potential future source of, public water supply. A portion of the aquifer falls within the mapped Zone II area of the Hartwell Road municipal water supply wellfield. The Hartwell Road Wellfield, part of the municipal water supply for the Town of Bedford, is located less than 1/2 mile northwest of NWIRP. The three wells located in this wellfield were closed in 1984 after VOC contamination was found in two of the wells. Investigations conducted by the Air Force, NWIRP, Raytheon and the Town of Bedford have been inconclusive in identifying a specific source of contamination which caused the shutdown of the wellfield. The entire wellfield remains inactive, but has not been officially abandoned under DEP regulations, and the Town has contingency plans to reactivate them at sometime in the future.

The Town of Bedford has also, in accordance with Massachusetts regulations, designated this area as an Aquifer Protection District in order to protect it as a source of municipal water supply.

Either of the two conditions above, groundwater within a mapped Zone II of a current public water supply, or groundwater within the area of an Aquifer Protection District, meet the criteria for classification as GW-1 under the MCP and therefore is determined to be of high use and value. In addition, all groundwater within the Commonwealth is considered to eventually discharge to a surface water body and is therefore classified as GW-3 under the MCP. The GW-1 classification is intended to ensure water quality sufficient for public consumption and the GW-3 classification is to ensure the water quality at the time of discharge to surface water is protective for non-consumptive public health exposures and for environmental receptors.

The Shawsheen River provides drinking water through intakes approximately 7 miles downstream. Extensive wetlands and several species of rare fauna and flora are found along Elm Brook and the Shawsheen River. The Shawsheen drinking water sources are not likely to be impacted by contamination from the Site owing to the distance that would be required for contaminant transport.

Based upon the above mentioned MCP classifications, the risk assessment and remediation plans for groundwater at the NWIRP site should include, but not be limited to, the following exposure pathways:

Human Health:

a) use as a public water supply, including consumption and other domestic uses,
b) use for industrial processes,
c) worker exposure during excavation,
d) recreational exposures resulting from discharge to surface water.

Ecological:

a) effects on the biota that make up the benthic community, and the food chain above considering persistence and bioaccumulation.

For your information, the Department has promulgated default cleanup standards for many contaminants in both soil and groundwater, considering various current and future use scenarios and exposures, which may be used in lieu of a risk assessment (MCP Method 1 risk evaluation). Provided the NWIRP site meets the criteria outlined in the MCP for use of Method 1, EPA and the Navy may choose to use these standards or to develop site specific cleanup criteria.

TABLE 1

Naval Weapons Industrial Reserve Plant (NWIRP), Bedford, Massachusetts, Groundwater Use and Value Determination
Massachusetts Department of Environmental Protection
September, 1998

USE AND VALUE FACTORS	NWIRP SITE: #3-2611 SITE-SPECIFIC DETERMINATION
Quantity	• Low yield on site and medium to high yield throughout study area.
Quality	• Elevated levels of chlorinated compounds on site migrating into study area groundwater. Site groundwater contaminants include volatile organic compounds (primarily tetrachloroethylene, trichloroethylene and BTEX compounds).
Current Public Drinking Water Supply	• DEP-approved Zone II[1] in the study area, on site Municipal Aquifer Protection District encompasses DEP-Approved Zone II area as well as Zones IIIA and B[2] within the study area. • Town water produced in Shawsheen Road Wells (outside the study area) supplemented by MWRA drinking water through a connection to the Lexington system; Hartwell Road Wells (within the study area) and Turnpike Road Wells (outside the study area) inactive due to contamination. • Not a Sole Source Aquifer, municipal water connections to the towns of Burlington, Billerica and Concord are available for emergency use only.

[1] **Zone II** means the area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at approved yield, with no recharge from precipitation). It is bounded by the groundwater divides which

Current Private Drinking Water Supply	• Private water supplies are located in the Study Area for potable and agricultural uses.
Likelihood and Identification of Future Drinking Water Use	• Study Area groundwater is designated by the Commonwealth as Groundwater I Category (GW1) commensurate with the designation of approved Zone II and the Municipal Aquifer Protection District[3]. • Study Area is highly urbanized, including mixed use, industrial and commercial development, and residential housing. • Aquifer is designated by the Town as an area for future drinking water supplies upon the implementation of a wellhead treatment system to decontaminate the water supply. Standby status as a potential drinking water source is mandated by municipal agreement with MWRA. • There are no known Deeds of Environmental Restriction or Activity and Use Limitations on the Study Area properties.
Other Current or Reasonable Expected Ground Water Use(s) in Review Area	• Several groundwater wells in the study area are used for non-potable activities such as irrigation.

result from pumping the well and by the contact of the aquifer with less permeable materials such as till or bedrock. In some cases, streams or lakes may act as recharge boundaries. In all cases, Zone II shall extend up gradient to its point of intersection with prevailing hydrogeologic boundaries (a groundwater flow divide, a contact with till or bedrock, or a recharge boundary).

[2] **Zone III** means that land area beyond the area of Zone II from which surface water and groundwater drain into Zone II. The surface drainage area as determined by topography is commonly coincident with the groundwater drainage area and will be used to delineate Zone III. In some locations, where surface and groundwater drainage are not coincident, Zone III shall consist of both the surface drainage and the groundwater drainage areas.

[3] **Aquifer Protection District** means an area designated by a municipality specifically for the protection of groundwater quality (to ensure its availability for use as a source of potable water supply) is considered a Potential Drinking Water Source Area under the MCP. These municipal designations must be in the form of: a) a local ordinance or bylaw adopted by the municipality (e.g., an Aquifer Protection District or Zone); b) an intermunicipal agreement approved by the municipal legislative body; or c) an executed inter-governmental contract for the purchase or sale of drinking water. Groundwater contamination within these designated areas must be cleaned up to GW-1 standards to meet the requirement of a Permanent Solution.

