FINAL FIVE-YEAR REVIEW

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Revision: 0

Prepared for:

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List of Acronyms

µg/L	Micrograms per liter
µg/m^3	Micrograms per cubic meter
APD	Aquifer Protection District
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	Below ground surface
BRA	Baseline risk assessment
BTEX	Benzene, toluene, ethylbenzene, and xylene
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Constituents of concern
CMR	Code of Massachusetts Regulations
CSM	Conceptual site model
CVOC	Chlorinated volatile organic compound
1,1-DCA	1,1-dichloroethane
1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichloroethene
1,2-DCE	1,2-dichloroethene (cis- and trans- isomers)
DO	Dissolved oxygen
ERA	Ecological Risk Assessment
ERH	Electrical resistance heating
ESD	Explanation of Significant Differences
EVO	Emulsified vegetable oil
FFA	Federal Facilities Agreement
FS	Feasibility Study
ft/day	Feet per day
gpd	Gallons per day
gpm	Gallons per minute
GUVD	Groundwater Use Value Determination
GWETS	Groundwater extraction and treatment system
H&S	Health & Safety
HHRA	Human health risk assessment
IAS	Initial Assessment Study
IBS	In-situ bioremediation system
IR	Installation Restoration
IRA	Interim Remedial Action
ISCO	In-situ Chemical Oxidation

LTM	Long-term monitoring
LUC	Land use controls
LUC RD	Land use controls Remedial Design
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum contaminant level
MCLG	Maximum contaminant level goal
MCP	Massachusetts Contingency Plan
mg/L	Milligrams per liter
MIDLANT	Mid-Atlantic
MMCLS	Massachusetts Drinking Water Standards at 310 Code of Massachusetts Regulations 22.00
MNA	Monitored natural attenuation
MOU	Memorandum of Understanding
msl	Mean sea level
mS/cm	Milli-Siemens per centimeter
mV	Millivolt
NAVFAC	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NRWQC	National Recommended Water Quality Criteria
NWIRP	Naval Weapons Industrial Reserve Plant
O&M	Operation and maintenance
ORP	Oxidation Reduction Potential
OU	Operable Unit
PCE	Tetrachloroethene
PDI	Pre-design investigation
PFC	Perfluorinated compounds
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
psi	Pounds per square inch
RA	Remedial Action
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial action objectives
RD	Remedial Design
RG	Remediation Goals
RI	Remedial Investigation
ROD	Record of Decision
RSL	Regional screening levels
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SFTA	Southern Flight Test Area
STM	Short-term measure

1,1,1-TCA	1,1,1-Trichloroethane
1,1,2-TCA	1,1,2-Trichloroethane
TCE	Trichloroethene
UST	Underground storage tank
U.S. EPA	United States Environmental Protection Agency
UU/UE	Unlimited use/unrestricted exposure
VC	Vinyl Chloride
VI	Vapor intrusion
VOC	Volatile organic compound

EXECUTIVE SUMMARY

This five-year review has been prepared by the Naval Facilities Engineering Command Mid-Atlantic for the following sites at Naval Weapons Industrial Reserve Plant Bedford, Middlesex County, Massachusetts:

- Site 3 — Northern Chlorinated Solvent Groundwater Plume
- Southern Flight Test Area (SFTA) — Southern Chlorinated Solvent Groundwater Plume
- Site 4 — Benzene, Toluene, Ethylbenzene, and Xylene Plume

A Record of Decision was signed for Operable Unit (OU) 1, Site 3, on 29 September 2010; this Site 3 ROD established remedial action objectives and remediation goals for the northern chlorinated solvent plume. The Site 3 ROD was amended via Explanation of Significant Difference on 14 March 2014 to include the SFTA, which is a chlorinated solvent plume south of Hartwell Road within the SFTA portion of the facility. Site 3 and the SFTA, although administratively connected through the decision document, represent two distinct plumes evaluated separately in this Five-Year Review.

The ROD for OU 4, Site 4, was signed on 28 September 2009.

OUs OU-00003, Site 1, and OU-00001, Site 2, received No Further Action decisions as no contamination is present at either site precluding unlimited use/unrestricted exposure and, therefore, are not included in this review. (Please note that OU designations have been misrepresented in previous documents, the OU and associated site numbers are reflected accurately in this review.)

This five-year review was conducted in accordance with Chief of Naval Operations Letter 5090 N453 SER/11U158119 of 7 June 2011, the United States Environmental Protection Agency's Comprehensive Five-Year Review Guidance (U.S. EPA, June 2001), and the Naval Facilities Engineering Command Toolkit for Preparing Five-Year Reviews (NAVFAC, April 2013).

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Naval Weapons Industrial Reserve Plant Bedford		
EPA ID: MA6170023570		
Region: 1	**State:** MA	**City/County:** Bedford/Middlesex

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** Navy
Author name (Federal or State Project Manager): Maritza Montegross
Author affiliation: Naval Facilities Engineering Command, Mid-Atlantic (NAVFAC MIDLANT)
Review period: September 2009 — September 2014
Date of site inspection: 12 August 2013
Type of review: Statutory
Review number: 1
Triggering action date: 28 September 2009
Due date ***(five years after triggering action date)*****:** 28 September 2014

Issues/Recommendations				
OU(s) without Issues/Recommendations Identified in the Five-Year Review:				
OU-00003 (Site 1) and OU-00001 (Site 2) received NFA decision as no contamination is present at either site precluding unlimited use/unrestricted exposure				
Issues and Recommendations Identified in the Five-Year Review:				
OU 00001/Site 3 (Northern Plume)	**Issue Category: No Issue**			
	Issue:			
	Recommendation:			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
				NA
OU 00001/SFTA (Southern Plume)	**Issue Category: No Issue**			
	Issue:			
	Recommendation:			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
				NA
OU 00004/Site 4 (BTEX Plume)	**Issue Category: No Issue**			
	Issue:			
	Recommendation:			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
				NA

Protectiveness Statement(s)		
Include each individual OU protectiveness determination and statement. If you need to add more protectiveness determinations and statements for additional OUs, copy and paste the table below as many times as necessary to complete for each OU evaluated in the FYR report.		
Operable Unit: 00001/Site 3 (Northern Plume)	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*
Protectiveness Statement: The construction of the remedy at OU 1 (Site 3) is complete and is protective of human health and the environment. Until such time that remedial goals are achieved, exposure pathways that could result in unacceptable risks are being controlled.		
Operable Unit: 00001/SFTA (Southern Plume)	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):*
Protectiveness Statement: The construction of the remedy at OU 1 (SFTA Site) is complete and is protective of human health and the environment. Until such time that remedial goals are achieved, exposure pathways that could result in unacceptable risks are being controlled.		

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
00004/Site 4	Protective	

Protectiveness Statement:

The construction of the remedy at OU 4 (Site 4) is complete and is protective of human health and the environment. Until such time that remedial goals are achieved, exposure pathways that could result in unacceptable risks are being controlled.

Sitewide Protectiveness Statement (if applicable)

For sites that have achieved construction completion, enter a sitewide protectiveness determination and statement.

Protectiveness Determination:	*Addendum Due Date (if applicable):*
Protective	

Protectiveness Statement:

Because the remedial actions at all OUs are protective, the site is protective of human health and the environment.

AUTHORIZING SIGNATURES

By my signature below, I approve the issuance of this Five Year Review for the former Naval Weapons Industrial Reserve Plant in Bedford, Massachusetts.

25 SEP 2014

CAPT Jorge P. Rios, CEC, USN
Commanding Officer,
Naval Facilities Engineering Command Mid-Atlantic
U.S. Department of the Navy

Date

1.0 INTRODUCTION

This is the first five-year review of the former Naval Weapons Industrial Reserve Plant (NWIRP) in Bedford, Middlesex County, Massachusetts. This five-year review has been prepared by the Naval Facilities Engineering Command Mid-Atlantic (NAVFAC MIDLANT). Sites at NWIRP Bedford subject to this five-year review include:

- Site 3 — Northern Chlorinated Solvent Groundwater Plume
- Southern Flight Test Area (SFTA) — Southern Chlorinated Solvent Groundwater Plume
- Site 4 — Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) Plume

NWIRP Bedford was placed on the National Priorities List on 31 May 1994. The triggering action for this review is the date of the Operable Unit (OU) 4, Site 4, Record of Decision (ROD) in September 2009. The OU 1, Site 3, ROD was signed in September 2010. In March 2014, the SFTA was added to Site 3 ROD via an Explanation of Significant Difference (ESD). The SFTA comprises a chlorinated solvent south of Harwell Road within the SFTA portion of the facility. Although administratively connected via the ESD, the SFTA represents a separate area of impact and, as such, is evaluated in this five-year review as its own site.

The five-year review was conducted in accordance with Chief of Naval Operations Letter 5090 N453 SER/11U158119 of 7 June 2011, the United State Environmental Protection Agency's (U.S. EPA's) *Comprehensive Five-Year Review Guidance* (U.S. EPA, June 2001), and the NAVFAC's *Toolkit for Preparing Five-Year Reviews* (NAVFAC, April 2013).

The purpose of this five-year review is to evaluate the implementation and performance of the remedies at Site 3, SFTA, and Site 4 to determine whether they are protective of human health and the environment. In addition, the review identifies any issues that may affect protectiveness of the remedies or the efficient implementation of the remedy, and provides recommendations to address them.

As required by statute, the Navy must implement five-year reviews consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA Section §121(c), as amended, states:

> In accordance with CERCLA, and NCP Part 300.430(f)(4)(ii) of the Code of Federal Regulations, if a remedial option is selected that results in any hazardous substances, pollutants, or contaminants remaining at a site, the remedial option shall be reviewed at a frequency of at least every five years after the initiation of the remedial action (RA) to assure that the RA is protective of human health and the environment.

Contamination is present at Site 3, the SFTA, and Site 4 that does not allow for unlimited use and unrestricted exposure (UU/UE). RAs have been implemented at all sites that includes active and passive groundwater remedies as wells as land use controls (LUCs) to ensure protection by preventing unacceptable exposures to site contaminants.

This five-year review has included a review of documents, discussions with personnel associated with the sites, and a site inspection. The Five Year Review also evaluates newly promulgated standards; changes in the standards that were identified as applicable or relevant and appropriate requirements (ARARs) and to be considered criteria; and the factors used to develop site-specific, risk-based levels at the time the RODs were signed. This information was reviewed to determine if changes since RA implementation at Site 3, SFTA and Site 4 might call into question the protectiveness of those remedies.

Where applicable, monitoring and sampling data, operation and maintenance (O&M) documentation, and construction oversight records were also examined. This information is included in the respective site-specific sections.

1.1 Report Organization

This report has been organized with the intent of meeting the general format requirements specified in the *Comprehensive Five-Year Review Guidance* (U.S. EPA, 2001), and summarizing the results of the five-year review for the three sites evaluated in a cohesive and comprehensive manner. Section 1 gives an overview of NWIRP Bedford, with general information common to Site 3, SFTA, and Site 4. Section 1 also discusses common elements of the five-year review process, including:

- Land use and LUCs
- Community involvement
- Timing of the next five-year review

Sections 2.0, 3.0, and 4.0 summarize the five-year reviews conducted for each of the sites. Site-specific discussions include:

- Site chronology
- Site-specific background
- Remedial action summary
- Progress since last five-year review
- Five-year review process
  - Document review
  - Data review and evaluation
  - Site inspection and interviews
- Technical assessment
  - Question A — Is the remedy functioning as intended by the decision documents?
  - Question B — Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid?
  - Question C — Has any other information come to light, which would call into question the protectiveness of the remedy?
- Issues
- Recommendations
- Protectiveness statement

1.2 Facility History

NWIRP Bedford, U.S. EPA 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. NWIRP Bedford was created in October 1952 when construction of the Naval Industrial Reserve Aircraft Plant began. The mission of NWIRP Bedford was to design, fabricate, and test prototype weapons equipment such as missile guidance and control systems. 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. 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. Since 2000, the facility has been unoccupied and activities are limited to the Navy's O&M of CERCLA RAs.

Five areas were initially identified for investigation under the Installation Restoration (IR) program but only four were selected for further investigation. The fifth area, the SFTA (comprising the southern plume of Site 3), was administratively added to Site 3 via ESD in March 2014; the Navy has continued to monitor the SFTA since 1993. Two sites (Sites 1 and 2) received no further action decisions in September 2000. No contamination remains at either site, which precludes UU/UE, therefore, Sites 1 and 2 do not warrant evaluation in this five-year review. Therefore, this five-year review addresses the following three sites:

- **Site 3 — Northern Chlorinated Solvent Groundwater Plume**
  Site 3 (the Northern Plume) is a chlorinated solvent groundwater plume that emanates from the Components Building loading dock area and predominantly flows north-northwest off-base towards Elm Creek. Elevated chlorinated volatile organic compound (CVOC) concentrations are present in the plume, with trichloroethene (TCE) being the dominant CVOC. The site remedy, as described in the 29 September 2010 ROD, includes an in-situ bioremediation system (IBS) to target the area of highest TCE concentrations in groundwater (located near the Components Building), continued operation of the downgradient groundwater extraction and treatment system (GWETS) for containment, monitored natural attenuation (MNA) of groundwater to reduce contamination at the fringes, LUCs restricting building occupancy, use of groundwater and residential development, and five-year reviews.

- **SFTA — Southern Chlorinated Solvent Groundwater Plume**
  The SFTA was originally identified during the Remedial Investigation (RI) for NWIRP Bedford in the early 1990s. Elevated CVOCs were detected, with TCE the primary CVOC; the source of the groundwater contamination has not been identified. Groundwater monitoring for compliance and MNA evaluation began in 1993. The 14 March 2014 ESD for Site 3 administratively linked the SFTA to Site 3, and specified MNA and LUCs restricting building occupancy, use of groundwater, and residential development as the long-term site remedy.

- **Site 4 — BTEX Plume**

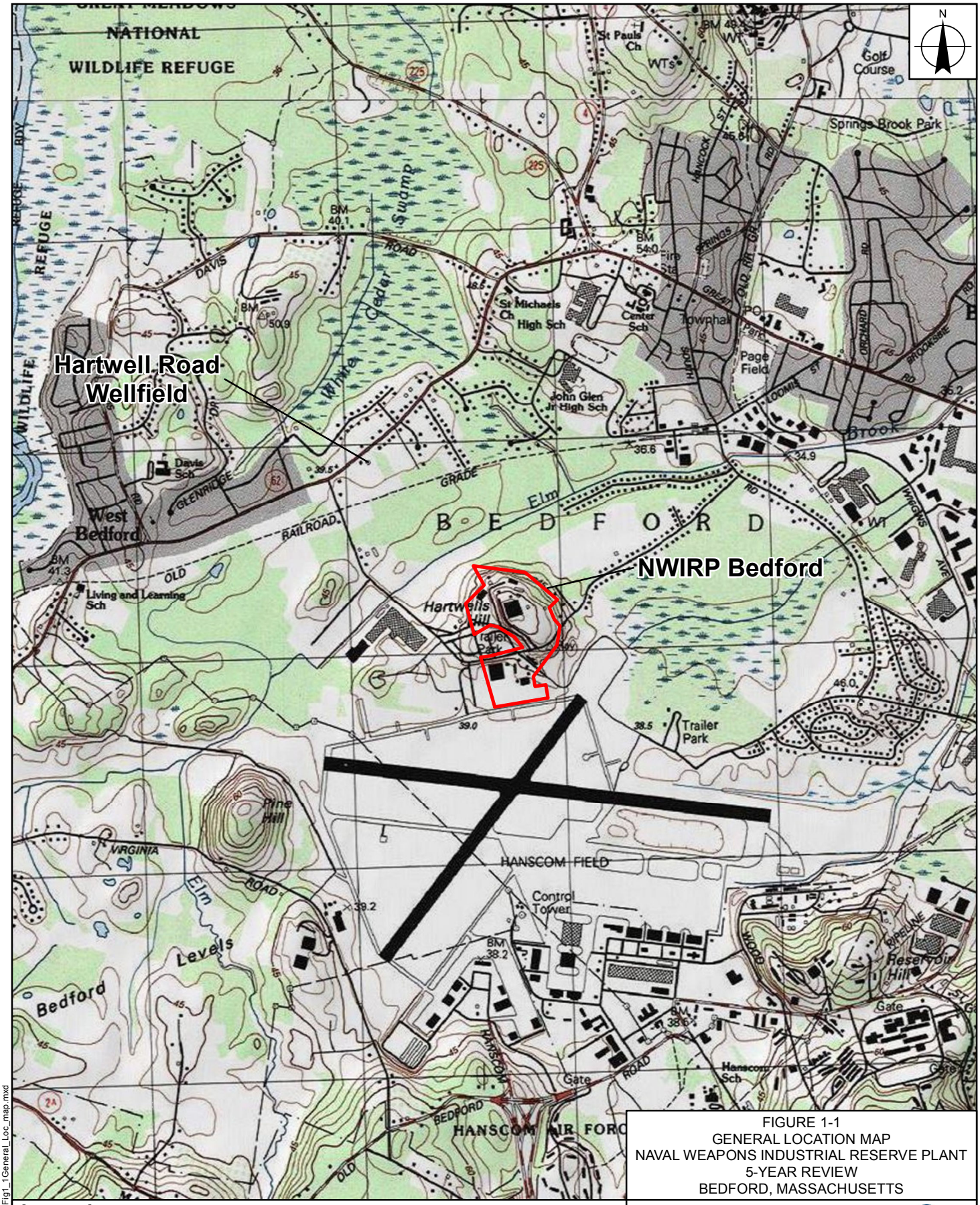
  The BTEX plume is associated with the former Transportation Building's vehicle maintenance activities and its former underground storage tank (UST). Historically, the associated dissolved-phase BTEX plume in groundwater extended to an off-base wetland area by Elm Brook. In addition, the fringe of the Site 3 CVOC plume overlaps with Site 4 and the respective constituents of concern (COCs) are comingled. The site remedy, as described in the 28 September 2009 ROD, selected possible additional source area excavation, MNA for groundwater, LUCs restricting building occupancy, use of groundwater and residential development, and five-year reviews. However, a pre-design investigation (PDI) determined excavation was no longer warranted. As the ROD had sufficient flexibility with regard to additional source excavation, no ROD Amendment or ESD was required in response to this finding. The 2012 Site Management Plan (Tetra Tech, 01 September 2011) formally documents this decision for the Navy and the U.S. EPA in accordance with the Federal Facilities Agreement (FFA) executed by the Navy and U.S. EPA in September 1999.