	• In the future, population increases and commercial development will require increased municipal drinking water well use, and possibly, use of private well water for irrigation.
Ecological Value	• Groundwater discharge to Elm Brook, Shawsheen River and several naturally occurring beaver ponds.
Public Opinion	• Public comment occurred during the promulgation of MCP regulations, and under CERCLA will occur during the Record of Decision process. Periodic meetings of the NWIRP Restoration Advisory Board also allow opportunities for public comment. A municipal bylaw, approved by the Massachusetts Attorney General and passed at Public Meeting, was promulgated to establish the current Aquifer Protection District, effectively altering the groundwater classification to GW1 in the study area. Expect substantial public opposition to the reactivation of inactive municipal wells until such time as a wellhead treatment system is installed, or if a challenge were received disputing the Aquifer Protection District Designation.

Appendix F

ARARs and To-Be-Considered Guidance

ARARs AND TBCs FOR ALTERNATIVE 4 (IN-SITU ENHANCED BIOREMEDIATION, DOWNGRADIENT GROUNDWATER EXTRACTION AND TREATMENT, LUCS, MNA)
SITE 3 – CHLORINATED SOLVENT GROUNDWATER PLUME
NWIRP BEDFORD, MASSACHUSETTS

	Requirement	Requirement Synopsis	Action to be Taken to Attain Requirement	Status
Chemical-Specific ARARs				
Federal				
Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) 40 CFR Part 141 Subpart B (141.11 – 141.16)		MCLs are enforceable standards that regulate the concentration of specific organic and inorganic contaminants that have been determined to adversely affect human health in public drinking water supplies. They also may be considered relevant and appropriate for groundwater aquifers potentially used for drinking water.	The groundwater at Site 3 has been designated as high use and value by the MassDEP. Therefore, MCLs will be used to develop remediation goals to be achieved throughout the source area and dissolved-phase plume areas through remedial action. This remedy includes enhanced bioremediation to achieve MCLs in source area groundwater. This remedy also includes groundwater extraction with above ground treatment to achieve MCLs at the property line and in the downgradient off-site plume area. MCLs in other areas will be achieved via MNA.	Relevant and Appropriate
SDWA Maximum Contaminant Level Goals (MCLGs) 40 CFR Part 141 Subpart F (141.50 – 141.51)		Non-zero MCLGs are non-enforceable health goals for public water supply systems. MCLGs are set at levels that would result in no known or expected adverse health effects with an adequate margin of safety. Non-zero MCLGs are to be used as cleanup goals when MCLs have not been established for a particular compound of concern.	The groundwater at Site 3 has been designated as high use and value by the MassDEP. Therefore, non-zero MCLGs will be used to develop remediation goals to be achieved throughout the source area and plume through remedial action. This remedy includes enhanced bioremediation to achieve non-zero MCLGs in source area groundwater. This remedy also includes groundwater extraction with above ground treatment to achieve non-zero MCLGs at the property line and in the downgradient off-site plume area. Non-zero MCLGs in other areas will be achieved via MNA.	Relevant and Appropriate
USEPA Risk Reference Doses (RfDs)		RfDs are considered the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	This remedy will address the identified risks determined by use of this guidance through a combination of source area treatment, plume migration control via groundwater extraction, MNA, and LUCs which will prevent potential non-carcinogenic risks associated with exposure to contaminated groundwater.	To be considered
USEPA Carcinogen Assessment Group, Cancer Slope Factors (CSFs)		CSFs represent the most up-to-date information in cancer risk from USEPA's Carcinogen Assessment Group.	This remedy will address the identified risks determined by use of this guidance through a combination of source area treatment, plume migration control via groundwater extraction, MNA, and LUCs which will prevent potential carcinogenic risks associated with exposure to contaminated groundwater.	To be considered
Guidelines for Carcinogen Risk Assessment EPA/630/P-03/001F (March 2005)		Guidance for assessing cancer risk.	This remedy will address carcinogenic site risks identified under these standards through source area treatment, extraction and treatment of the downgradient plume, LUCs, and MNA.	To be considered
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens EPA/630/R-03/003F (March 2005)		Guidance for assessing cancer risks to children.	This remedy will address carcinogenic site risks to children identified under these standards through source area treatment, extraction and treatment of the downgradient plume, LUCs, and MNA.	To be considered

ARARs AND TBCs FOR ALTERNATIVE 4 (IN-SITU ENHANCED BIOREMEDIATION, DOWNGRADIENT GROUNDWATER EXTRACTION AND TREATMENT, LUCS, MNA)
SITE 3 – CHLORINATED SOLVENT GROUNDWATER PLUME
NWIRP BEDFORD, MASSACHUSETTS

	Requirement	Requirement Synopsis	Action to be Taken to Attain Requirement	Status
State				
MA Drinking Water Standards 310 CMR 22.00		These regulations establish state MCLs or MMCLs for public water supply systems. If MMCLs are more stringent than federal levels, the state levels are used as the ARAR.	The groundwater at Site 3 has been designated as high use and value by the MassDEP. Remedial action for Site 3 will use these standards to develop remediation goals for the source area and plume if they are more stringent than the federal MCL or non-zero MCLG or MA groundwater quality standard. This remedy includes groundwater extraction wells capable of providing a hydraulic barrier to migration of COCs from the source area and restoring the off-site plume area as well as bioremediation and MNA to reduce COC concentrations. Extracted groundwater can be treated to MMCLs by ex-situ treatment.	Relevant and Appropriate
Location-Specific ARARs				
Federal				
Fish and Wildlife Coordination Act 16 USC 661 *et seq.*		Requires federal agencies involved in actions that will result in the control or structural modification of any stream or body of water (e.g., wetland) for any purpose to take action to protect fish and wildlife resources that may be affected by the action. The Navy must coordinate with appropriate federal and state resource agencies to ascertain the means and measures necessary to mitigate, prevent, and compensate for project related losses of fish and wildlife resources and to enhance the resources.	Measures to mitigate or compensate adverse project-related impacts to fish and wildlife resources in the wetland area will be taken, if determined necessary. The appropriate federal and state resource agencies will be coordinated with prior to implementation of the remedial action.	Applicable
Historic Sites Act of 1935 (16 USC §461 *et seq.*); National Historic Landmarks (36 CFR Part 65)		The purpose of the National Historic Landmarks program is to identify and designate National Historic Landmarks, and encourage the long range preservation of nationally significant properties that illustrate or commemorate the history and prehistory of the United States.	Features with potential historical/cultural significance will be evaluated during the remedial design phase. Should this remedy impact historical properties/structures determined to be protected by this standard, activities will be coordinated with the Department of the Interior.	Applicable
National Historic Preservation Act (NHPA) of 1966 (16 USC §470 *et seq.*); Protection of Historic Properties (36 CFR Part 800)		Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment.	Features with potential historical/cultural significance will be evaluated during the remedial design phase. Should this remedy impact properties/structures determined to be protected by this standard, activities will be coordinated with the Advisory Council on Historic Preservation.	Applicable