Additional details about each of these three sites are provided in Sections 2.0, 3.0, and 4.0, respectively.

1.3 Facility Location

NWIRP Bedford is located in eastern Massachusetts, in the Town of Bedford of Middlesex County (Figure 1-1). The inactive Navy facility, which is in the southwest portion of Bedford, is approximately 14 miles northwest of downtown Boston. It is bounded by the Lawrence G. Hanscom Field (Hanscom Field) and Hanscom Air Force Base to the south; by the former Raytheon Electronic Systems Facility, a Patriot Integration Test Facility, wetlands, and residences to the west; by woods and wetlands to the north; and by woods, residences, and wetlands to the east.

The Town of Bedford zoning for the majority of the NWIRP Bedford property is zoned as "Industrial Park (A)." The area north of the Components Laboratory and the off-property wetland area are zoned as "Residential B."



Legend

NWIRP Bedford Property Line

0 1,250 2,500 Feet

FIGURE 1-1
GENERAL LOCATION MAP
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
5-YEAR REVIEW
BEDFORD, MASSACHUSETTS

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: B. ELLIOTT	DATE: 10/30/2013
DRAWN BY: MSENNE	TASK ORDER NUMBER: XW58

Basemap Source: USGS Topo Quad Concord, 1981© 2013 National Geographic Society, i-cubed

X:\Navy\Bedford_MA\Fig1_1General_Loc_map.mxd

1.3.1 Surface Features

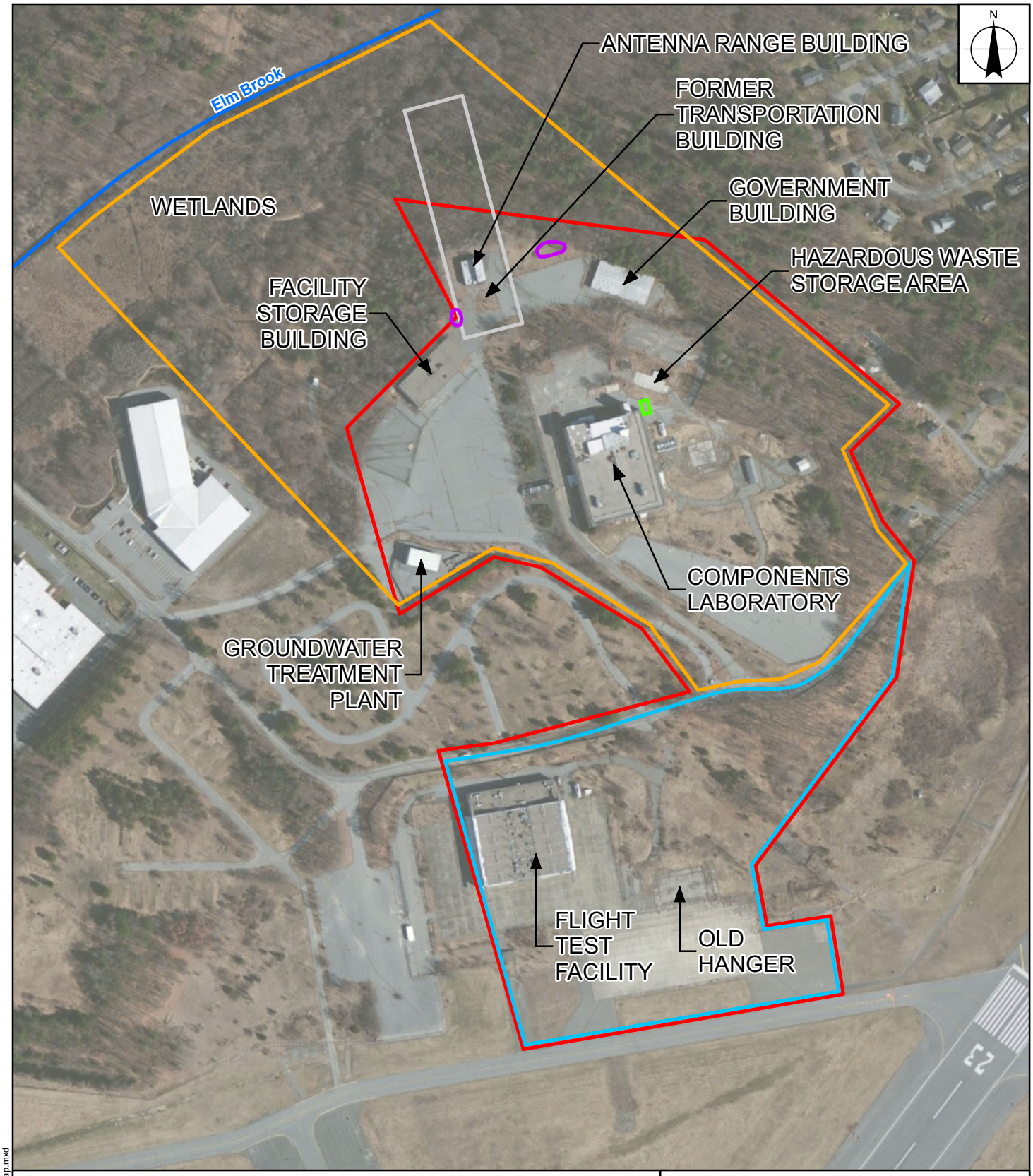
The surface topography of NWIRP Bedford is dominated by Hartwells Hill. The peak elevation of Hartwells Hill is approximately 205 feet above mean sea level (msl). Hartwells Hill is sloped most steeply on the northwestern and southeastern sides, and less steeply on the eastern and southwestern sides, forming a nearly classic drumlin shape with the long axis oriented in the northwest-southeast direction.

The highest concentrations within Site 3 groundwater are located beneath the paved shipping and receiving area on the north side of the Components Laboratory atop Hartwells Hill. The immediate topography of the Site 3 source area is relatively flat with a gentle slope to the north, away from the Components Laboratory. The SFTA is located south of Hartwells Road and is a mostly flat, paved area. Site 4 lies in the northern portion of NWIRP Bedford, extending from the top of Hartwells Hill and north towards Elm Brook and its associated wetland area. The main structure still present in the vicinity of Site 4 is the Antenna Range Building. The northern slope of Hartwells Hill just north of the Antenna Range Building drops steeply from an elevation of approximately 170 feet to about 140 feet msl near the property boundary. The wetlands to the north near Elm Brook represent local topographical lows, with elevations ranging from approximately 110 to 114 feet msl.

Pertinent surface features and site LUC boundaries, which encompass the areas of impact, are illustrated on Figure 1-2.

1.3.2 Geology

The geology of NWIRP Bedford 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 till/moraine deposits and lacustrine/outwash and till/moraine deposits occurs along the lower flanks of Hartwells Hill. 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 (Tetra Tech, 01 June 2010).



Stream
Site 1
Site 2
Site 3 - Land Use Control Boundary
Site 4 - Land Use Control Boundary
NWIRP Bedford Property Line
Southern Flight Test Area (SFTA) - Land Use Control Boundary

0 175 350 Feet

FIGURE 1-2
SITE LOCATION MAP
5-YEAR REVIEW
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: B. ELLIOTT	DATE: 6/26/2014
DRAWN BY: NRINEHART	TASK ORDER NUMBER: WE38

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Basemap Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

1.3.3 Hydrogeology

Precipitation falling on Hartwells Hill infiltrates through the unsaturated zone and recharges the underlying shallow groundwater. At the top of the hill, the principal water-bearing unit is the sandy till. The depth to the water table beneath the top of the hill 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. The hydraulic conductivity (K) values are estimated as 1 foot per day (ft/day) for the upper fill, 0.1 ft/day for the sandy till unit, and 0.01 ft/day for the silty till, clayey till, and bedrock units (Tetra Tech, 01 June 2010).

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. 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. In October 1998, the Massachusetts Department of Environmental Protection (MassDEP) determined that groundwater underlying NWIRP Bedford is of "high use and value" (MassDEP, 15 October 1998). Groundwater at the NWIRP Bedford is not currently used for potable purposes.

The NWIRP Bedford property on Hartwells Hill is within the Zone II of the Hartwell Road municipal water supply well field and the wetland area associated with Elm Brook is in Zone III (Tetra Tech, 01 June 2010). Zone II areas are designated as the area of influence of a pumping well under the most severe pumping and recharge conditions that can be realistically anticipated. Zone III refers to the area from which surface water and groundwater drain into Zone II. The Hartwell Road well field is located 0.4 miles to the northwest, downgradient of the Site 3 and Site 4 plumes. The municipal well field contains three wells, which were closed in 1984. However, although this well field remains inactive, it has not been officially abandoned under MassDEP regulations, and the Town of Bedford has contingency plans to reactivate the wells sometime in the future.

1.4 Former, Current, and Future Land Use and Land Use Controls

NWIRP Bedford was an active industrial research facility from the mid-1950s until December 2000. Since that time, the facility has remained vacant and inactive except for the operation of remediation systems. NWIRP Bedford is fenced and gated to control access, however trespassing by teenagers and adults has been observed and some vandalism has occurred.

The Town of Bedford zoning for the majority of the NWIRP Bedford property is zoned as "Industrial Park (A)." The offsite area north of the Components Laboratory, including the wetland area, is zoned as "Residential B." Naval Sea Systems Command has considered the property excess since December 2000 and intends to transfer the property after all CERCLA requirements have been satisfied.[1] The foreseeable future use of NWIRP Bedford is expected to be similar to the current use pattern (i.e., industrial use). The offsite land use surrounding the NWIRP property are also expected to be similar (i.e., mix of commercial/industrial and residential uses). Further residential development between Elm Brook and the facility boundary is unlikely due to the presence of the wetlands.

In accordance with Site 3, SFTA, and Site 4 decision documents, LUCs have been implemented at each site as contaminants have been left in place at levels that do not allow for UU/UE. The LUCs ensure that remaining contamination does not pose an unacceptable risk to human health. LUCs are summarized below:

Site 3 and SFTA:

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

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

- Prevent occupancy of site structures until concentrations allow for industrial use of the property.

- Prevent residential development until concentrations allow for UU/UE.

[1] An Operating Properly and Successfully report is expected to be completed for the entire facility by June 2015.

Site 4:

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

- Prevent occupancy of site structures until concentrations allow for industrial use of the property.

- Prevent residential development until concentrations allow for UU/UE.

In addition to the LUC components above, the following LUC is applicable to SFTA:

- Maintain the integrity of the groundwater monitoring wells.

Land Use Control Remedial Design (LUC RD) documents have been developed for the sites to implement LUCs in accordance with the decision documents.

1.5 Five-Year Review Process

The five-year review was started in August 2013. The MassDEP was notified verbally of the start of the Five-Year Review. The following team members assisted in the review:

- Maritza Montegross, Navy Remedial Project Manager at NAVFAC MIDLANT
- Jan Nielsen and Dave Barclift, Navy Technical Reviewers at NAVFAC LANT
- Matthew Audet, EPA Remedial Project Manager, U.S. EPA Region 1
- David Gallagher, State Remedial Project Manager, MassDEP
- Jennifer O'Keefe, Resolution Consultants Project Manager (Navy CLEAN contractor)[2]
- Robert McCarthy, Resolution Consultants Project Manager (Navy CLEAN contractor)
- Jim Ropp, Tetra Tech NUS Project Manager (Navy CLEAN contractor)
- Jim Nicotri, CH2M HILL Project Manager (Navy Remedial Action Contractor)
- Pat Schauble, Health & Safety (H&S) Environmental (Navy O&M Contractor)
- Bob Santosuosso, H&S Environmental (Navy O&M Contractor)

[2] Comprehensive Long-Term Environmental Action Navy

The five-year review consisted of the following activities: a review of relevant documents, site inspections (12 August 2013), and interviews. The final report is anticipated to be complete by September 2014 and will be placed in the Information Repositories and Administrative Record (AR) file for NWIRP Bedford. Relevant project documentation can be found at the following Information Repository location:

Bedford Public Library (www.bedfordlibrary.net/)
7 Mudge Way
Bedford, Massachusetts 01730

In addition, the AR can be accessed online through the following Navy web site:

www.navfac.navy.mil/products_and_services/ev/products_and_services/env_restoration/administrative_records.html

1.5.1 Community Involvement

In March 1996, a Restoration Advisory Board (RAB) was established for NWIRP Bedford. The RAB is comprised of members of the community, local environment group members, and state and federal officials. The RAB meets periodically and represents the primary method of communicating information to the community. Public notices announcing RAB meetings, public meetings, public hearings, and the availability of documents are generally advertised in two local newspapers (*Bedford Minuteman* and *Lexington Minuteman*).

Notice to conduct the five-year review was published in the *Bedford Minuteman* on 10 October 2013 and the *Lexington Minuteman* on 3 October 2013 (Appendix A). A Notice of Availability of the Five-Year Review Report will be posted in the aforementioned publications in September 2014 and will also be provided to RAB members. The notice will indicate that the Navy made available copies of the report in the Information Repository listed above.

A summary of the final Five-Year Review Report will be provided to the RAB at a future meeting.

1.5.2 Next Review

The next review will be conducted pursuant to CERCLA and the U.S. EPA's Office of Solid Waste and Emergency Response Directive 9355.7-03B-P (U.S. EPA, June 2001) and is scheduled to be completed in 2019.

2.0 SITE 3 — NORTHERN CHLORINATED SOLVENT GROUNDWATER PLUME

2.1 Site 3 Introduction

NWIRP Bedford is divided into northern and southern sections that are separated by Hartwell Road. The northern section (Site 3) is located on Hartwells Hill, and consists of the Components Laboratory and its auxiliary buildings, the Compact Test Range (formerly the Advanced Medium Range Air-to-Air Missile Development Building), the Facilities Storage Building, the Antenna Range Facility, a former incinerator, the Government Building, and the Vitro Tower.

The Site 3 plume is emanating from beneath the paved shipping and receiving area on the north side of the Components Laboratory atop Hartwells Hill. 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 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 2-1). The 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 Site 4 plume is within the Site 3 plume boundaries and the respective COCs are co-mingled.