ARARs AND TBCs FOR ALTERNATIVE 4 (IN-SITU ENHANCED BIOREMEDIATION, DOWNGRADIENT GROUNDWATER EXTRACTION AND TREATMENT, LUCS, MNA)
SITE 3 – CHLORINATED SOLVENT GROUNDWATER PLUME
NWIRP BEDFORD, MASSACHUSETTS

Requirement	Requirement Synopsis	Action to be Taken to Attain Requirement	Status
State			
MA Wetlands Protection Act MGL ch. 131; 310 CMR 10.00	These regulations set performance standards for work within state-regulated wetland resources and their buffer zones (including within 200 feet of a river and 100 feet from other resource areas). Resource areas at the site covered by the regulations include stream banks, bordering vegetated wetlands, land under bodies of water, land subject to flooding, and riverfront.	Monitoring wells may be constructed in the wetland resource areas and buffer zones. No practicable alternative to this construction exists. Any temporary disturbance of a wetland will be restored.	Applicable
Antiquities Act and Regulations (MGL ch. 9, §§26-27; Massachusetts Historical Commission (950 CMR §70.00); Antiquities Act and Regulations (MGL ch. 9, §§26-27; Protection of Properties Included in the State Register of Historic Places (950 CMR §71.00)	Projects which are state-funded or state-licensed or which are on state property, must eliminate, minimize, or mitigate adverse effects to properties listed in the register of historic places. Establishes requirements for review of impacts for state-funded or state-licensed projects and projects on state-owned property. Establishes state register of historic places. Establishes coordination with the National Historic Preservation Act.	Features with potential historical/cultural significance will be evaluated during the remedial design phase. Should this remedy impact the historical, architectural, archaeological, or cultural qualities of a property determined to be protected by these standards, whether listed or not, activities will be coordinated with the Massachusetts Historical Commission.	Relevant and Appropriate
Action-Specific ARARs			
Federal			
RCRA Generator and Handler Requirements 40 CFR Parts 260-262	Federal standards used to identify, manage, and dispose of hazardous waste. Massachusetts has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions have been adopted by the State.	If wastes are generated as part of collection, treatment, or monitoring activities for Site 3, they will be characterized as either hazardous or non-hazardous. If determined to be hazardous waste, they will be stored, transported, and disposed of in accordance with these standards.	Applicable
RCRA Air Emission Standards for Equipment Leaks 40 CFR Part 264, Subpart BB	Contains air pollutant emission standards for equipment leaks at hazardous waste TSD facilities. Contains design specifications and requirements for monitoring for leak detection. These standards apply to equipment that contains or contacts hazardous wastes with organic concentrations of at least 10 percent by weight.	For the groundwater treatment system, design specifications and leak monitoring will be conducted in accordance with the substantive requirements of this regulation.	Relevant and Appropriate
USEPA OSWER Publication 9345.3 – 03 FS January 1992	Management of investigation-derived waste (IDW) must ensure protection of human health and the environment.	IDW that may be produced from well installation and groundwater sampling will comply with this publication.	To be considered
Clean Water Act National Pollutant Discharge Elimination System (NPDES) 40 CFR Parts 122-125 and 131	These regulations establish discharge limitations, monitoring requirements, and best management practices for any direct discharge from a point source, such as a treatment system, into surface waters, including wetlands. Includes stormwater requirements for construction projects that disturb over one acre.	If there are direct discharges of pollutants from point sources to surface waters, then the substantive requirements of these regulations will be met. Stormwater standards will also be met through sedimentation and erosion controls and through monitoring during construction activities.	Applicable

ARARs AND TBCs FOR ALTERNATIVE 4 (IN-SITU ENHANCED BIOREMEDIATION, DOWNGRADIENT GROUNDWATER EXTRACTION AND TREATMENT, LUCS, MNA)
SITE 3 – CHLORINATED SOLVENT GROUNDWATER PLUME
NWIRP BEDFORD, MASSACHUSETTS

Requirement	Requirement Synopsis	Action to be Taken to Attain Requirement	Status
Clean Water Act (33 U.S.C. § 1251 *et seq.*); National Recommended Water Quality Criteria (NRWQC) 40 CFR § 122.44	Federal NRWQC include (1) criteria for protection of human health from toxic properties of contaminants ingested through drinking water and aquatic organisms, and (2) criteria for protection of aquatic life.	COC concentrations in Elm Brook and the associated wetlands will be monitored to determine whether water quality is being impacted by the groundwater plume, and to ensure that NRWQC substantive requirements are being met.	Relevant and Appropriate
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and UST Sites, USEPA OSWER Directive 9200.4-17 (9/97)	This directive provides guidance regarding the use of monitored natural attenuation for the remediation of contaminated groundwater.	This remedy includes monitored natural attenuation as a remedial component. Groundwater monitoring will be conducted in a manner consistent with this directive.	To be considered
Performance Monitoring of MNA Remedies for VOCs in Ground Water USEPA/600/R-04/027, April 2004	This directive sets forth detailed requirements for natural attenuation monitoring of volatile organic compounds in groundwater.	This remedy includes monitored natural attenuation as a remedial component. Groundwater monitoring will be conducted in a manner consistent with this directive.	To be considered
Underground Injection Control; 40 CFR 144, 146, 147.1100	These regulations address the injection of wastes, chemicals or other substances into the subsurface.	The planned in-situ remediation by injecting biological or chemical substances into the subsurface will follow the substantive requirements of these regulations.	Applicable
State			
MA Wellhead Protection Regulations 310 CMR §22.21	Requires protective zones around a wellhead be established that limit activities and land uses in the zones. The Site is in designated Zones II and III.	The remedy will be implemented to remediate and protect groundwater quality within the Wellhead zones with respect to the Site 3 groundwater plume.	Applicable
Massachusetts Hazardous Waste Rules for Identification and Listing of Hazardous Wastes 310 CMR 30.100	This regulation establishes requirements for determining whether wastes are hazardous.	Waste generated as part of the remedial action for Site 3 will be characterized as hazardous or non-hazardous per these regulations.	Applicable
MA Hazardous Waste Management Rules (HWMR) Requirements for Generators 310 CMR 30.300	These regulations contain requirements for generators of hazardous waste. The regulations apply to generators of sampling waste and also apply to the accumulation of waste prior to off-site disposal.	Wastes generated as a part of a remedial action for Site 3 that are considered hazardous will be handled in compliance with the substantive requirements of these regulations.	Applicable
MA HWMR Use and Management of Containers 310 CMR 30.680 and Storage and Treatment in Tanks 310 CMR 30.690	These regulations set forth requirements for facilities that use containers and tanks to store or treat hazardous waste.	Packing and accumulation of treatment sludges generated from the groundwater treatment facility and other wastes, if determined to be hazardous waste, will be managed in compliance with these regulations.	Relevant and Appropriate
MA HWMR General standards for hazardous waste facilities 310 CMR 30.500	General facility requirements for waste analysis, security measures, inspections, personnel training, and closure/post-closure for facilities which use, treat, store, or dispose hazardous wastes.	For the groundwater treatment plant, waste analysis, security measures, inspection, and personnel training will be conducted in accordance with the substantive requirements of this regulation.	Relevant and Appropriate
Massachusetts Hazardous Waste Rules - Special requirements for wastewater treatment units 310 CMR 30.605	Standards for wastewater treatment units for the treatment of hazardous waste.	For the groundwater treatment plant, safety and planning activities will be conducted in accordance with the substantive requirements of this regulation.	Relevant and Appropriate

ARARs AND TBCs FOR ALTERNATIVE 4 (IN-SITU ENHANCED BIOREMEDIATION, DOWNGRADIENT GROUNDWATER EXTRACTION AND TREATMENT, LUCS, MNA)
SITE 3 – CHLORINATED SOLVENT GROUNDWATER PLUME
NWIRP BEDFORD, MASSACHUSETTS

Requirement	Requirement Synopsis	Action to be Taken to Attain Requirement	Status
Massachusetts Supplemental Requirements for Hazardous Waste Management Facilities 314 CMR 8.03	This regulation outlines the additional requirements that must be satisfied in order for a RCRA facility to comply with the NPDES regulation.	Monitoring and engineering controls will be performed in accordance with the substantive requirements of this regulation.	Relevant and Appropriate
Massachusetts Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharges 314 CMR 12.03(8); 12.04(2),(3),(5),(8-12), 12.05(1),(6),(12), 12.06(1-3)	Establishes operation and maintenance standards for wastewater treatment works.	Operation and maintenance of the groundwater treatment system will meet the substantive requirements of this regulation. The groundwater treatment system will not allow untreated groundwater to bypass the system, will have an alarm system in place, and will be maintained properly and safely with adequate tools, equipment, parts, personnel, etc. Sampling and analysis will be conducted according to the site plan.	Relevant and Appropriate
MA Surface Water Discharge Permit Program 314 CMR 3.00	This program establishes requirements intended to maintain the quality of surface waters by controlling the direct discharge of pollutants to surface waters. Direct discharges to surface waters must meet effluent discharge limits established by this program.	Direct discharges of pollutants from point sources to surface waters will meet the substantive requirements of these regulations.	Applicable
MA Surface Water Quality Standards 314 CMR 4.00	These regulations limit or prohibit discharges of pollutants to surface waters to ensure that the surface water quality standards of the receiving waters are protected and maintained or attained.	COC concentrations in Elm Brook and the associated wetlands will be monitored to determine whether or not water quality is being impacted by the groundwater plume, and to ensure that state water quality standards substantive requirements are being met.	Relevant and Appropriate
MA Groundwater Discharge Permit Program 314 CMR 5.00	This program is designed to protect state groundwater for its highest potential use by regulating discharges of pollutants to state groundwaters and requiring MassDEP to regulate the outlet for groundwater dischargers and associated treatment works.	Current treated discharge from the groundwater treatment system is made to the ground and permeates the soil prior to contacting groundwater. Therefore, the substantive portions of these regulations will be complied with.	Applicable
MA HWMR Groundwater Protection 310 CMR 30.660-30.679	These regulations require groundwater monitoring at specified regulated units that treat, store, or dispose of hazardous waste. Maximum concentration limits for the hazardous constituents are specified in 310 CMR 30.668.	Groundwater monitoring will be conducted in accordance with the substantive requirements of this regulation.	Relevant and Appropriate
MA Underground Injection Control Program 310 CMR 27.00	These regulations address the discharge of wastes, chemicals, or other substances into the subsurface.	The planned *in-situ* remediation by injecting biological or chemical substances into the groundwater will follow the substantive requirements of these regulations. The groundwater treatment plant's discharge of treated groundwater onto the ground will also meet the substantive requirements of this regulation.	Relevant and Appropriate
Massachusetts Well Decommissioning Standards 313 CMR 3.03	These regulations provide standards to be followed when abandoning a well.	Relevant substantive standards of these regulations will be followed to the extent that the remedy involves decommissioning of monitoring wells.	Applicable
Erosion and Sediment Control Guidance	Standards for preventing erosion and sedimentation.	Remedial actions will be managed to control erosion and sedimentation.	To Be Considered

ARARs AND TBCs FOR ALTERNATIVE 4 (IN-SITU ENHANCED BIOREMEDIATION, DOWNGRADIENT GROUNDWATER EXTRACTION AND TREATMENT, LUCS, MNA)
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NWIRP BEDFORD, MASSACHUSETTS

Notes:
MNA: Monitored Natural Attenuation
MassDEP: Massachusetts Department of Environmental Protection
USEPA: United States Environmental Protection Agency
CFR: Code of Federal Regulations
CMR: Code of Massachusetts Regulations
ARAR: Applicable or Relevant and Appropriate Requirement
TBC: to be considered (guidance documents)
LUC: Land Use Control
COC: chemical of concern
MCL: Maximum Contaminant Level
MMCL: Massachusetts Maximum Contaminant Level
RCRA: Resource Conservation and Recovery Act
OSWER: Office of Solid Waste and Emergency Response
TSD: treatment, storage or disposal
TSDF: treatment, storage or disposal facility
NPDES: National Pollutant Discharge Elimination System