Site 3 COCs

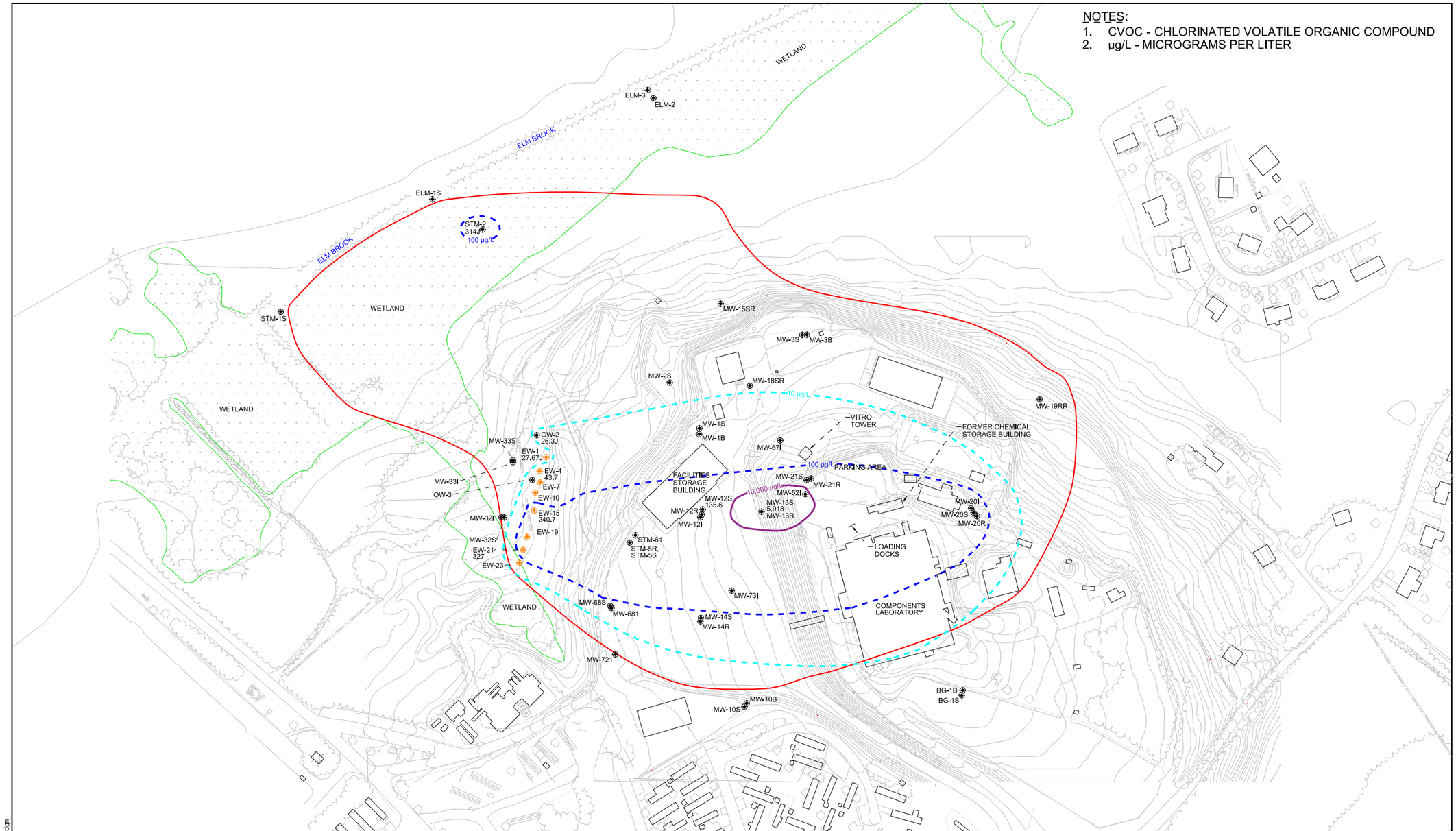
- 1,1-Dichloroethene
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- Cis-1,2-dichloroethene
- 1,1,2-Trichloroethane
- Tetrachloroethane
- Trichloroethene
- Vinyl chloride

The Site 3 ROD, signed 29 September 2010, selected installation of an IBS near the Components Building, continued operation of the GWETS, MNA, LUCs, and five-year reviews for the site.

2.2 Site 3 Chronology

Site 3 was first identified as a potential source of contamination in the Initial Assessment Study (IAS) in 1986, and contamination was confirmed by an RI in the early 1990s. Interim Remedial Actions (IRA), consisting of an extraction well system, were implemented in 1997 and operated continuously since then. The Site 3 ROD was finalized and signed in 2010. The IRA was adopted as part of the final RA (subsequently renamed the GWETS) and installation of the designed remedy was completed in November 2012. RA monitoring activities are ongoing. Dates for major events are presented in Table 2-1.

NOTES:
1. CVOC - CHLORINATED VOLATILE ORGANIC COMPOUND
2. µg/L - MICROGRAMS PER LITER



LEGEND

- GROUNDWATER MONITORING WELLS
- EXTRACTION WELLS
- "J" ESTIMATED
- 200 TOPOGRAPHIC LINE
- SITE 3

INTERPRETED LINE OF EQUAL TOTAL CVOC CONCENTRATION (µg/L)

- 10,000
- 1,000
- 100
- 10

N

0 100 200 300
SCALE IN FEET

INTERPRETED TOTAL CVOC CONCENTRATIONS
IN SHALLOW OVERBURDEN
GROUNDWATER, SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL JOINT VENTURE

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FIGURE 2-1
SITE 3 SHALLOW OVERBURDEN
TOTAL CVOC ISOCONCENTRATIONS
SEPTEMBER 2013
5-YEAR REVIEW
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: R. McCARTHY	DATE: 6/26/2014
DRAWN BY: N. RINEHART	TASK ORDER NUMBER: WE38

Service Layer Credits: Map taken from AGVIQ Environmental Services CH2M HILL Joint Venture

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Table 2-1
Site 3 Chronology

Date	Event	Additional Information
1985-1986	Initial Assessment Study (IAS)	In 1985, an IAS was conducted at the NWIRP Bedford, which identified a need for further investigation into potential contaminant sources in surface water and groundwater at the site (BCM Eastern, 01 April 1986).
1989-1990	Phase I Remedial Investigation (RI)	The Phase I RI, conducted between 1989 and 1990 by Dames & Moore, determined that volatile organic compounds (VOCs), primarily chlorinated solvents, were present in onsite groundwater. The investigations also concluded that additional work was required to characterize the nature and extent of contamination.
1993-1997	Phase II RI	The Phase II RI (Tetra Tech, 01 September 2000) characterized the sources and extent of on- and offsite VOCs, including a chlorinated solvent plume associated with Site 3. Inorganics (i.e., metals), semivolatile organic compounds, polychlorinated biphenyls, pesticides, and polycyclic aromatic hydrocarbons were either not detected or were found not to be a significant problem in groundwater. The Phase II RI included comprehensive human health risk assessment (HHRA) and ecological risk assessment (ERA) evaluating exposure to on- and offsite constituents of concern (COCs) associated with NWIRP Bedford. A detailed groundwater flow model was developed to evaluate the offsite fate of the Site 3 plume.
31 May 1994	National Priorities List (NPL)	U.S. EPA listed NWIRP Bedford on the National Priorities List.
1997	Interim Remedial Actions (RAs)	To prevent the migration of VOCs from Site 3 to Elm Brook and the associated wetlands, the Navy implemented an offsite groundwater pump-and-treat system in accordance with the Massachusetts Contingency Plan (MCP). The offsite system was re-named the Immediate Response Action after the revised MCP was published, and then renamed again for program consistency to the Interim Remedial Action (IRA) after the site moved to the CERCLA program. The Navy has been conducting quarterly or semiannual groundwater monitoring of over 40 wells on and off Navy property since IRA system start-up in 1997.
15 October 1998	Groundwater Use Value Determination (GUVD)	The Commonwealth of Massachusetts established an Aquifer Protection District (APD) at NWIRP Bedford based on a drinking water source groundwater classification per the 15 October 1998 GUVD letter (MassDEP, 15 October 1998). The GUVD and APD prompted the Navy to conduct a risk evaluation addendum that was completed in 2001 along with the Supplemental Phase II RI.
30 September 1999	Federal Facilities Agreement (FFA)	An FFA was executed by the Navy and U.S. EPA on 30 September 1999. MassDEP is not party to the FFA; however, in accordance with CERCLA and the National Contingency Plan, MassDEP has participated in ongoing discussions and strategy sessions, as well as provided oversight and guidance through their review of the Navy Installation Restoration Program documents.
2000-2001	Supplemental Phase II RI/Baseline HHRA Addendum and ERA	Final Phase II RI and Site 3 (including the SFTA) Supplemental Investigation further detailed the previous RI activities and presented the results of an HHRA and an ERA for NWIRP Bedford. Qualitative evaluation of VI pathway was presented.
2002-2005	Electrical Resistance Heating (ERH) Pilot Test and Supplemental Investigations	Multiple investigations to assist in development of remedial alternatives and to characterize the source area result in the elimination of potential for sources from under the Components Laboratory Building, further definition of the extent of the Site 3 source, and a determination that electrical resistance heating (ERH) would likely achieve 95% removal of the source if implemented at full scale.

Table 2-1
Site 3 Chronology

Date	Event	Additional Information
2010	Final Feasibility Study (FS), Source Area Investigation and Supplemental HHRA	A supplemental risk evaluation for Site 3 was prepared as part of the FS using May 2010 U.S. EPA Regional Screening Levels (RSLs) and February 2010 groundwater data from the Site 3 source area. The results of the 2010 risk evaluation further support the basis for taking action at Site 3. The Final FS presented five remedial alternatives to address CVOC contamination in Site 3 groundwater.
29 September 2010	Site 3 Record of Decision (ROD) Signed	U.S. EPA signed the Navy ROD on 29 September 2010. 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 There have been no remedy modifications (ROD amendments).
2011	Site 3 LUC Remedial Design (RD)	Established LUC performance objectives and monitoring requirements for prohibiting the use of site groundwater, prohibiting residential redevelopment of the site, restricting site building occupancy (includes annual compliance inspection and reporting), and maintaining the remedial action components (e.g., pump-and-treat system and monitoring well network). Note occupancy restrictions may be lifted or modified if completion of the planned VI study provides results indicating the buildings are protective.
2010-2012	Site 3 RD	A bioremediation field pilot testing program occurred in 2011 in order to validate the overall design concept, reduce the level of uncertainties, test the selected equipment functionality, and obtain field operational data. The Site 3 RD was completed in January 2012.
2012	Site 3 RA Construction	The Navy commenced construction of the Site 3 RA (in situ enhanced bioremediation) in summer 2012. The system was operational beginning in October 2012.
2012 to present	Site 3 Performance Monitoring	In October 2012, a baseline groundwater monitoring event at Site 3 was conducted prior to system startup. The first round of injections was completed in November 2012. Performance monitoring began with the January 2013 quarterly event. October 2013 IBS performance monitoring data (AGVIQ-CH2MHill, 20 January 2014) indicate that conditions favorable for degradation are being developed within the treatment area, and some wells are exhibiting CVOC reduction.
2012 to present	Site 3 LUC and LTM	Annual Site 3 LUC inspections started in 2012 and quarterly Site 3 groundwater LTM reports continue using a monitoring network similar to the one established as part of the IRA in 1997. Issues identified during the LUC inspections are limited to minor fence and wellhead repairs; the NWIRP Bedford facilities remain unoccupied. Groundwater contaminant concentration and trend data are available from 1997 through 2013 in many wells (Appendix B). Overall, the trend for TCE and total CVOCs is downward in all but a few locations based on Mann-Kendall, Seasonal Kendall, and curve fit information. The CVOC plume size has reduced over time. The *Groundwater Monitoring Report, September 2013 Monitoring Event* (AGVIQ-CH2MHill, December 2013) indicates there are a few locations, such as bedrock wells BG-1Band source area well MW-13S, that will need to be monitored for upward trends.

Table 2-1
Site 3 Chronology

Date	Event	Additional Information
2013-2014	Site 3 Explanation of Significant Differences (ESD)	The Navy has prepared an ESD for the Site 3 ROD, which incorporates the SFTA property into the MNA program and LUCs established with the Site 3 RA (Tetra Tech, September 2013). The ESD was approved by U.S. EPA in March 2014.
2014	Site 3 and SFTA LUC RD	The Navy is working in partnership with U.S. EPA and MassDEP to update the LUC RD to remove occupancy restrictions at the SFTA as vapor investigations determined TCE concentrations were so low that the pathway was incomplete. However, all other elements of the LUC RD will remain the same (see Section 1.5). Modifications to the LUC RD are anticipated to occur in 2014.

2.3 Site 3 Background

The initial environmental investigation activities conducted at NWIRP Bedford under the Navy's IR Program were conducted in accordance with the Massachusetts Contingency Plan (MCP) (310 Code of Massachusetts Regulations [CMR] 40.0000). This is because NWIRP Bedford was classified as a priority site under Chapter 21E of the MCP, and then subsequently as a "Tier 1A" site. NWIRP Bedford was listed on the NPL in May 1994 and the selected remedy for Site 3 was selected in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986, and (to the extent practicable) the NCP. As such, remedial studies and activities leading up to the ROD were conducted in accordance with CERCLA and the NCP rather than the MCP.

2.3.1 General Site Description

Site 3 consists of an approximate 6,700 square foot subsurface area of elevated CVOCs in the saturated zone and an approximate 64-acre plume of dissolved-phase CVOCs in groundwater extending primarily northwest to a wetland area on private property. The contaminants emanate from an area under the paved shipping and receiving (loading dock) area associated with the former Components Laboratory building located on Hartwells Hill. CVOCs are slow to migrate from the area due to the low permeability of the glacial till layers.

The COCs at Site 3 include tetrachloroethene (PCE), TCE, cis-1,2-dichloroethene (cis-1,2-DCE), 1,1,2-trichloroethane (1,1,2-TCA), 1,1-dichloroethane (1,1-DCA), and 1,2-dichloroethane (1,2-DCA). The predominant Site 3 COC is TCE, which was detected at a historical maximum concentration of 240,000 micrograms per liter (µg/L) in June 2003 (Table 2-2); TCE's current maximum concentration is 5,200 µg/L. The remediation goal (RG) for TCE is 5 µg/L. Current plume maps and potentiometric contours of shallow and deep overburden and bedrock intervals from the September 2013 groundwater sampling event are presented on Figure 2-1.

Maximum volatile organic compound (VOC) concentrations were detected in surface water in Elm Brook in 1997: 33 µg/L cis-1,2-DCE and 170 µg/L TCE. Following implementation of the IRA (the containment remedy), surface water concentrations in Elm Brook decreased below applicable ARARs (surface water quality criteria, discussed in Section 2.7.2) by the time of ROD development. Long-term monitoring (LTM) of Elm Brook indicates that concentrations have remained below ARARs since groundwater containment began.

Table 2-2
Site 3 Historical/Current Groundwater Maximum Concentrations (µg/L)

Constituent of Concern	Historic Maximum/Location		Current Maximum/Location	
1,1-Dichloroethene	11,000	MW-55I	1,400	MW-52I
1,1-Dichloroethane	12,000	MW-55I	610	MW-52I
1,2-Dichloroethane	4,000	MW-55I	18	MW-52I
cis-1,2-Dichloroethene	91,000	MW-55I	12,000	MW-52I
1,1,2-Trichloroethane	4,000	MW-55I	13	MW-52I
Tetrachloroethene	4,000	MW-55I	310	MW-13S
Trichloroethene	240,000	MW-55I	5,200	MW-13S
Vinyl Chloride	4,000	MW-55I	2,900	MW-52I

2.3.2 History of Contamination

Prior to 1980, only limited records are available concerning spills within the loading dock area associated with the Components Laboratory. The only known spill at Site 3 is the 1976 release of one 55-gallon drum of a chlorinated solvent Axothene, known to contain 1,1,1-trichloroethane (1,1,1-TCA). Although there have been no other documented releases of chlorinated solvents, it is believed that other releases may have been similar to the documented one. Based on extensive historic record review and interviews of facility personnel, relatively small accidental releases, rather than deliberate disposal, were identified as the most likely cause of the Site 3 (northern plume) contamination.

2.3.3 Initial Response Actions

To prevent the migration of CVOCs from Site 3 to Elm Brook and the associated wetlands, the Navy implemented groundwater pump-and-treat for containment in 1997 (initially referred to as the Short-Term Measure, then the Immediate Response Action, then the IRA).[3] Since 1997, the system has been operated continuously throughout the CERCLA investigations. An environmental monitoring program was adopted in 1997 to monitor the efficacy of the IRA.

2.3.4 Basis for Taking Remedial Action

Unacceptable human health risks were identified for exposure to 1,1-Dichloroethene (1,1-DCE), 1,2-DCA, cis-1,2-DCE, PCE, TCE, and Vinyl Chloride (VC) in Site 3 groundwater. Risks include

[3] Following integration into the ROD remedy, this system was renamed the GWETS.

non-cancer hazards and cancer risk for a hypothetical future onsite residential scenario. Although the reasonably anticipated future land use scenario for NWIRP Bedford property is industrial, the identified residential risks warranted mitigation due to the Town of Bedford's APD and the state's Groundwater Use Value Determination (GUVD). The risk assessment for Site 3 indicated that soil at the site was protective of current and anticipated future use (industrial site worker and teenage trespasser scenarios).

A quantitative vapor intrusion (VI) study was not performed for any of the buildings located in proximity to contamination at Site 3, so the LUC RD for Site 3 prohibited building occupancy in the northern section of NWIRP Bedford.

2.4 Remedial Actions

This section outlines the selected remedy for Site 3.

2.4.1 Remedy Selection

The U.S. EPA signed the Navy's Site 3 ROD on 29 September 2010.

2.4.2 Remedial Action Objectives

The ROD identified the following RAOs for Site 3:

1. 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.

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

3. 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 groundwater at the site is designated as high use and value by the MassDEP. Therefore, Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs), SDWA non-zero Maximum Contaminant Level Goals (MCLGs), and Massachusetts Drinking Water Standards at 310 CMR 22.00 (MMCLs) were used to develop RGs. ROD RGs for Site 3 groundwater were selected as the more stringent standards of the federal and state drinking water MCLs and non-zero MCLGs, as shown in Table 2-3.

Table 2-3
Groundwater Remediation Goals — Site 3

Constituent of Concern	Record of Decision Cleanup Level	Record of Decision Note
1,1-Dichloroethene	7 µg/L	2010 MCL
1,1-Dichloroethane	70 µg/L	2009 Massachusetts Office of Research and Standards Guideline
1,2-Dichloroethane	5 µg/L	2010 MCL
cis-1,2-Dichloroethene	70 µg/L	2010 MCL
1,1,2-Trichloroethane	3 µg/L	2010 MCLG
Tetrachloroethene	5 µg/L	2010 MCL
Trichloroethene	5 µg/L	2010 MCL
Vinyl chloride	2 µg/L	2010 MCL

2.4.3 Remedy Description

RAs at Site 3 were identified in the 2010 Site 3 ROD:

- In-situ enhanced bioremediation of the source area
- Continued operation of the existing groundwater pump-and-treat system at the property line for plume capture and control
- MNA/LTM
- LUCs
- Five-year reviews

2.4.4 Remedy Implementation

Remedy implementation at Site 3 began in 2011, with pre-design activities for pilot testing of an IBS and the continued operation of the GWETS.

Pump-and-Treat System: The GWETS at Site 3 was implemented in 1997 as a pre-ROD IRA and consisted of a row of 23 extraction wells (EW-1 to EW-23) at the base of Hartwells Hill (Figure 2-2). The purpose of this system was to prevent the CVOC plume from migrating toward Elm Brook. Since the system was effective in containing the northern plume, the system was incorporated into the final remedy (the GWETS).

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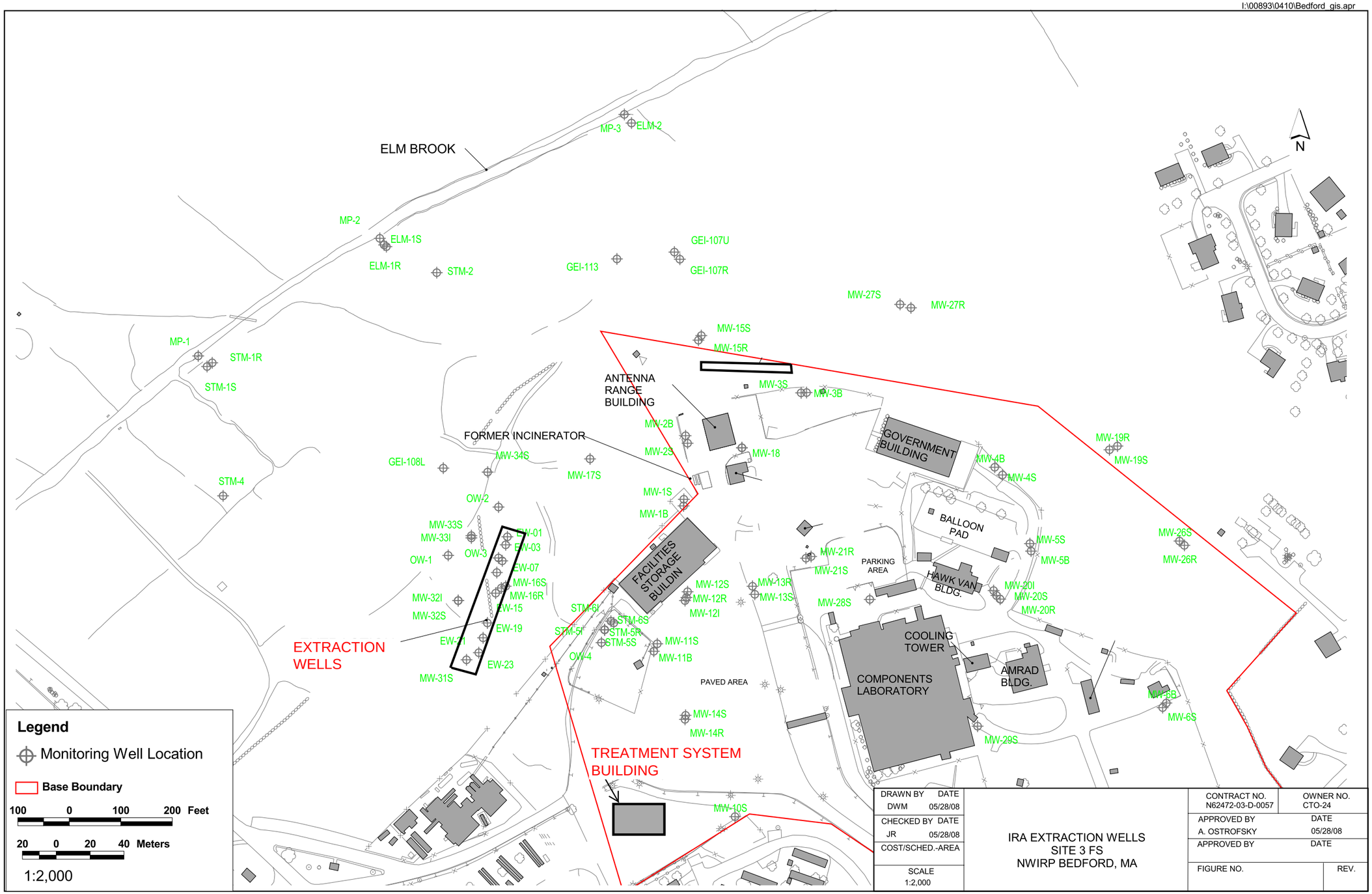

DRAWN BY	DATE
DWM	05/28/08
CHECKED BY	DATE
JR	05/28/08
COST/SCHED.-AREA	
SCALE 1:2,000	

IRA EXTRACTION WELLS
SITE 3 FS
NWIRP BEDFORD, MA

CONTRACT NO. N62472-03-D-0057	OWNER NO. CTO-24
APPROVED BY A. OSTROFSKY	DATE 05/28/08
APPROVED BY	DATE
FIGURE NO.	REV.

FIGURE 2-2
GROUNDWATER EXTRACTION TREATEMENT SYSTEM
5-YEAR REVIEW
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: R. McCARTHY	DATE: 6/26/2014
DRAWN BY: N. RINEHART	TASK ORDER NUMBER: WE38

Service Layer Credits: Map taken from AGVIQ Environmental Services CH2M HILL Joint Venture and modified by EnSafe

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The extraction wells are 6 inches in diameter, and are screened across the water table to depths of 8 to 31 feet bgs. The lateral spacing between the wells ranges from 10 to 20 feet. Each extraction well is equipped with an individual pump controlled by water level switches, which can cycle on and off. The system was designed to operate at a total capacity of up to 30 gallons per minute (gpm). The system was effective in containing the northern plume; therefore, the system was incorporated into the final remedy. The system currently operates at an average rate of approximately 12 gpm (range of 6.3 to 16.7 gpm during 2013). An evaluation of influent, effluent, and mass removal data is provided in subsequent sections of this report.

The extraction wells discharge to a treatment system that pre-treats the groundwater to remove naturally occurring metals, and then uses granular activated carbon to remove CVOCs. Treated water is allowed to recharge to the aquifer via discharge to the ground surface downgradient of the treatment facility and upgradient of the wetlands and Elm Brook. The discharge seeps into the ground with no observable flow reaching the boundary of the bordering vegetated wetlands (Tetra Tech, 01 January 2012).

Discharge monitoring and reporting for the GWETS is performed monthly by the O&M contractor.

Pre-Design Testing: The bioremediation field pilot testing program occurred in 2011 in order to validate the overall design concept, reduce the level of uncertainties, test the selected equipment functionality, and obtain field operational data. Based on the test results, it was possible to reduce the need to "overdesign" the full-scale system, thereby reducing the overall cost of the remedy implementation. The pilot study was conducted in accordance with the Work Plan for Field Pilot Testing for Bioremediation Design (letter work plan by Tetra Tech, dated 19 October 2011).

A summary of the pilot testing program follows below:

- Diluted electron donor (substrate) was injected into TW-1 and TW-2 continuously over a period of 16 days (30 November to 16 December 2011). TW-1 and TW-2 are adjacent to Elm Brook and sample locations ELM-1S, ELM-1R, and STM-2.

- A vegetable oil emulsion was used as substrate during the pilot test (same as planned for the full-scale system). A total of 80 pounds of substrate was injected during the test. The resulting daily substrate injection rate was 5 pounds per day. The corresponding average injected substrate concentration was approximately 770 milligrams per liter (mg/L) (similar to the projected full-scale conditions).

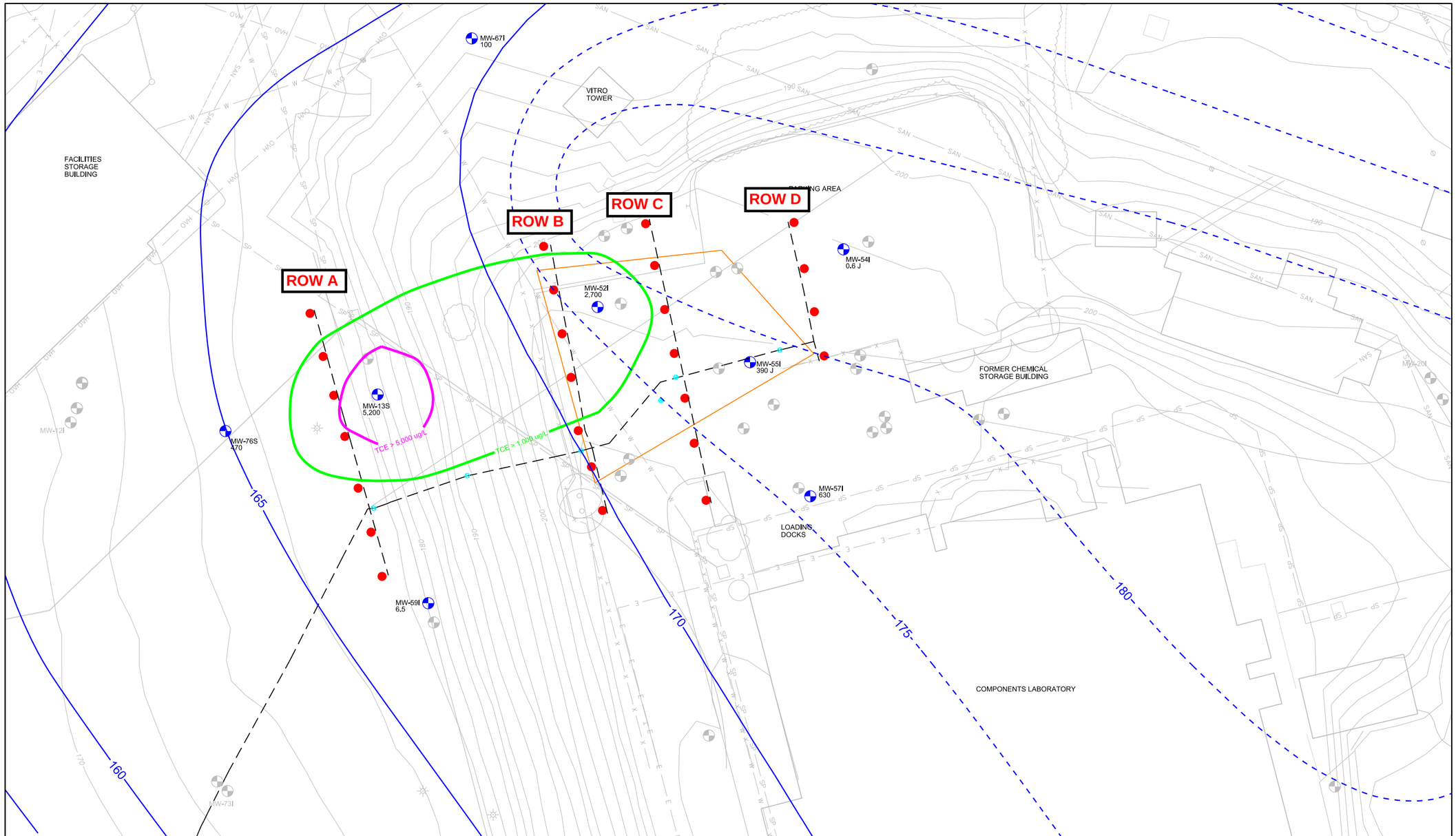
- A total of 12,400 gallons of diluted substrate solution were injected during the pilot test. An average injection rate over 16 days of the pilot test was 0.54 gpm.

- Overall, the pilot test validated the selected remedial approach (in situ enhanced bioremediation) and provided operational data to help optimize the full-scale system design and reduce both the future system installation and the O&M costs. Based on the pilot test results, the total number of required injection wells was reduced from 32 to 25 wells, and the injection equipment system set-up was simplified and streamlined.

IBS Implementation: The Site 3 remedial design (RD) was completed in January 2012 and the RA Work Plan was completed in April 2012. The Navy commenced construction of the Site 3 IBS in summer 2012. Twenty-four injection wells and 150 feet of trenched pipe connecting injection wells were connected to the groundwater treatment plant during August and September 2012. The injection system plant, injection well development, and well vault construction was completed between September and October 2012 (Tetra Tech, 15 November 2012). Figure 2-3 illustrates the location of the IBS.

System functional testing and start-up activities for the Site 3 IBS were conducted in November 2012, and start-up commenced with emulsified vegetable oil (EVO) injection beginning on 21 November. The initial design target water injection flow and manifold injection pressure were 1.5 gpm and 50 pounds per square inch (psi), respectively. The EVO injection based on a design of 0.72 gallons per day (gpd) per 1.0 gpm at this water injection rate is 1.08 gpd. Over the first few days, the IBS experienced low flow rates (0.4 gpm) and high pressures (80 psi). After troubleshooting, the orifice size in each well was increased to better accommodate the EVO without plugging during injection and the system resumed operation on 27 November 2012. These activities were documented in more detail in the Start-Up Report submitted to NAVFAC on 7 December 2012.

Performance Sampling: Groundwater samples were collected from select performance monitoring wells periodically during the first year of active remediation to evaluate the effectiveness of the IBS in achieving established site cleanup goals (Tetra Tech, 01 January 2012).



AGVIQ
AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL
JOINT VENTURE

LEGEND:

- PERFORMANCE MONITORING WELL LOCATION
- APPROXIMATE INJECTION WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- 110 SEPTEMBER 2013 TCE CONCENTRATION (ug/L)
- 200 TOPOGRAPHIC LINE
- UNDERGROUND TRENCH TO INJECTION WELLS
- TCE > 5,000 ug/L TCE CONTOUR (2013)
- TCE > 1,000 ug/L TCE CONTOUR (2013)
- CURRENT SITE 3 SOURCE AREA
- INTERPRETED GROUNDWATER CONTOUR FOR SHALLOW OVERBURDEN, SEPTEMBER 2013 (DASHED WHERE INFERRED)
- 180 GROUNDWATER ELEVATION (ft MSL)

NOTE:

1. UNDERGROUND TRENCH LOCATION IS SHOWN APPROXIMATE AND MAY VARY IN THE FIELD.

N

0 20 40 60
SCALE IN FEET

SITE 3
INJECTION SYSTEM, PERFORMANCE MONITORING LOCATIONS, AND SITE 3 PLUME
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

423171.04

FIGURE 2-3
IN-SITU BIOREMEDIATION SYSTEM
5-YEAR REVIEW
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: R. McCARTHY	DATE: 6/26/2014
DRAWN BY: N. RINEHART	TASK ORDER NUMBER: WE38

Service Layer Credits: Map taken from AGVIQ Environmental Services CH2M HILL Joint Services and modified by EnSafe.

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Baseline performance monitoring was conducted in October 2012, following the installation of the injection well array and performance monitoring well MW-76S. The first quarterly event took place approximately 6 weeks after the start of EVO injection in January 2013 (AGVIQ-CH2MHill, 06 March 2013). The second quarterly event took place in October 2013. Two additional performance monitoring events remain to be conducted; in accordance with the modified injection and operation schedule, these will be conducted in the third and fourth quarter of operations, to represent mid- and post-injection performance.[4] Subsequently, one additional quarterly report and one combined quarterly/annual report will be issued to present the comprehensive results of the performance monitoring (AGVIQ-CH2MHill, 20 January 2014). Performance monitoring data is discussed in subsequent sections of this report.

Long Term monitoring: LTM at Site 3 is specified in the 2010 ROD as semiannual for the first two years, and then the frequency may be reduced depending upon prior results. Based on the most recent Sampling and Analysis Plan (SAP), the site remains at a semiannual frequency for COC and MNA parameters in groundwater, and annual sampling for COCs in surface water (AGVIQ-CH2MHill, 25 October 2012). Per the SAP, three additional wells are to be installed to characterize the deep and shallow plumes between the extraction wells and Elm Brook. The most recent semiannual LTM included in this five-year review was September 2013 (AGVIQ-CH2MHill, 17 December 2013), and the most recent annual report with both surface and groundwater data was March 2013 (AGVIQ-CH2MHill, 01 May 2013). LTM data for Site 3 is provided in Appendix B and discussed in subsequent sections of this report.

2.4.5 Remedy Operations/Operations & Maintenance

GWETS Treatment System Performance: The GWETS system currently operates at an average rate of approximately 12 gpm (range of 6.3 to 16.7 gpm during 2013). Treatment system effluent is discharged to ground surface. The discharge seeps into the ground with no observable flow reaching the boundary of the bordering vegetated wetlands (Tetra Tech, 01 January 2012). The activities associated with O&M of the GWETS are documented in monthly O&M reports.[5]

The onsite discharge is monitored monthly. Discharge data for December 2012 through November 2013 were reviewed for the five-year review. Cumulative system flow, influent and effluent concentration, and cumulative mass removed by the GWETS are graphically represented in each O&M report. Routine maintenance requirements are also summarized in monthly

[4] Third quarter operations will roughly represent the April through June timeframe; fourth quarter will represent the July through September timeframe.
[5] The O&M reports from December 2012 to November 2013 (H&S Environmental, 18 December 2013) were reviewed for preparation of the five-year review.