(1) In accordance with the National Contingency Plan (NCP), "applicable" requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, or other circumstance found at a CERCLA site. "Relevant and appropriate" requirements, while not "applicable" to a hazardous substance, pollutant, contaminant, or remedial action, address situations sufficiently similar to those encountered at the CERCLA site so that their use is well suited to the particular site. Only state standards that are more stringent than federal standards and have been promulgated at the state level (i.e., are legally enforceable and generally applicable) may be applicable or relevant and appropriate. "Applicability" is a legal determination of jurisdiction of existing statutes and regulations, whereas "relevant and appropriate" is a site-specific determination of the appropriateness of existing statutes and regulations. Therefore, relevant and appropriate requirements allow flexibility not provided by applicable requirements in establishing statutory and regulatory standards for a remedial action. Other requirements "to be considered" (TBC) are federal and state non-promulgated advisories or guidance that are not legally binding and do not have the status of potential ARARs (i.e., they have not been promulgated by statute or regulation). However, if there are no specific ARARs for a chemical or site condition, or if ARARs are not deemed sufficiently protective, then guidance or advisory criteria can be identified and used to ensure the protection of human health and the environment.

Appendix G

Town Statement for Land Use Controls

TOWN OF BEDFORD

BEDFORD, MASSACHUSETTS 01730

TTD/TTY: 781-687-6124

Richard T. Reed, *Town Manager*

Town Hall
Bedford, MA 01730
781-275-1111

August 25, 2009

NAVFAC MID-ATLANTIC, Northeast IPT
Attn: OPNEEV (Maritza Montegross)
9742 Maryland Avenue
Norfolk, VA 23511-3095

Dear Ms. Montegross:

The purpose of this letter is to address concerns of the United States Navy (Navy), the United States Environmental Protection Agency (EPA), and the Massachusetts Department of Environmental Protection (MassDEP) regarding implementing groundwater use restrictions in areas of contamination adjacent to the Naval Weapons Industrial Reserve Plant (NWIRP) property located by Hartwell Road in Bedford, Massachusetts. As described below, the Town agrees to support the Navy with implementing and enforcing institutional controls until the Navy has completed restoration of the groundwater aquifer which satisfies the Town's Aquifer Protection District Bylaw, found at Section 13 of the Bedford Zoning Bylaws.

The Navy has kept the Town apprised of the progress on environmental cleanups at NWIRP through periodic Restoration Advisory Board (RAB) meetings and an Information Repository maintained at the Town of Bedford Free Public Library. It is our understanding that Town representatives will have the opportunity to review and comment on the Navy's Proposed Plans for Site 3 (chlorinated solvent plume) and Site 4 (BTEX plume) prior to the Superfund Records of Decision. The Navy has indicated that the Proposed Plans will continue the commitment that the Navy has made to clean up the groundwater contamination which originated from the Site 3 and Site 4 source areas located on NWIRP property and which has impacted adjacent private properties. The Navy has indicated that as part of the site clean up efforts, land use controls (as groundwater use restrictions) will be necessary until groundwater restoration has been achieved.

The Navy has indicated that it will implement controls on the federally-owned property of NWIRP and has requested that the Town support the controls in adjacent areas through existing Town bylaws. The affected adjacent properties are privately owned. To the best of our knowledge, the Board of Health has never issued a private drinking water well permit within the adjacent areas affected by the Site 3 and Site 4 groundwater contaminant plumes. Therefore, while remedial actions are being undertaken at NWIRP and groundwater contamination is present in the aquifer, the Town agrees to the Navy's request to help prevent unacceptable exposure to groundwater contamination in those areas by preventing the installation of private drinking water wells within the affected areas. Section 8 of the Town of Bedford Board of Health, Code of Health Regulations (Private Wells), which was adopted under authority of Chapter 111, Section 31 of Massachusetts General Laws, includes a requirement for any landowner to obtain a permit from the Board of Health to install wells anywhere in the Town of Bedford. Section 8 also provides the Board of Health to require the re-testing of any existing wells for specified parameters if the Board

believes there is a risk to the public health, safety, or welfare. The contaminants of concern that have been identified at NWIRP Sites 3 and 4 (various volatile organic compounds) are included in the regulation's list of parameters to be tested in private drinking water or irrigation wells.

Accordingly, the Town Board of Health will continue to enforce these regulations to ensure that groundwater wells are not installed which would cause a risk to public health, safety, or welfare. Any proposed change in land use or use of groundwater as a drinking water source would have to be reviewed and approved by Board of Health, which is well aware of the potential for groundwater contamination in this area. Accordingly, the Board of Health voted at their July 8, 2009 meeting the following motion:

> **Voted** to give assurances to the Town Manager that the Bedford Board of Health will not issue drinking water well permits within the adjacent areas affected by Site 3 and Site 4 (Naval Weapons Industrial Reserve Plant Superfund site) groundwater contaminant plumes as long as the contaminants cause water quality to be below acceptable drinking water standards.

Please continue to use our Director of Public Health, Mr. David Black, as our point of contact for matters concerning groundwater contamination associated with NWIRP. Please also include our Conservation Administrator, Ms. Elizabeth Bagdonas, in such correspondence given that the affected areas are within, or are adjacent to, delineated wetlands within the Town of Bedford.

Further, by copy of this letter, I am requesting that both the Board of Health and the Conservation Commission ensure that the Navy is immediately notified in the event any changes are proposed in the land and/or groundwater use in the properties abutting NWIRP.

Sincerely,

Richard T. Reed
Town Manager

Copy to: Richard Warrington, Director, Bedford Public Works
David Black, Director, Bedford Board of Health
Elizabeth Bagdonas, Bedford Conservation Administrator
Matt Audet, EPA
Mike Moran, Ma5sDEP
Jim Ropp, Tetra Tech

Section 8 Private Wells

Section 8.1: Definitions

Unless otherwise noted below, the following terms shall have the following definitions throughout all of Section 8.

8.1.1 Agent: Any person designated and authorized by the Board to execute these regulations. The agent shall have all the authority of the Board and shall be directly responsible to the Board and under its direction and control.