O&M reports. Supplemental data illustrating GWETS containment, influent and effluent trends, and system data are provided in Appendix C.

IBS Treatment System Performance: Between 27 November 2012 and 13 February 2013, the Site 3 IBS operated a total of 2,004 hours, injected 108 gallons of EVO (933 pounds) at an average fluid injection rate of 1.9 gpm, an average EVO injection rate of 1.32 gpd, and a manifold injection pressure that varied between a low of 32 psi (high flow of 2.3 gpm) and a high of 50 psi (low flow of 1.5 gpm). The elevated injection pressures were found to be associated with biofouling inside the system lines and wells. To improve system performance, the system was flushed, drained, and shut down for the winter to allow for performance monitoring and optimization of Site 3 IBS injection design. During this period, all injections were to Row A wells only (Figure 2-3). Performance monitoring data evaluations are discussed in subsequent sections of this report.

All IBS modifications were documented in more detail in the Site 3 IBS monthly operation reports submitted to NAVFAC for the months of December 2012 through February 2013. The Site 3 IBS was restarted on 24 June 2013 after a period of downtime to allow for formation of biological activity in the treatment area. During this time, groundwater monitoring wells in the remediation area were monitored monthly to confirm the presence of bioactivity and the development anaerobic reactive barrier zone in the treatment area. Data from this event are discussed in subsequent sections of this report.

During July 2013, the Site 3 IBS operated using a pulsed injection scenario in which a higher concentration of EVO is injected at the same overall flow rate for 24 hours followed by injecting de-oxygenated water only for the remainder of the week (6 days). This process is repeated each week. This optimized injection strategy was recommended by the EVO vendor as a means of injecting a sufficient amount of EVO while avoiding potential biofouling within the system piping. Between 24 June 24 2012 and 30 July 30 2013 the Site 3 IBS operated a total of 899 hours, and injected 39 gallons of EVO (335 pounds) in 151 hours at an average fluid injection rate of 3.5 gpm (an average EVO injection rate of 6.05 gpd) and a manifold injection pressure that varied between a low of 25 psi and a high of 57 psi. During this period, all injections were to Row A wells only. These activities were documented in more detail in the Site 3 IBS monthly operation reports submitted to NAVFAC for the months of June and July 2013.

The Site 3 IBS operated on all four injection rows, alternating between the four rows (two rows at a time, switching every two weeks) from August 2013 through the end of December 2013 when the system shut down for the winter. Slight decreases in flow rate were observed starting in November 2013, indicating that wellhead cleanout/redevelopment was required during the winter shutdown period. The system was restarted in April 2014; the remaining 8 drums of EVO will be injected through August 2014.[6]

Performance monitoring events will be conducted in third quarter (mid-injection) and fourth quarter (post-injection). These activities will be documented in more detail in the Site 3 IBS monthly operation reports.

2.5 Progress Since Last Review

This is the first five-year review of Site 3.

2.6 Five-Year Review Process

2.6.1 Document Review

The historical documents and events from the 1986 IAS, the RI initiated in the 1990s, through to the ROD that was finalized and signed in 2010, the RD from 2010 to 2012, and implementation of the RA in 2012 are summarized in Table 2-1 and in Sections 2.2 through 2.4 of this document. Section 5.0 presents a full list of all the documents reviewed in this effort. The following sections present the relevant site data review and the site inspection associated with the current five-year review period ending in January 2014.

2.6.2 Data Review and Evaluation

This is the first five-year review period since the signing of the 2010 ROD for Site 3. The following data have been reviewed for assessment of Site 3 remedy:

- Performance monitoring data (to gauge the effectiveness of IBS)
- LTM data (to gauge the effectiveness of the GWETS), including both groundwater and surface water
- GWETS treatment system monitoring (influent and effluent monitoring)

[6] Restart was timed for when there was more microbial activity and fewer maintenance problems.

Groundwater Monitoring at Site 3 — Performance Monitoring: During the Site 3 baseline performance groundwater monitoring event conducted in October of 2012, analytical samples were collected from eight designated Site 3 performance monitoring wells at NWIRP Bedford in accordance with the approved SAP (AGVIQ-CH2MHill, 21 March 2012). Groundwater cleanup goals were exceeded in all eight of the performance monitoring wells sampled, with the highest CVOC concentrations in the treatment area wells MW-13S (downgradient end), MW-52I (middle), and MW-55I (upgradient end), and in well MW-76S, immediately downgradient of the injection area. These results are consistent with past monitoring results as reported in the *November 2011 Long Term Groundwater Monitoring Report for Site 3 RA* (Tetra Tech, 09 May 2012).

Performance monitoring results are shown in Tables 2-4 and 2-5 for geochemical/field parameters and VOCs, respectively. As noted previously, three sampling events have been performed: the baseline event (October 2012), first quarter sampling (January 2013), and second quarter sampling (September/October 2013).[7]

Field water quality data generally indicate a decrease in concentrations of oxidized species and the overall redox potential of the aquifer, as shown through decreases in dissolve oxygen (DO) and oxidation-reduction potential (ORP) values, which indicates favorable conditions for reductive dechlorination of Site 3 CVOCs. However, substrate has yet to distribute throughout the treatment area, as indicated by low total organic carbon and volatile fatty acid values (AGVIQ-CH2MHill, 20 January 2014). Chemical data for select wells are shown in Table 2-4.

Remaining performance monitoring events were conducted in June 2014 (third quarter, mid-injection) and will be conducted in September 2014 (fourth quarter, post-injection). These activities will be documented in more detail in the Site 3 IBS monthly operation reports submitted to NAVFAC for the months of April 2014 through August 2014 (AGVIQ-CH2MHill, 20 January 2014)

[7] Following review of groundwater data collected during this first quarterly performance monitoring event, AGVIQ-CH2M Hill, the design engineer (Tetra Tech), and the Navy determined that biological activity was not yet occurring in the initial injection area (Row A wells). Thus, the system was shut down to monitor select performance monitoring wells for the formation of a reactive anaerobic barrier zone, and second quarter sampling was delayed until the IBS was restarted. Monitoring of field parameters only was conducted at three performance monitoring wells (MW-13S, MW-59I, and MW-76S) adjacent to the initial injection area (Row A) approximately monthly during system shutdown between February and June 2013.

Table 2-4
Site 3 Performance Groundwater Data — Baseline, First, and Second Quarters

Well	Date	Total Purge volume (Liters)	Total Purge Time (minutes)	Color	pH	Specific Conductivity (mS/cm)	Temperature (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Oxidation-Reduction Potential (mV)	Flow Rate (Liters/minute)
MW-13S	10/3/2012 (baseline)	12	30	Clear	6.23	1.023	15.77	1.39	0.64	-143.5	0.14
	1/8/2013 (First Quarter)	10.5	35	Clear	6.04	0.225	13.03	0.00	0.37	28.1	0.30
	10/23/2013 (Second Quarter)	15	75	Clear	6.03	0.752	14.67	3.02	8.62	14.67	0.20
	10/23/2013[1]	7	40	Clear	6.04	0.808	14.92	11.30	0.92	-38.2	0.20
MW-52I	10/4/2012 (baseline)	10.2	60	Cloudy	6.93	0.739	15.52	26.1	3.92	-87.9	0.17
	1/8/2013 (First Quarter)	17	88	Somewhat Cloudy	6.63	0.775	12.79	37.1	0.42	-123.0	0.15
	10/23/2013 (Second Quarter)	9	70	Mostly clear	7.17	0.576	15.28	12.4	0.29	-158.1	0.10
MW-54I	10/4/2012 (baseline)	14.5	50	Very Cloudy/turbid	7.86	0.416	15.35	65.8	0.85	-187.0	0.20
	1/8/2013 (First Quarter)	19.5	65	Somewhat cloudy	8.65	0.414	13.82	23.4	0.19	75.5	0.30
	10/23/2013 (Second Quarter)	6.5	88	Slightly cloudy	7.27	0.549	16.60	62.0	0.24	-181.4	0.10
MW-55I	10/4/2012 (baseline)	2.75	95	Clear	9.26	0.680	15.30	3.1	0.00	-211.7	0.25
	1/8/2013 (First Quarter)	11.75	75	Somewhat Cloudy	9.64	0.635	12.53	27.1	0.11	-135.7	0.15
	10/23/2013 (Second Quarter)	4.5	45	Slightly Cloudy	7.79	0.633	16.48	28.9	0.27	-206.5	0.10
MW-57I	10/5/2012 (baseline)	5	135	Very Cloudy	7.76	0.785	16.66	175.0	7.58	-124.0	<0.05
	1/9/2013 (First Quarter)	15.9	70	Clear	7.26	0.699	14.03	0.00	0.34	-76.4	0.20
	10/24/2013 (Second Quarter)	19.25	91	Clear	7.39	0.564	13.51	7.0	0.39	-132.4	0.10
MW-59I	10/5/2012	12	60	Mostly clear	5.84	0.350	15.39	9.3	0.17	-22.0	0.20

Table 2-4
Site 3 Performance Groundwater Data — Baseline, First, and Second Quarters

Well	Date	Total Purge volume (Liters)	Total Purge Time (minutes)	Color	pH	Specific Conductivity (mS/cm)	Temperature (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Oxidation-Reduction Potential (mV)	Flow Rate (Liters/minute)
	(baseline)										
	1/9/2013 (First Quarter)	18	73	Mostly clear	6.75	0.542	11.92	11.8	0.28	-75.1	0.275
	10/23/2013 (Second Quarter)	14	50	Clear	7.09	0.360	16.23	4.96	0.46	-176.5	0.30
MW-67I	10/4/2012 (baseline)	17	60	Clear	7.05	0.712	12.60	1.79	0.99	-110.0	0.29
	1/9/2013 (First Quarter)	7.5	48	Somewhat Cloudy	7.68	0.609	10.59	38.90	0.23	-176.8	0.15
	10/23/2013 (Second Quarter)	10	45	Mostly Clear	8.14	0.743	12.78	8.8	0.35	-244.7	0.20
MW-76S	10/4/2012 (baseline)	14.4	60	Clear	5.94	0.901	19.66	0.0	0.56	-410.5	0.24
	1/8/2013 (First Quarter)	18.5	53	Somewhat Cloudy	6.1	0.591	12.91	20.9	0.39	-30.5	0.30
	10/23/2013 (Second Quarter)	8	35	Clear	6.46	0.551	19.03	0.0	0.43	-70.0	0.20

Notes:
[1] Well MW-13S repurged (for water quality parameters only) on 24 October 2013 due to abnormal readings in initial sampling period on 23 October 2013.
(Data Source: AGVIQ-CH2MHill, 20 January 2014)

Table 2-5
Select IBS Monitoring Wells Responses (µg/L)

Well/Date	Tetrachloroethene	Trichloroethene	Cis-1,2-Dichloroethene	Vinyl Chloride
MW-13S				
Baseline (2012 October)	940 J	18,000	5,600	32
First Quarter (2013 January)	220 J	5,300	3,200	7.8
Second Quarter (2013 September/October)	310	5,200	2,200	63
MW-52I				
Baseline (2012 October)	140	4,700	8,100	1,700
First Quarter (2013 January)	600	13,000	18,000	2,100
Second Quarter (2013 September/October)	2.5 J	2,700	12,000	2,900
MW-55I				
Baseline (2012 October)	98	450 J	20,000	160
First Quarter (2013 January)	120	470	14,000	200
Second Quarter (2013 September/October)	110	390 J	10,000	79

(Data Source: AGVIQ-CH2MHill, 20 January 2014)

Effectiveness of the recently installed IBS system has been documented in monthly O&M reports (AGVIQ-CH2MHill, 20 January 2014). October monitoring data indicated continued CVOC degradation, particularly of parent products to lower-order daughter products in all wells except MW-57I, and generally increasing daughter product concentrations. Geochemical conditions appear to be shifting as biodegradation progresses, such that aquifer conditions are more favorable for reductive dechlorination.[8]

Continued monitoring of groundwater MNA parameters beyond the implementation phase of the IBS will be required until COCs are no longer detected above cleanup levels in groundwater. This can be achieved as part of the ongoing LTM.

Groundwater Monitoring at Site 3 — Long Term Monitoring: To gauge the effectiveness of the containment (pump-and-treat) system and MNA component of the RA, 28 groundwater and eight extraction wells are monitored for site COCs and MNA parameters. LTM at Site 3 is specified in the 2010 ROD as semiannual for the first two years, and then the frequency may be reduced depending upon prior results. The site remains at a semiannual frequency for COC and

[8] The system O&M subcontractor has noted that some of the current variability in analytical results may be caused by the distribution of the carbon substrate within the treatment zone; conditions will continue to change with ongoing EVO injections and in 2014 and subsequent long-term carbon release.

MNA parameters in groundwater, and annual sampling for COCs in surface water (AGVIQ-CH2MHill, 25 October 2012). The most recent annual LTM event reported at the time of this five-year review was conducted in September 2013 (AGVIQ-CH2MHill, 17 December 2013).

The September 2013 Site 3 Groundwater Reports include the cumulative groundwater and surface water data collected at Site 3 sample locations since 1997. Trend analyses include curve fit information (usually log fit) where applicable. Statistical analysis includes Seasonal Kendal and Mann-Kendall evaluations presented in tabular format.

The following locations were selected for discussion as they are representative of the area of highest concentration, mid-plume in close proximity to the GWETS, and conditions at the downgradient end of the plume near Elm Brook:

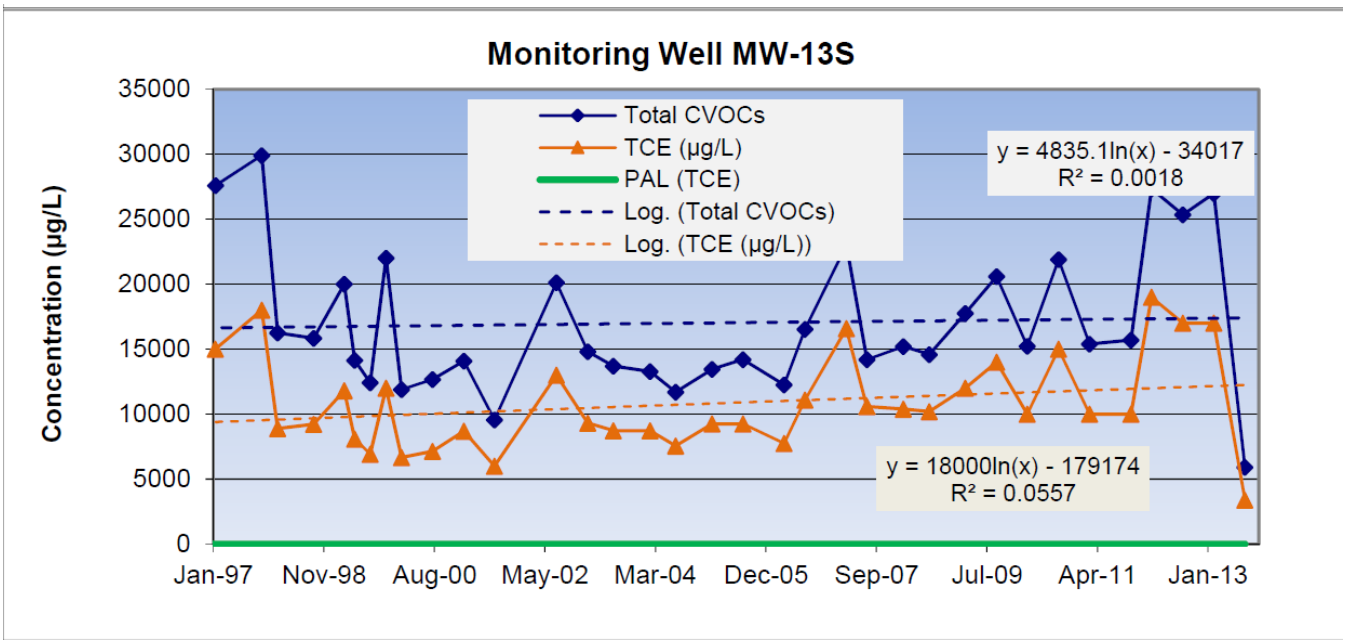
- MW-13S, near the source area and inside the IBS system (Figure 2-4)
- OW-2, immediately adjacent to the GWETS system (Figure 2-5)
- STM-2, adjacent to Elm Brook, downgradient of the GWETS system (Figure 2-6)

In general, CVOC concentrations are historically declining downgradient and near the GWETS; the CVOC concentrations in the source area have been historically steady, but may be showing the initial effects of the IBS in the September event. Overall, the trend for TCE and total CVOCs is downward in all but a few locations based on Seasonal Kendall, Mann-Kendall, and visual inspection of trend graphs (Appendix B).