8.1.2 Applicant: Any individual, corporation, association, trust, or partnership who intends to have a Private Well constructed.

8.1.3 Aquifer: A water bearing geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

8.1.4 Board: The Board of Health of Bedford, Massachusetts.

8.1.5 Business of Digging or Drilling: A person who charges a fee for digging or drilling a well, or a person who advertises for hire the availability to dig or drill wells within the Commonwealth of Massachusetts.

8.1.6 Certified Laboratory: Any laboratory currently certified by the Department of Environmental Protection for analysis of drinking water in Massachusetts. Provisional certification shall also qualify.

8.1.7 Monitoring Well: A well designated to facilitate down-hole measurement of groundwater and/or gas levels and/or the collection of groundwater and/or gas samples. A Monitoring Well shall not be used to supply water.

8.1.8 Private Well: Any dug, driven, or drilled hole, with a depth greater than its largest surface diameter, developed to supply water and not subject to regulation by 310 CMR 22.00.

8.1.9 Private Drinking Water Well: A Private Well intended and/or used for human consumption.

8.1.10 Private Irrigation Well: A Private Well serving water to irrigate lawns, shrubs, trees, vegetables, ornamental plants and other such items. Irrigation well water shall NOT serve as water intended for human consumption.

8.1.11 Pumping Test: A procedure used to determine the characteristics of a well and adjacent aquifer by installing and operating a pump.

8.1.12 Registered Well Driller: Any person registered with the Department of Environmental Management/Office of Water Resources to dig or drill wells in the Commonwealth of Massachusetts.

8.1.13 Static Water Level: The level of water in a well under non-pumping conditions.

8.1.14 Structure: A combination of materials assembled at a fixed location to give support or shelter, such as a building, framework, retaining wall, fence, or the like.

Section 8.2: Well Construction Permit/Registration

8.2.1 Approval to construct a Private Well from the Board is required as follows.

a) For a Private Drinking Water Well the Applicant shall obtain a permit from the Board. A completed Private Well Application must be filed with and approved by the Board.

b) For a Private Irrigation Well the Applicant must register with the Agent. A completed Private Irrigation Well Application must be filed with and approved by the Agent.
c) Monitoring Wells may be constructed without a permit or registration if constructed in accordance with the Department of Environmental Protection Standard Reference for Monitoring Wells (1992, 1999; et seq.).

8.2.2 Each permit application and each registration application shall include the following:
a) the property owner's name and address
b) the well driller's name and proof of valid state registration
c) a plan with a specified scale showing the location of the proposed well in relation to existing or proposed above or below ground structures.
d) a description of visible prior and current land uses within two-hundred (200) feet of the proposed well location, which represent a potential source of contamination, including but not limited to the following:
1) existing and proposed structures
2) subsurface sewage disposal systems
3) subsurface fuel storage tanks
4) public ways
5) utility rights-of-way
6) any other potential sources of pollution.
e) a permit/registration fee in accordance with Appendix B of the Bedford Board of Health Code of Regulations.

8.2.3 Well Construction Permits and Well Construction Registrations are not transferable.

8.2.4 Private Wells shall not be permitted within the Zone I protection area of any public water supply well in Bedford as defined per 310 CMR 22.00.

8.2.5 The Board/Agent may grant the Applicant's application for permit/registration, when in its opinion the construction of a Private Well will not result in harm to the public health or local environment. The Board may deny the application if it appears the construction will result in harm to the public health or environment. The Board may also request additional information from the Applicant before rendering a decision.

Note: Copies of Private Well applications will be furnished to the Bedford Department of Public Works, Conservation Commission and Building Department. The Applicant shall comply with all other applicable local, state and federal laws, statutes and regulations. It is the responsibility of the Applicant to consult with the Bedford Department of Public Works, Conservation Commission and Building Department to determine if any other bylaws or regulations mandate additional requirements or conditions.

8.2.6 All Private Wells shall be constructed in accordance with the Massachusetts Department of Environmental Protection Private Well Guidelines (2001; et seq.).

Section 8.3: Water Supply Certificate

8.3.1 The issuance of a Water Supply Certificate by the Board shall certify that the Private Drinking Water Well may be used as a drinking water supply. A Water Supply Certificate must be issued for the use of a Private Drinking Water Well prior to the issuance of an occupancy permit for an existing structure or prior to the issuance of a building permit for new construction which is to be served by the well.

8.3.2 The following shall be submitted to the Board to obtain a Water Supply Certificate:
a) a copy of the Water Well Completion Report as required by the DEM Office of Water Resources (313 CMR 3.00)
b) a copy of the Pumping Test Report required pursuant to Section 8.5 of these regulations
c) a copy of the Water Quality Report required pursuant to Section 8.6 of these regulations

8.3.3 Upon the receipt and review of the above documents, the Board shall make a final decision on the application for a Water Supply Certificate. A final decision shall be in writing and shall comprise one of the following actions:

a) Issue a Water Supply Certificate. All Water Supply Certificates issued by the Board shall include the following disclaimer: "The issuance of a Water Supply Certificate shall not be construed as a guarantee by the Board or its Agent that the water system will function satisfactorily nor that the water supply will be of sufficient quality or quantity for its intended use."
b) Deny the Applicant a Water Supply Certificate and specify the reasons for the denial.
c) Issue a conditional Water Supply Certificate with those conditions which the Board deems necessary to ensure fitness, purity and quantity of the water derived from that Private Well. Said conditions may include but not be limited to requiring treatment or additional testing of the water.

Section 8.4: Well Location and Use Requirements

8.4.1 In locating a Private Well, the applicant shall identify all potential sources of contamination which exist or are proposed within two hundred (200) feet of the site. When possible, the well shall be located upgradient of all potential sources of contamination and shall be as far removed from potential sources of contamination as possible, given the layout of the premises.

8.4.2 Each Private Well shall be accessible for repair, maintenance, testing, and inspection. The well shall be completed in a water bearing formation that will produce the required quantity of water under normal operating conditions.

8.4.3 Each Private Well shall be located at least ten (10) feet from any property line. The centerline of a well shall, if extended vertically, clear any projection from an adjacent structure by at least five (5) feet.

8.4.4 All Private Wells shall be located a minimum of 25 feet from the normal driving surface of any public roadway or a minimum of 15 feet from the road right-of-way, whichever is greater.