The *Groundwater Monitoring Report, September 2013 Monitoring Event* (AGVIQ-CH2MHill, December 2013) indicates there are a few locations (such as bedrock wells BG-1B, source area well MW-13S, and STM-2 located in the downgradient wetland area) that will need to be monitored for upward trends. Importantly, downgradient Elm Brook surface water sampling locations STM-1S and ELM-1S have not shown detections above surface water ARARs since the late 1990s after the extraction remedy was implemented.[9] Therefore, the September 2013 detection at STM-2 (Figure 2-6) is considered anomalous at this time and not an indication of remedy operational issues. Continued monitoring will be used to evaluate this anomaly.

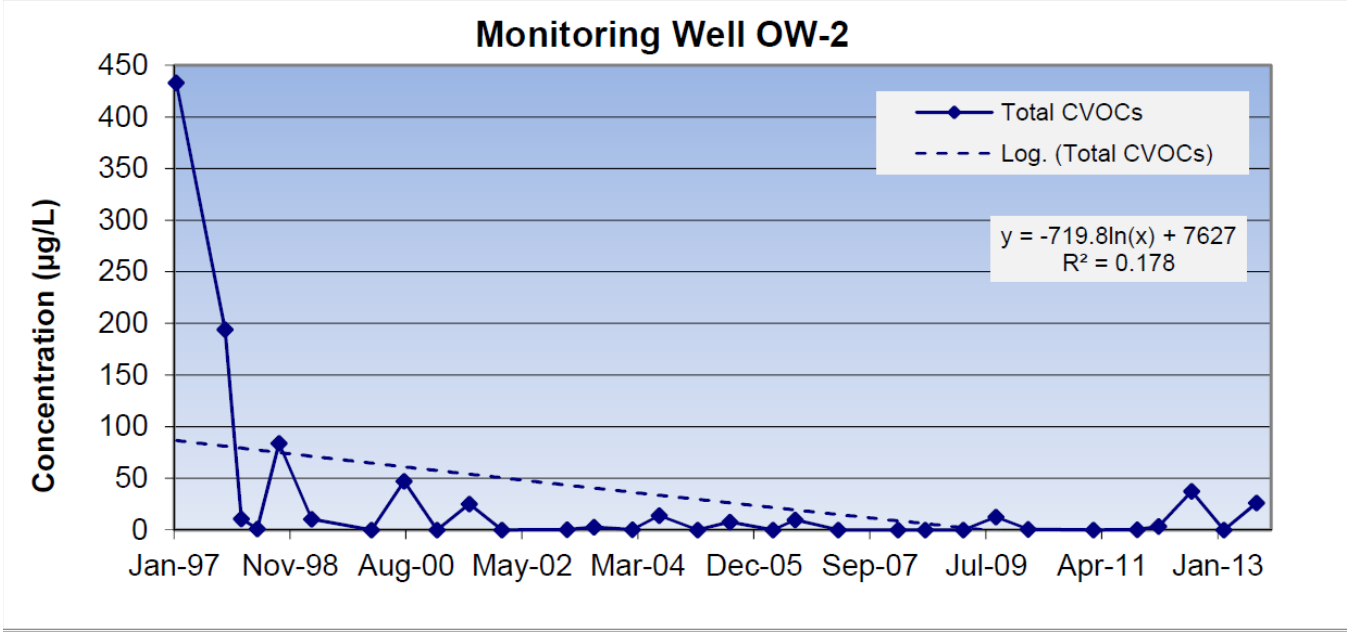
[9] Surface water data are included in Appendix B.

Figure 2-4 Groundwater Well MW-13S Trends 1997-2013



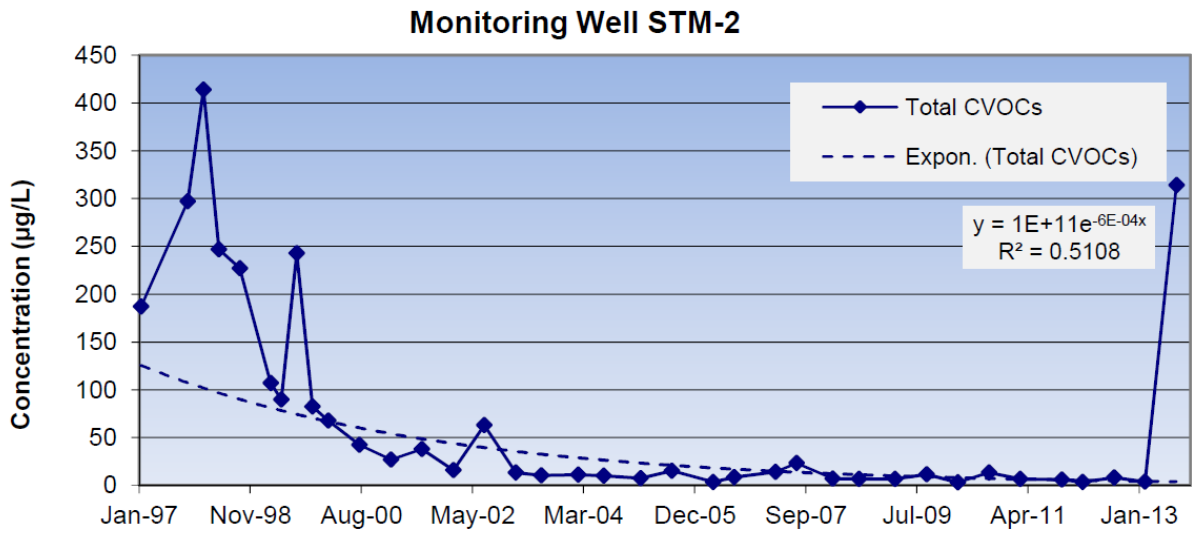
(Source: AGVIQ-CH2MHill, 17 December 2013)

Figure 2-5 Groundwater Well OW-2 Trends 1997-2013



(Source: AGVIQ-CH2MHill, 17 December 2013)

Figure 2-6 Elm Brook Monitoring Wells STM-2 Trends 1997-2013



(Source: AGVIQ-CH2MHill, 17 December 2013)

Recent monitoring events at Site 3 have included geochemical data. The areas of depressed DO appear to be consistent with past events. MNA result tables are shown in Appendix B.

Additional wells (MW-81I, MW82S, and MW-83S) were proposed to be installed per the 2012 SAP to characterize the deep and shallow plume between the extraction wells and Elm Brook. These wells will be incorporated into the LTM and sampled at a semiannual frequency. At this time, no changes are recommended for LTM analytes or sampling frequency; the existing SAP has a protocol for LTM optimization. Continued monitoring of groundwater COCs and MNA parameters will be conducted in accordance with the ROD and SAP and optimized as warranted.

GWETS Treatment System Monitoring: The GWETS treated approximately 66 million gallons of groundwater between 1997 when operations began and 2010 when the final Site 3 feasibility study (FS) was first released. Based on monthly GWETS reports from December 2012 through November 2013, approximately 5.8 million gallons of groundwater were treated in the most recent 12 month period reported. By extrapolation, over this five-year review period, an estimated 27 million gallons were treated and discharged to ground surface.

Figure 2-7 presents the influent water flows since 1997. Influent water flows to the treatment system increased from 1997 through 2005, but have stabilized since about 2005.

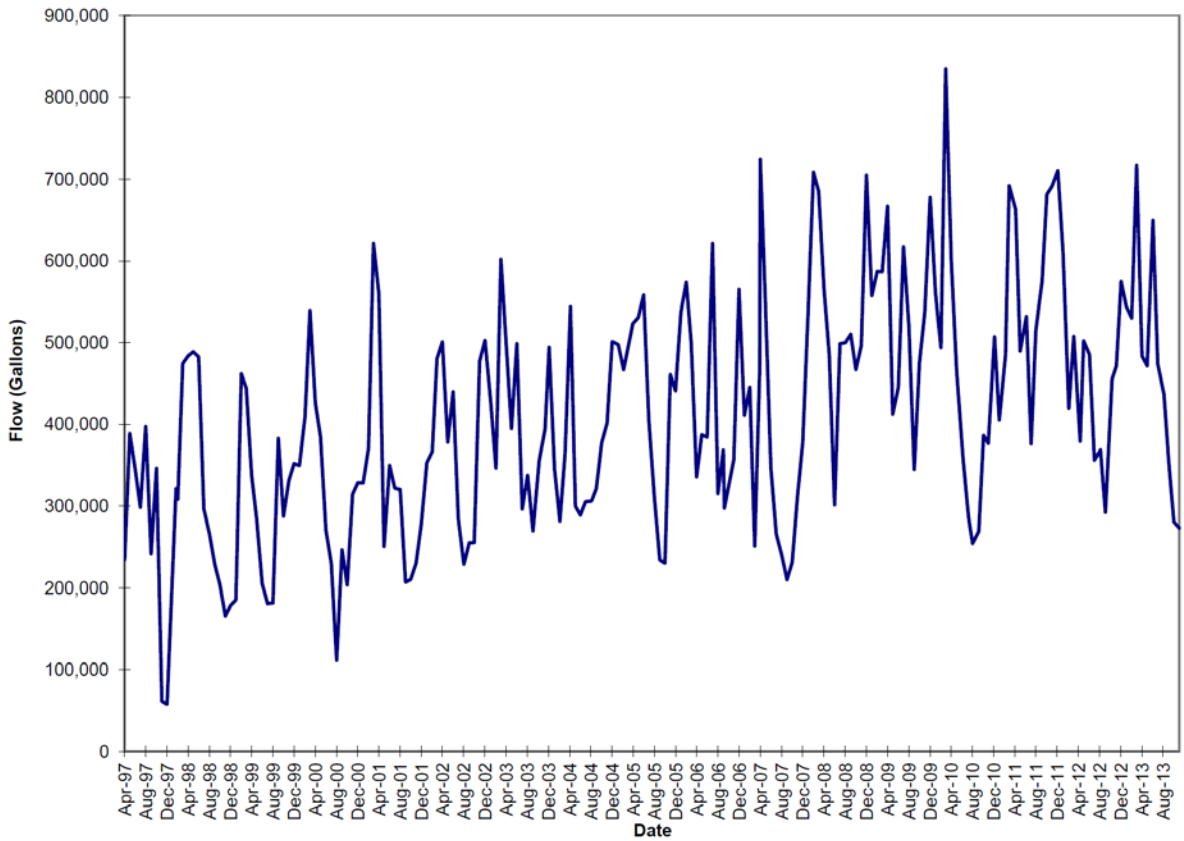
Figure 2-8 shows treatment system influent data during the last 16 years of operation, including this five-year review period. Influent concentrations have decreased since 1997, but have stabilized since about 2005 based on visual inspection of the trends, with TCE concentrations generally ranging from 100 to 130 µg/L.

2.6.3 Site Inspection and Interviews

A site inspection was conducted on 12 August 2013. Representatives of facility management Health & Safety (H&S) and the Comprehensive Long-Term Environmental Action Navy (CLEAN) contractor were present. The site inspection included the following activities:

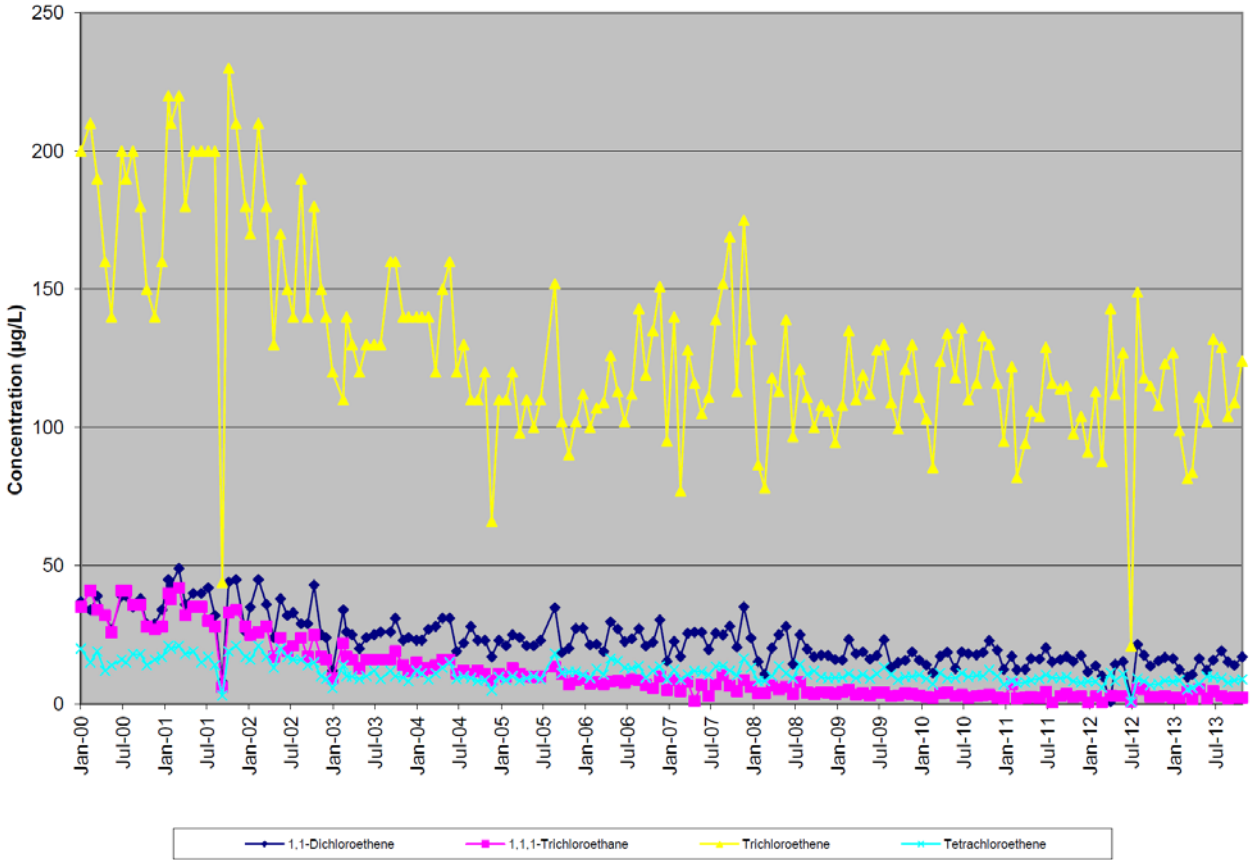
- Tour and inspect groundwater treatment system and bio-injection system building including treatment tanks, pumps, supply tanks and drums, bag filters, and multimedia filter.
- Tour and inspection of groundwater extraction wells and pump house, pumps, controls, and meters.
- Tour and inspection of monitoring wells and bio-injection wells.

Figure 2-7 Influent Flow GWETS 1997-2013



(Source: H&S Environmental, 18 December 2013)

Figure 2-8 Influent Concentrations GWETS 1997-2013



(Source: H&S Environmental, 18 December 2013)

- Tour of onsite buildings and evaluation of LUCs (signs of occupancy).

- Observation of site fencing and new offsite athletic fields.

- Interviews with site contractors, facility manager (Mr. Bob Santosuosso, H&S), and Jim Ropp (Tetra Tech) regarding operations and status of facilities.

Appendix D includes the Site Inspection Checklist and site figures used as part of the walk through and Appendix E includes the photo log from the walk through.

- **Remediation Systems**

  The GWETS is currently operated by H&S and appeared to be operational and in good condition. O&M manuals and monthly effluent sampling records were present onsite. The Site 3 IBS is also present within the GWETS system building (operated by Tetra Tech). The Site 3 IBS is operational and in good condition.

- **Site 3**

  The Site 3 wells appear to be generally in good condition and are accessible. Most wells are in flush-mount manholes; however, those located in the woods and along the edges of the parking lot are in standpipes. The standpipes in the parking lot are surrounded with steel bollards.

  A privately owned athletic field borders Site 3 to the south. The field is artificial turf and is not capped; however, the field is outside of the contamination zone. There are no occupants in any of the site buildings. Groundwater is not being used as drinking water. No major issues were identified during the Site 3 inspection in August 2013.

Supplemental to the site inspection in August 2013, the 2013 Annual LUC Report (Tetra Tech 24 October 2013) identified signs of trespassers including vandalism, fireworks debris, litter, cut fencing, and damaged fencing. The same LUC report also indicated onsite groundwater wells and offsite extraction wells are missing locks. Repairs will be conducted within the next inspection period as part of routine O&M activities. Repairs will be documented in annual O&M reports. No issues were identified during the LUC inspections to call the protectiveness of the remedy into question.

2.7 Technical Assessment

Technical assessment of Site 3 is addressed in this section.

2.7.1 Question A: Is the remedy functioning as intended by the decision documents?

The selected remedy for Site 3 consists of source area treatment using the IBS, continued operation of the GWETS, MNA, LUCs, and five-year reviews. The remedy is functioning as intended, as described below.

- **Remedial action performance (is the remedy operating as designed?)**

  The GWETS is operating as designed; containment is being achieved. The IBS is operating as intended after optimization of the injection design during implementation. The IBS will continue to be under evaluation through 2014. Once reducing conditions are established, degradation processes will accelerate, and progress toward ROD cleanup goals will be assessed. The LUCs for Site 3 are operating as designed and will continue to be evaluated annually. At present, the site buildings remain unoccupied.