8.4.5 Each Private Well shall be located at least 25 feet, laterally, from the normal high water mark of any lake, pond, river, stream, ditch, or slough. When possible, private wells shall be located in areas above the 100-year floodplain.

8.4.6 A suction line or well shall be located a minimum of 10 feet from a building sewer constructed of durable corrosion resistant material with watertight joints, or 50 feet from a building sewer constructed of any other type of pipe; 50 feet from a septic tank; 100 feet from a leaching field; and 100 feet from a privy.

8.4.7 Water supply lines shall be installed at least 10 feet from and 18 inches above any sewer line. Whenever water supply lines must cross sewer lines, both pipes shall be constructed of class 150 pressure pipe and shall be pressure tested to assure watertightness.

8.4.8 The Board reserves the right to impose minimum lateral distance requirements from other potential sources of contamination not listed above. All such special well location requirements shall be listed, in writing, as a condition of the well construction permit.

8.4.9 No Private Well, or its associated distribution system, shall be connected to the distribution system of a public water supply system.

Section 8.5: Water Quantity Requirements

8.5.1 For a Private Drinking Water Well the Applicant shall submit to the Board for review and approval a Pumping Test Report. The Pumping Test Report shall include the name and address of the well owner, well location referenced to at least two permanent structures or landmarks, date the pumping test was

performed, depth at which the pump was set for the test, location for the discharge line, static water level immediately before pumping commenced, discharge rate and, if applicable, the time the discharge rate changed, pumping water levels and respective times after pumping commenced, maximum drawdown during the test, duration of the test, including both the pumping time and the recovery time during which measurements were taken, recovery water levels and respective times after cessation of pumping, and reference point used for all measurements.

8.5.2 In order to demonstrate the capacity of the well to provide the Required Volume of water, a pumping test shall be conducted in the following manner:

a) The volume of water necessary to support the household's daily need shall be determined using the following equation: (number of bedrooms plus one bedroom) x (110 gallons per bedroom) x (a safety factor of 2) = number of gallons needed daily.
b) The storage capacity of the well shall be determined using the measured static water level and the depth and radius of the drillhole or casing.
c) The Required Volume shall be calculated by adding the volumes of water in (a) and (b) above. It is this volume of water that must be pumped from the well within a 24-hour period.

8.5.3 The pumping test may be performed at whatever rate is desired. Following the pumping test, the water level in the well must be shown to recover to within eighty-five (85) percent of the pre-pumped static water level within a twenty-four (24) hour period.

Example 1: For a one bedroom house with a well six (6) inches in diameter and contains 200 ft. of standing water:

1) *1 bedroom + 1 bedroom = (2 bedrooms) x (I10 gallons per bedroom) x (safety factor of 2) = 440 gallons needed daily.*
2) *the volume of a 6-inch well is 1.5 gallons for every foot of water column length. Therefore, (200 ft. of standing water) x (1.5 gal/ft.) = 300 gallons.*
3) *440 gallons + 300 gallons = 740 gallons that must be pumped from the well in 24 hours or less to demonstrate suitable capacity. Recovery up to 85% of the static water level must also occur within 24 hours after cessation of pumping.*

Example 2: For a 4 bedroom house with a well that is six (6) inches in diameter and contains 100 ft. of standing water:

1) *4 bedroom house + I bedroom = (5 bedrooms) x (110 gallons per bedroom) x (safety factor of 2) = 1,100 gallons needed daily.*
2 *the volume of a 6-inch well is 1.5 gallons for every foot of water column length. Therefore, (100 ft. of standing water) x (1.5 gal/ft.) = 150 gallons.*
3) *1,100 gallons + 150 gallons=1,250 gallons that must be pumped from the well in 24 hours or less to demonstrate suitable capacity. Recovery up to 85% of the static water level must also occur within 24 hours after cessation of pumping.*

Section 8.6: Water Quality Testing Requirements

8.6.1 Prior to the use of a Private Well the Applicant must conduct water quality testing in compliance with regulations 8.6.2 through 8.6.6. All costs and laboratory arrangements for the water testing are the responsibility of the Applicant.

8.6.2 A water sample shall be collected either after purging three well volumes or following the stabilization of the pH, temperature and specific conductance in the pumped well. The water sample to be tested shall be collected at the pump discharge or from a disinfected tap in the pump discharge line. In no event shall a water treatment device be installed prior to sampling.

8.6.3 The required water quality test, utilizing an applicable US EPA approved method for drinking water testing shall be conducted by an EPA or Massachusetts certified laboratory and shall include analysis for the parameters specified in 8.6.6 and the results shall not exceed Massachusetts drinking water standards for public water supplies:

8.6.4 Following receipt of the water quality test results, the applicant shall submit a Water Quality Report to the Board which includes:

1) a copy of the certified laboratory's test results
2) the name of the individual who performed the sampling
3) where in the system the water sample was obtained

8.6.5 The Board reserves the right to require re-testing of the specified parameters, or testing for additional parameters when, in the opinion of the Board, it is necessary due to local conditions or for the protection of the public health, safety and welfare.

8.6.6 Analysis of water from a Private Drinking Water Well shall include all of the parameters listed below. Analysis of water from a Private Irrigation Well shall include the Volatile Organic Compounds and Metals listed below.

Coliform Bacteria

Metals
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Lead
Copper
Mercury
Selenium
Thallium

Other Inorganic Compounds
Asbestos
Cyanide
Flouride
Nitrate
Nitrite
Total Nitrate and Nitrite

Volatile Organic Compounds
Benzene
Carbon Tetrachloride
Dichloromethane
o-Dichlorobenzene
para-Dichlorobenzene
1,2-Dichloroethane
cis-1,2-Dichloroethylene
trans-1,2-Dichloroethylene
1,1 Dichloroethylene
1,2-Dichloropropane
Ethylbenzene
Monochlorobenzene
Styrene
Tetrachloroethylene
Toluene
Trichloroethylene
1,1,1-Trichloroethane
1,2,4-Trichlorobenzene
1,1,2-Trichloroethane
Vinyl Chloride
Xylenes (total)

Radionuclides
Gross Alpha Activity
Radium – 226 & 228
Uranium
Radon

Synthetic Organic Compounds
Alachlor
Atrazine
Benzo(a)pyrene
Carbofuran
Chlordane
Dalapon
Di(2-ethylhexyl)adipate
Di(2-ethylhexyl)phthalate
Dinoseb
Diquat
Dibromochloropropane (DBCP)
2,4-D
Endothall
Endrin
Ethylene Dibromide (EDB)
Glyphosate
Heptachlor
Heptachlor epoxide
Hexachlorrobenzene
Hexachloropentadiene
Lindane
Methoxychlor
Oxamyl (Vydate)
Polychlorinated biphenyls (PCBs)
Pentachlorophenol
Picloram
Simazine
2,3,7,8-TCDD (Dioxin)
Toxaphene
2,4,5-TP (Silvex)
Total Trihalomethanes

Section 8.7: Decommissioning Requirements

8.7.1 Abandoned wells, test holes, and borings shall be decommissioned so as to prevent the well, including the annular space outside the casing, from being a channel allowing the vertical movement of water.

8.7.2 The owner of the Private Well shall decommission the well if the well meets any of the following criteria:

a) construction of the well is terminated prior to completion of the well
b) the well owner notifies the Board that the use of the well is to be permanently discontinued.
c) the well has been out of service for at least three years
d) the well is a potential hazard to public health or safety and the situation cannot be corrected
e) the well is in such a state of disrepair that its continued use is impractical
f) the well has the potential for transmitting contaminants from the land surface into an aquifer or from one aquifer to another and the situation cannot be corrected

8.7.3 The owner of the Private Well shall be responsible for ensuring that all abandoned wells and test holes or borings associated with private well installation are properly plugged in accordance with the Massachusetts Department of Environmental Protection Private Well Guidelines (2001; et seq.). Only registered well drillers may plug abandoned wells, test holes, and borings.

TOWN OF BEDFORD
BEDFORD, MASSACHUSETTS 01730

Richard T. Reed, *Town Manager*

TTD/TTY: 781-687-6124

Town Hall
Bedford, MA 01730
781-275-1111

September 27, 2010

NAVFAC MID-ATLANTIC, Northeast IPT
Attn: OPNEEV (Maritza Montegross)
9742 Maryland Avenue
Norfolk, VA 23511-3095

Dear Ms. Montegross:

The purpose of this letter is to support the United States Navy (Navy), the United States Environmental Protection Agency (EPA), and the Massachusetts Department of Environmental Protection (MassDEP) to ensure the safety of land uses in areas of groundwater contamination adjacent to the Naval Weapons Industrial Reserve Plant (NWIRP) property located on Hartwell Road in Bedford, Massachusetts. As described below, the Town plans to notify the Navy of any future proposed land use change on the adjacent properties until the Navy has completed its restoration of the groundwater aquifer which satisfies MassDEP and EPA drinking water standards and meets the purposes of the Town's Aquifer Protection District Bylaw, found at Section 13 of the Bedford Zoning Bylaws.

The Navy has kept the Town apprised of the progress on environmental cleanups at NWIRP through periodic Restoration Advisory Board (RAB) meetings and an Information Repository maintained at the Town of Bedford Free Public Library. Town representatives have had the opportunity to review and comment on the Navy's Proposed Plans for Site 3 (chlorinated solvent groundwater plume) and Site 4 (BTEX plume) prior to the Superfund Records of Decision. The Navy's Site 3 Proposed Plan (July 2010) and Site 4 Record of Decision (September 2009) summarized the potential risks associated with exposure to Site 3 and Site 4 contaminants and indicated the Navy's commitment to clean up the groundwater contamination located on NWIRP property and which has impacted adjacent private properties. In a letter to the Navy dated August 25, 2009, the Town agreed to support the Navy's cleanup efforts with respect to proposals for private wells in the adjacent properties affected by Sites 3 and 4.

The Navy recently requested additional Town support in the form of information sharing and consultation regarding any proposed new construction or development of the adjacent properties until groundwater restoration has been achieved. In this regard, when land development is proposed in the proximity of NWIRP confirmed hazardous waste site(s), it is the intent of the Town, through its boards and/or commissions during site plan review process or within the subdivision review process for any such proposed development, to require the applicant(s) to:

a) Submit to the Town a written opinion from a Licensed Site Professional (LSP) including detailed analysis and justification addressing the proposed land use/development and the appropriateness of such development for the site given the proximity to the confirmed hazardous waste site(s); and,

b) After receiving the LSP opinion, the Town will submit it for review to the appropriate regulatory agency (MassDEP and/or EPA) and the Navy for their comments and recommendations prior to the Town considering approval of the proposed development.

The information would be used by the Navy for evaluations relative to the status of the Site 3 and Site 4 groundwater cleanups and to make the Town officials aware of any concerns.

The affected adjacent properties are privately owned and contained delineated wetlands. Currently, the Town is not aware of any proposals to build new structures/dwellings within the areas affected by the Site 3 and Site 4 groundwater contaminant plumes. Due to the presence of wetlands associated with Elm Brook (including wetland buffer zones), development of the affected adjacent properties is not anticipated.

Any proposed change in current land use would have to be reviewed and approved by the Planning Board, Board of Health and Conservation Commission, which are well aware of the potential for groundwater contamination adjacent to NWIRP. The Town Board of Health will continue to coordinate with the Navy regarding the status of land use adjacent to NWIRP. Please continue to use the Town's Director of Public Health as the Town's point of contact for matters concerning groundwater contamination associated with NWIRP. Please also include the Town's Conservation Administrator, in such correspondence given that the affected adjacent properties are within, or are adjacent to, delineated wetlands within the Town of Bedford.

Further, by copy of this letter, I am requesting that the Planning Board, Board of Health and the Conservation Commission ensure that the Navy is notified in the event any changes are proposed in the land use in the properties abutting NWIRP.

Very truly yours,

Richard T. Reed
Town Manager

Copy to: Richard Warrington, Director, Bedford Public Works
David Black, Director, Bedford Board of Health
Elizabeth Bagdonas, Bedford Conservation Administrator
Planning Director Richard Joly
Matt Audet, EPA
Mike Moran, MassDEP
Dave Gallagher, MassDEP
Jim Ropp, Tetra Tech