- **System operations/O&M**

  Site 3 GWETS and IBS are presently operational and in good condition, and system operating procedures/data assessment procedures are sufficient to maintain the effectiveness of response actions. The monitoring well network is operational and will continue to be inspected annually.

- **Opportunities for optimization**

  The IBS and associated monitoring program underwent optimization during 2013 while a bioremediation zone developed downgradient of injection points. No opportunities for optimization at the GWETS were identified during this first five-year review. However, as with any LTM program, there is an ongoing LTM optimization effort to evaluate reductions in sampling frequency, sampling parameters, and sampling locations.

- **Implementation of institutional controls and other measures**

  No issues were identified during the LUC audits from 2012 or 2013 for Site 3. Security/fencing repairs were identified in the 2013 LUC inspection report, along with well maintenance activities; however, these are not a component of the LUC. Routine O&M addresses these repairs annually following identification of problems (if any) during LUC inspections. The Site 3 buildings remain unoccupied. Site 3 groundwater is not being used for potable purposes.

- **Early indicators of potential issues**

  There were no early indicators or potential issues identified that could call the protectiveness of the remedy into question. However, increasing trends were identified in monitoring wells BG-1B and source area well MW-13S. Background bedrock (and potentially deep overburden) monitoring well BG-1B currently exceeds project action limits; and concentrations of CVOCs are present in BG-1S screened in the shallow overburden. Discreet interval sampling methods should be considered in BG-1B to characterize the deep overburden and bedrock, alternatively, well abandonment and replacement with wells screened in the respective stratigraphic units should be considered.

  Local groundwater flow direction in bedrock is interpreted to the southeast and downgradient monitoring well MW-22R, located at the downgradient property boundary, contains trace amount of CVOCs. Additional well installations should be considered to evaluate the southeasterly groundwater flow component, and to further characterize groundwater between BG-1 and MW-22. These additional wells would evaluate the potential for CVOC migration in sufficient travel time to prevent offsite migration. Increasing trends identified in the source area should be monitored; however, the monitoring well network is sufficient to characterize migration from the source area and does not present a concern.

  Additional wells (MW-81I, MW-82S, and MW-83S) were proposed in the 2012 SAP to further characterize groundwater in the deep and shallow overburden downgradient of the extraction wells. The wells have not yet been installed.

  Emerging contaminant 1,4-Dioxane is a potential contaminant and is discussed in Section 2.7.4.

- **Vapor Intrusion Evaluation**

  Based on the concentrations of CVOCs in groundwater, there is a potential for VI at Site 3. Consequently, the existing LUCs include a restriction on building occupancy thereby mitigating unacceptable exposures.

2.7.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

The following elements were reviewed to assess the risk assessments performed for Site 3:

- **Changes in chemical, location, and action specific ARARs and to-be-considered criteria**

  The ARARs listed in the decision documents for Site 3 were reviewed for this five-year review, as were newly promulgated federal and state regulations. Primary components of the ARAR evaluation include:

  - Evaluation of location-specific ARARs
  - Evaluation of action-specific ARARs
  - Evaluation of chemical-specific ARARs for groundwater
  - New guidance regarding VI
  - New regulations regarding risk calculation
  - Evaluation of surface water criteria, relative to Elm Brook
  - Evaluation of discharge criteria, relative to the GWETS

  Location and Action Specific ARARs

  A review of all location- and action-specific ARARs for Sites 3 was conducted. No significant changes to ARARs were identified that render the current remedy unprotective.

  Chemical Specific ARARs

  The groundwater at NWIRP Bedford is designated as high use and value by the MassDEP (MassDEP, 15 October 1998). Therefore, SDWA MCLs, SDWA non-zero MCLGs, and MMCLs were used to develop remediation goals for this site. Table 2-6 presents the groundwater RGs from the Site 3 ROD and compares those cleanup levels to the most recently promulgated Massachusetts MCLs. Based on this comparison, there are no changes to the groundwater ARARs that would impact the Site 3 boundary definitions or groundwater-specific response actions.

Table 2-6
Groundwater Remediation Goals
Site 3 — Chlorinated Solvent Groundwater Plume
NWIRP Bedford, Massachusetts

Constituents of Concern	Record of Decision Groundwater Cleanup Level	Record of Decision Groundwater Cleanup Level Source	2014 Massachusetts Contingency Plan GW-1	GW-1 Note
1,1-Dichloroethene	7 µg/L	2010 MCL	7 µg/L	MMCL
1,1-Dichloroethane	70 µg/L	2009 ORSGL	70 µg/L	ORSGL
1,2-Dichloroethane	5 µg/L	2010 MCL	5 µg/L	MMCL
cis-1,2-Dichloroethene	70 µg/L	2010 MCL	70 µg/L	MMCL
1,1,2-Trichloroethane	3 µg/L	2010 MCLG	5 µg/L	MMCL
Tetrachloroethene	5 µg/L	2010 MCL	5 µg/L	MMCL
Trichloroethene	5 µg/L	2010 MCL	5 µg/L	MMCL
Vinyl chloride	2 µg/L	2010 MCL	2 µg/L	MMCL

Surface Water ARARs — Elm Brook

While surface water does currently not pose an unacceptable risk to human health and the environment, surface water is monitored as part of the LTM plan due to historical groundwater-to-surface water discharges. Surface water in Elm Brook is evaluated based on the relevant and appropriate requirements of the Clean Water Act and the National Recommended Water Quality Criteria (NRWQC) at 40 CFR 122.44 and Massachusetts Surface Water Quality Standards at 314 CMR 4.00, which incorporates the NRWQC requirements. At the time of the Site 3 ROD, the most recently published NRWQC table was from 2009 (U.S. EPA, 2009). The most current NRWQC values are now available online.[10]

Table 2-7 presents the surface water ARARs from 2009, and compares them to current NRWQC. There are no changes to the surface water ARARs that would impact Site 3 groundwater response actions.

[10] http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm (accessed January 2014)

Table 2-7
Surface Water ARARs
Site 3 — Chlorinated Solvent Groundwater Plume
NWIRP Bedford, Massachusetts

COC Requiring Action	ROD GW Cleanup Level	2009 SW ARAR	ARAR Source	HH NRWQC 2009*	Last NRWQC Update
1,1-Dichloroethene	7 µg/L	7,100 µg/L	NRWQC	7,100 µg/L	HH 2003
1,1-Dichloroethane	70 µg/L	70 µg/L	ORSG	—	—
1,2-Dichloroethane	5 µg/L	37 µg/L	NRWQC	37 µg/L	HH 2002
cis-1,2-Dichloroethene	70 µg/L	—	—	—	—
1,1,2-Trichloroethane	3 µg/L	16 µg/L	NRWQC	16 µg/L	HH 2002
Tetrachloroethene	5 µg/L	3.3 µg/L	NRWQC	3.3 µg/L	HH 2002
Trichloroethene	5 µg/L	30 µg/L	NRWQC	30 µg/L	HH 2002
Vinyl chloride	2 µg/L	2.4 µg/L	NRWQC	2.4 µg/L	HH 2003

Note:
* Recommended criteria may change per external review, draft of NRWQC which has not been finalized (comment period ended August 13, 2014)

GWETS Discharges

Discharges from the Site 3 GWETS were evaluated based on applicable requirements of the National Pollutant Discharge Elimination System (NPDES) standards at 40 CFR 122-125, 40 CFR 131, and Massachusetts Surface Water Discharge Permit Program requirements at 314 CMR 3.00 (discharges to surface water), 314 CMR 4.00 (surface water quality), and 314 MR 5.0 (discharges to groundwater).

GWETS discharges, however, are to ground surface, and impact neither surface water nor groundwater, although during RD potential impacts to surface water during high water events were considered. Therefore, ROD RGs and the NPDES standards are used as guides. Current O&M reporting should be reviewed for appropriate discussion/evaluation of effluent discharge. Table 2-8 shows both ROD groundwater cleanup levels and surface water ARARs and compares them to effluent concentrations in November 2013.

Table 2-8
Surface Water Discharge Limits
Site 3 — GWETS Discharge
NWIRP Bedford, Massachusetts

Analyte	Record of Decision Cleanup Level	Surface Water NRWQC	November 2013 Treated Effluent Concentration
1,1-Dichloroethene	7 µg/L	7,100 µg/L	< 0.67 µg/L
1,1-Dichloroethane	70 µg/L	70 µg/L	1.2 µg/L
1,2-Dichloroethane	5 µg/L	37 µg/L	< 0.35 µg/L
cis-1,2-Dichloroethene	70 µg/L	—	< 0.54 µg/L
1,1,1-Trichloroethane	—	—	< 0.94 µg/L
1,1,2-Trichloroethane	3 µg/L	16 µg/L	< 0.49 µg/L
Tetrachloroethene	5 µg/L	3.3 µg/L	< 0.61 µg/L
Trichloroethene	5 µg/L	30 µg/L	< 0.45 µg/L
Vinyl chloride	2 µg/L	2.4 µg/L	< 0.61 µg/L
Benzene	5 µg/L	51 µg/L	< 0.45 µg/L
Ethylbenzene	1,000 µg/L	2,100 µg/L	< 0.38 µg/L
Toluene	700 µg/L	15,000 µg/L	< 0.46 µg/L
Xylene	10,000 µg/L	—	< 0.41 µg/L
2-methylnaphthalene	150 µg/L	—	NA
Naphthalene	140 µg/L	140 µg/L	< 0.79 µg/L

(Data Source: H&S Environmental, 18 December 2013)

- **Changes in exposure pathways**

  With the possible exception of the emerging contaminant 1,4-dioxane (associated with former site constituent 1,1,1-TCA), new contaminants and/or contaminant sources (including remedy byproducts) are not anticipated. 1,4-Dioxane was not a routinely monitored parameter during the 1990s and early 2000s; it has been identified as an emerging contaminant associated with 1,1,1-TCA usage since that time. A SAP to include 1,4-dioxane will be prepared to assess the presence/absence of 1,4-dioxane at Site 3.

  Physical site conditions and the conceptual site model (CSM) have not changed in a way that could affect the protectiveness of the remedy.

- **Changes in toxicity and other contaminant characteristics and risk assessment methods**

  The baseline risk assessment (BRA) for Sites 3, SFTA and 4 were conducted concurrently in accordance with the U.S. EPA *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual* and other supplemental guidance (U.S. EPA, 1989, 1991, 1992). The risk assessments are described in both the Site 3 and Site 4 RODs, and are summarized briefly below:[11]

  - A BRA, including a human health risk assessment (HHRA) and ecological risk assessment (ERA) were initiated in 1996 for the whole of NWIRP Bedford and completed in 2000 during the Phase II RI (Tetra Tech, September 2000).

    — The HHRA assessed soil, groundwater, sediment, and surface water for the following scenarios: onsite workers (industrial) (surface soil, groundwater-to-indoor air), construction worker (surface and subsurface soil), trespassing teenager (soil, groundwater-to-indoor air), offsite resident (groundwater-to-indoor air, dermal contact with groundwater, incidental contact with groundwater), onsite resident (exposure to surface soil, drainage area sediment).

    — The ERA evaluated potential risk to terrestrial vertebrates (e.g., small mammals and birds), terrestrial invertebrates (e.g., earthworms), terrestrial plants, and aquatic life (fish and benthic invertebrates associated with Elm Brook). Exposure pathways 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.

[11] Risk is assessed holistically here for ease of discussion.

- In 2001, an HHRA Addendum (Tetra Tech, 01 October 2001) was conducted to account for the change in groundwater classification per the APD and Groundwater Use Value Determination Letter (MassDEP, 15 October 1998). The 2001 addendum included groundwater (assuming onsite residents ingested groundwater, as well as exposure to VOCs via inhalation during showering and dermal contact), relying upon the findings of the 1996 BRA for the other media evaluated. The HHRA Addendum also qualitatively evaluated the VI pathway qualitatively because risks were assumed to be minor relative to those estimated for the groundwater ingestion pathway. The 2009 Site 4 ROD utilizes the 2001 BRA addendum and the 2000 BRA/BERA in evaluating risk and determining COCs.

- In 2010, a supplemental risk evaluation for Site 3, which included the SFTA, was prepared to incorporate updated site conditions as defined during supplemental source area investigations.[12] The supplemental risk assessment evaluated all of the CVOCs detected in Site 3 groundwater using an onsite residential use scenario due to changes in aquifer designation as discussed in Section 1.4.3.

Risk assessment findings included:

- At Site 3, the HHRA identified unacceptable human health risks 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 onsite residential scenario.[13] Although the reasonably anticipated future land use scenario for NWIRP Bedford property is industrial, the identified residential risks associated with Site 3 groundwater warranted mitigation due to the Town of Bedford's APD and the state's GUVD (Section 1.4.3). The 2000 BRA completed for Site 3 in 2000 identified no unacceptable risks associated with soil, surface water, or sediment for current or expected future land use scenarios (onsite workers [industrial], construction workers, and trespassing teenagers). The residential scenario for surface soil and drainage area sediment was evaluated; subsurface soil was not evaluated, however, LUCs restrict residential development of the property.
- At Site 4, the HHRA indicated that future land use risks would exceed both carcinogenic and non-carcinogenic regulatory risk thresholds if groundwater within

[12] The supplemental risk assessment was submitted as part of the Final Site 3 FS (Tetra Tech, 29 June 2010) using May 2010 U.S. EPA RSLs and February 2010 groundwater data from the Site 3 source area.
[13] Note that the ESD identifies TCE as the only COC at SFTA.

the plume were to be used as drinking water in the future. The HHRA identified the primary contributor to carcinogenic risk as benzene, and the primary contributors to non-carcinogenic risk were 2-methylnaphthalene, benzene, ethylbenzene, and toluene in groundwater. The 2000 BRA completed for the Site 4 in 2000 identified no unacceptable risks associated with soil for current and expected future use scenarios (onsite workers [industrial], construction workers, and trespassing teenagers); source area excavation was primarily to facilitate the successful natural attenuation of COC concentrations in groundwater.[14] The Site 4 ROD indicates soil was not evaluated for the residential soil scenario; however, LUCs restrict residential development of the property.

- The ERA concluded that there is a very low potential for ecological risks at NWIRP Bedford for SFTA, Site 3 and Site 4.

The following observations were made during the five-year review risk assessment review:

- Remedial goals defined in the RODs for Site 3 and Site 4 (and the ESD for the SFTA) are primarily ARARs, which were used for remedy design and implementation as opposed to the risk assessment findings described above. Therefore, the protectiveness of the remedies is not sensitive to risk assessment changes.

- RAGS Parts E and F were published after most of the risk assessments for these sites were completed. Re-evaluation of risk is not warranted for the five-year review because the groundwater remedy uses ARARs, not risk, and no significant changes in approach were or would be affected by changes in risk assessment.

- Exposure model calculations and other inputs to risk calculations have changed since the initial risk assessments were performed. However, re-evaluation of risk is not warranted for the five-year review because the groundwater remedy uses ARARs, and (with the exception of VI) no significant changes in approach were identified. If it were necessary to re-evaluate risk for an UU/UE scenario (e.g., onsite residential use), current guidance would likely include scenarios not previously evaluated, such as VI, and would also include the following considerations:
  - Risk would also be evaluated using a cumulative risk approach.

[14] As noted in Section 4.4.4, no source area actions were required at Site 4, as soil was below industrial-based target benchmarks in predesign sampling events.

- Many constituents of potential concern(COPC)toxicity values (slope factors, etc.) have been updated since the initial risk assessment from 1996-2000, so toxicity factors have changed (e.g., TCE, arsenic, chromium, and various polycyclic aromatic hydrocarbons).

- Current U.S. EPA guidance recommends screening to identify COPCs using current U.S. EPA Regional Screening Level (RSL) tables based on a target risk of 1E-06 risk and an adjusted target hazard index of 0.1, which U.S. EPA first released in 2013 to account for cumulative risks.

- VI risk assessment methods have been updated by U.S. EPA in 2002 and again in April 2014. VI is discussed separately for Site 3, SFTA, and Site 4.

In summary, risk assessment findings at NWIRP Bedford were based on current and proposed future use assuming industrial or trespassing scenario could be complete in the future. LUCs have been implemented to prevent future residential land use, and ARARs were used to design the groundwater remedy. After this five-year review, it was determined that integrating new risk assessment guidance and updating risk calculations at this time would not increase or improve the protectiveness of site remedies and determined the remedy to be protective because the remedy is based upon ARARs and because LUCs are in place preventing residential development. The need to conduct additional risk assessments will be evaluated prior to any land use changes.

- **Expected progress towards meeting RAOs**

  As discussed in Section 2.6, the GWETS continues to contain contaminated groundwater and minimize impacts to Elm Brook, and data indicates that the IBS is establishing a biological treatment zone onsite. LUCs prevent consumption of contaminated groundwater and restrict property use. The remedy is functioning as intended and is progressing towards meeting RGs for groundwater.

Vapor Intrusion Evaluation

This Five-Year Review evaluated VI in accordance with U.S. EPA's *Supplement to the Comprehensive Five-Year Review Guidance: Assessing Protectiveness at Sites for Vapor Intrusion* (U.S. EPA, 14 November 2012).

Since the issuance of the Site 3 ROD in 2010, there have been changes to state regulations associated with triggering an assessment of the VI pathway; federal guidance has also been revised since ROD issuance. Massachusetts state guidance (WSC#-11-435 [MassDEP, 20 December 2011]) further describes state protocol for addressing VI; U.S. EPA also issued guidance in 2013.[15]

The 2011 Massachusetts guidance requires that VI assessments should be performed under the following conditions:

- When groundwater contaminant detections of volatile organic compounds (VOCs) within 100 feet of an occupied structure exceed 10 times the Massachusetts GW-2 Standards.

- When VOC detections in soil within the vadose zone are adjacent to (6 feet horizontally and 10 feet vertically) an occupied structure.

TCE concentrations in Site 3 groundwater exceed 10 times MassDEP screening levels for VI into indoor air (MCP GW-2 standard) for 1,1-DCE, cis-1,2-DCE, TCE, and VC, as shown in Table 2-9. No vapor screening has been performed at Site 3 to date. LUCs, however, prohibit building occupancy; therefore there is no potential risk associated with the VI pathway.

Table 2-9
Site 3 Vapor Intrusion Screening MassDEP Groundwater Screening Criteria (µg/L)

Constituent of Concern	Maximum Site 3 Groundwater Concentration (2013)	2014 Massachusetts Contingency Plan GW-2 Standard
1,1-Dichloroethene	1,400	80
1,1-Dichloroethane	610	2,000
1,2-Dichloroethane	18	5
cis-1,2-Dichloroethene	12,000	20
1,1,2-Trichloroethane	13	900
Tetrachloroethene	310	50
Trichloroethene	5,200	30
Vinyl chloride	2,900	2

[15] *Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air, External Review Draft* (U.S. EPA, 11 April 2013).

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

No information has been identified to call the protectiveness of the remedy into question.

NWIRP Bedford is excess property, thus it will be transferred as soon as the Navy obtains regulatory concurrence on the Operating Properly and Successfully Demonstration Report and identifies a buyer. The Navy is excessing the property with the LUC to prevent building occupancy and maintain industrial land use. If the Navy or a future owner of NWIRP Bedford decides to change land use, VI assessment and evaluation prior to the removal of the LUC restricting building occupancy would be required as stated in the LUC RD. Any change from industrial land use would also need to be evaluated using the same process.

No new or previously unidentified ecological risks, natural disaster impacts, or other information (not previously addressed in Question B) that could call into question the protectiveness of the remedy were identified. Regarding VI or protectiveness of the site remedy with respect to VI:

- The groundwater plume has not migrated during this five-year review period; concentration reductions due to active site remedial measures and MNA are ongoing.
- The water table has not risen/fallen or changed configuration substantially.
- No new information about aquifer lithology, utilities, building conditions, etc. has been identified which would change the CSM.

2.7.4 Summary of Technical Assessment

Site 3 does not present a current or future risk to human health or the environment as LUCs have been implemented to limit groundwater and vapor exposure, and restrict property use. Remedial actions have been implemented to (a) contain groundwater, prevent offsite migration, and prevent exposure to contaminated groundwater, and (b) treat onsite groundwater to reduce CVOCs through biological means. MNA was implemented for the remainder of the plume. The implemented remedy is functioning as intended and trends are generally decreasing. Additional evaluation of select locations with increasing trends, including upgradient well BG-1, should be conducted. Additional wells will be installed and included in future LTM to aid in the characterization of the deep and shallow plumes extending into the wetland area. Additional wells should be considered to evaluate the potential for southeasterly flow in bedrock.

1,4-Dioxane has been identified as an emerging contaminant and, as such, has not previously been analyzed. There is a potential for 1,4-dioxane to be present as 1,1,1-TCA is a former site constituent. The potential presence of this contaminant does not call into question the protectiveness of the remedy; however, it is recommended that a SAP be developed for sampling for 1,4-dioxane.

The 2013 Annual Land Use Control Report (Tetra Tech, 24 October 2013) identified signs of trespassers including vandalism, fireworks debris, litter, cut fencing, and damaged fencing. The same report also indicated onsite groundwater wells and offsite extraction wells are missing locks. Although these site features are not a component of the remedy, repairs should be conducted within the next inspection period per the LUC inspection recommendations. Repairs will be documented in the annual O&M reports.

2.8 Issues

No issues were identified that would affect the current or future protectiveness of the remedy.

2.9 Recommendations and Follow-up Actions

No issues were identified that would affect the current or future protectiveness of the remedy and therefore, no recommendations have been made.

2.10 Protectiveness Statement

The construction of the remedy at OU 1, Site 3, is complete and is protective of human health and the environment. Until such time that remedial goals are achieved, exposure pathways that could result in unacceptable risks are being controlled.

3.0 SFTA — SOUTHERN CHLORINATED SOLVENT GROUNDWATER PLUME

3.1 SFTA Introduction

NWIRP Bedford is divided into northern and southern sections that are separated by Hartwell Road (Figure 3-1). The SFTA comprises the southern portion of the base and is located south of Hartwell Road abutting Hanscom Field (Hanscom Air Force Base). Most of the buildings at the SFTA have been decommissioned and demolished and the site is vacant.

A small area of CVOC contamination, predominantly TCE, is present in bedrock groundwater in the south-central portion of the SFTA. The original source of the contamination has not been identified, and no remaining source of TCE has been found at the site.

SFTA COC
- Trichloroethene

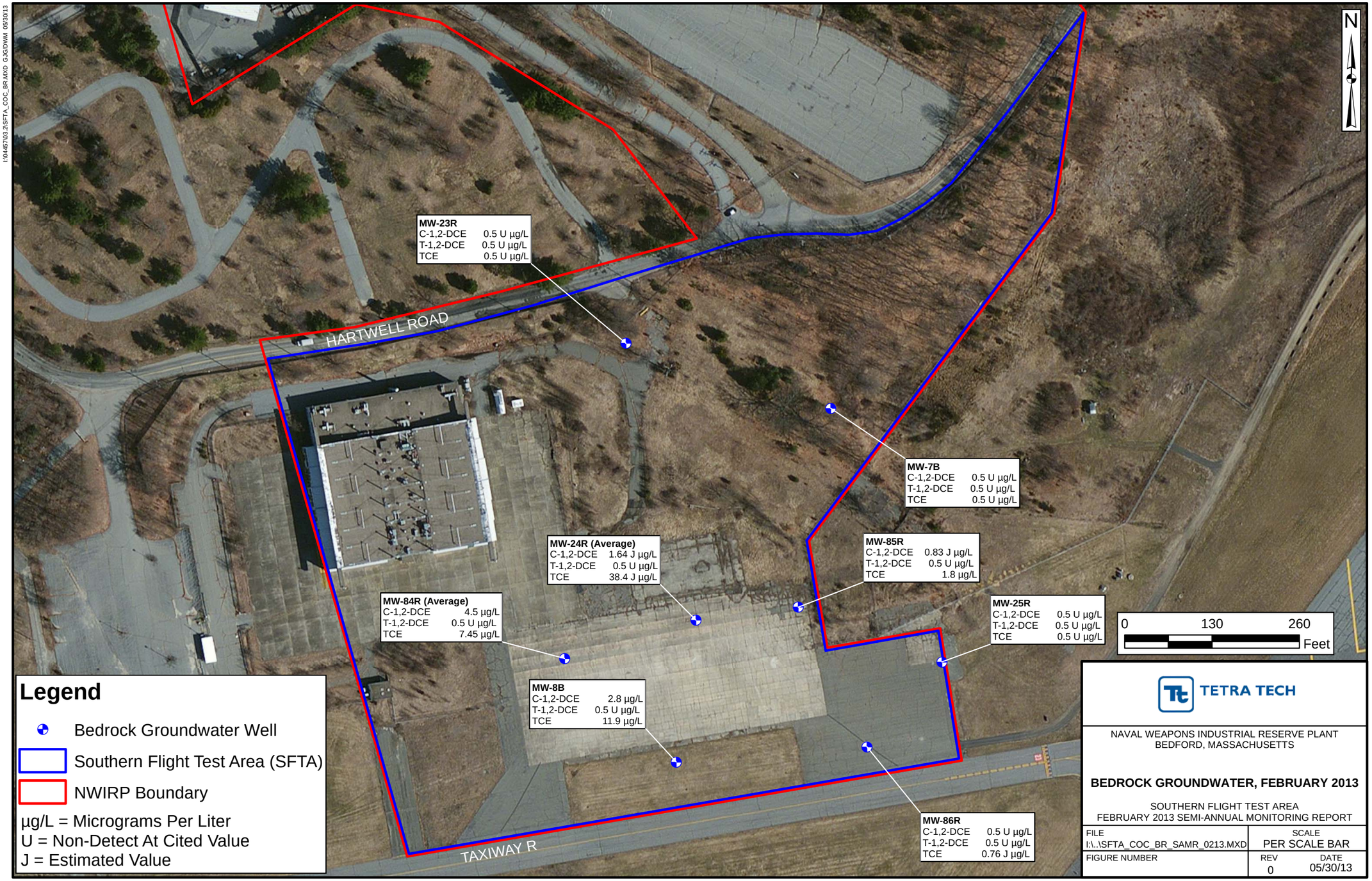
In March 2014, the Navy prepared an ESD for the Site 3 ROD which administratively incorporated the SFTA into the Site 3 remedy. In May 2014, a draft amended LUC RD was issued for Site 3, which included the SFTA.

The Navy is currently working to transfer the SFTA property. To evaluate the potential for the removal of the occupancy restriction component of the LUC, the Navy conducted a supplemental VI assessment in February 2013. The assessment determined that no complete pathway was present for VI. Based on these findings, the Navy is working in partnership with U.S. EPA and MassDEP to amend the LUC RD to remove the occupancy restriction component of the LUC at the SFTA. Modifications to the LUC RD for the SFTA are expected to be completed by the end of 2014.

3.2 SFTA Chronology

Dates for major events are presented in Table 3-1.

I:\0445703.2\SFTA_COC_BR.MXD GJG/DWM 05/30/13



TETRA TECH

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

BEDROCK GROUNDWATER, FEBRUARY 2013

SOUTHERN FLIGHT TEST AREA
FEBRUARY 2013 SEMI-ANNUAL MONITORING REPORT

FILE	SCALE
I:\..\SFTA_COC_BR_SAMR_0213.MXD	PER SCALE BAR
FIGURE NUMBER	REV 0 / DATE 05/30/13

Note: TCE is the COC, additional constituents are degradation products

FIGURE 3-1
SFTA TCE CONCENTRATIONS IN BEDROCK GROUNDWATER
FEBRUARY 2013
5-YEAR REVIEW
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: R. McCARTHY	DATE: 7/1/2014
DRAWN BY: N. RINEHART	TASK ORDER NUMBER: WE38

Service Layer Credits: Map taken from Tetra Tech and modified by EnSafe

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Table 3-1
Southern Flight Test Area Chronology

Date	Event	Additional Information
1985-1986	Initial Assessment Study (IAS)	In 1985, an IAS was conducted at the NWIRP Bedford, which identified a need for further investigation into potential contaminant sources in surface water and groundwater at the site (BCM Eastern, 01 April 1986). Subsequent studies identified the plumes that eventually became Site 3 and the Southern Flight Test Area (SFTA).
1989-1990	Phase I Remedial Investigation (RI)	The Phase I RI, conducted between 1989 and 1990 by Dames & Moore, determined that volatile organic compounds (VOCs), primarily chlorinated solvents, were present in onsite groundwater. The investigations also concluded that additional work was required to characterize the nature and extent of contamination.
1993-1997	Phase II RI	The Phase II RI (Tetra Tech, 01 September 2000) characterized the sources and extent of on- and offsite VOCs, including a chlorinated solvent plume associated with Site 3 (which included the SFTA). Inorganics (i.e., metals), semivolatile organic compounds, polychlorinated biphenyls, pesticides, and polycyclic aromatic hydrocarbons were either not detected or were found not to be a significant problem in groundwater. The Phase II RI included comprehensive human health risk assessment (HHRA) and ecological risk assessments (ERA) evaluating exposure to on- and offsite constituents of concern (COCs) associated with NWIRP Bedford. Soil gas sampling during the Phase 2 RI did not identify any onsite sources at the SFTA.
31 May 1994	National Priorities List	U.S. EPA listed NWIRP Bedford on the National Priorities List.
1998-present	Semiannual Monitoring	Groundwater has been monitored since 1989. Since 2002, the SFTA has been on a semiannual monitoring schedule. Long-term monitoring (LTM) reports continue using a monitoring network similar to the one established as part of the RI.
15 October 15 1998	Groundwater Use Value Determination (GUVD)	The Commonwealth of Massachusetts established an Aquifer Protection District (APD) at NWIRP Bedford based on a drinking water source groundwater classification per the 15 October 1998 GUVD letter (MassDEP, 15 October 1998). The GUVD and APD prompted the Navy to conduct a risk evaluation addendum that was completed in 2001 along with the Supplemental Phase II RI.
May 1998	Supplemental Work Plan	Work Plan for investigations to supplement the findings of the Phase 2 RI
30 September 1999	Federal Facilities Agreement (FFA)	An FFA was executed by the Navy and U.S. EPA on 30 September 1999. MassDEP is not party to the FFA; however, in accordance with CERCLA and the NCP, MassDEP has participated in ongoing discussions and strategy sessions, as well as provided oversight and guidance through their review of the Navy IR Program documents.
January 2000	Supplemental RI Report	Groundwater sampling conducted to assess possible SFTA source. Low level CVOCs were detected, no source was identified.
2000-2001	Supplemental Phase II RI/Baseline HHRA Addendum and ERA	Final Phase II RI and Site 3 (including the SFTA) Supplemental Investigation further detailed the previous RI activities and presented the results of an HHRA and ERA for NWIRP Bedford. Qualitative evaluation of the vapor intrusion (VI) pathway was presented.

Table 3-1
Southern Flight Test Area Chronology

Date	Event	Additional Information
August 2008	Memorandum of Understanding (MOU)	The Navy and Air Force signed an MOU which provides for information sharing between the Navy and Air Force regarding groundwater quality at the SFTA and Hanscom Air Force Base.
2013-2014	Site 3 Explanation of Significant Differences (ESD)	An ESD was finalized for the Site 3 Record of Decision (ROD) to incorporate the SFTA. U.S. EPA signed the Navy ESD on 14 March 2014. The major components of the selected remedy for the SFTA include the following: • Monitored Natural Attenuation (MNA) and LTM • Land use controls • Five-year reviews There have been no remedy modifications (ROD amendments).
2013-2014	Vapor Intrusion Evaluations	A VI study was performed in 2013 at the SFTA. Based on the findings of the VI assessment, the final LUC Remedial Design (LUC RD) eliminated the occupancy restriction component of the LUC.
2014	Site 3 and SFTA LUC RD	The Navy is working in partnership with U.S. EPA and MassDEP to update the LUC RD to remove occupancy restrictions at the SFTA, as vapor investigations determined TCE concentrations were so low that the pathway was incomplete. However, all other elements of the LUC RD will remain the same (see Section 1.5). Modifications to the LUC RD are anticipated to occur in 2014.

3.3 SFTA Background

The SFTA was first identified as a potential source of contamination in the IAS in 1986. The Navy identified four IR sites to be addressed under CERCLA at NWIRP Bedford. The SFTA was not identified as an IR program site, but the area was investigated during the RI. Contamination in groundwater was confirmed at the SFTA during the RI conducted in the early 1990s.

In 2008 a Memorandum of Understanding (MOU) was signed by the Navy and Air Force. The purpose of the MOU was to provide for the sharing of groundwater quality data generated from the SFTA and neighboring Hanscom Air Force Base.

3.3.1 General Site Description

The SFTA is located south of Hartwell Road abutting Hanscom Field (Hanscom Air Force Base) and currently consists of the Flight Test Facility, the Deluge Pump Station, a guard house, small storage building and parking lot. The Flight Test Facility is surrounded on three sides with a concrete apron with access to the taxiways and runways of Hanscom Field.

The 1990 Phase I Supplemental Investigation included groundwater and soil gas sampling. The investigation identified detections of TCE in two soil gas samples (near the highest area of groundwater concentrations) and CVOCs in bedrock groundwater. In 1992, supplemental soil gas

investigations were conducted along the northeast portion of the SFTA to identify a source area. No target CVOCs were identified in any of the samples (Tetra Tech, 2013).

In 1998, three additional monitoring well clusters were installed to further characterize the vertical and horizontal extent of CVOCs in groundwater (targeting overburden and bedrock). Target CVOCs were not identified in the new overburden wells above trace levels. No CVOCs were identified in the upgradient bedrock monitoring well. In 2013, three additional monitoring wells were installed in shallow bedrock to provide characterization of the plume.

Low levels of TCE remain present in bedrock groundwater above the RG. TCE was detected at a historical maximum concentration of 250 µg/L in 1993 (Table 3-2); TCE's maximum concentration in February 2013 was 38.4 µg/L. The COC concentration map from the February 2013 groundwater sampling event is provided as Figure 3-1.

Table 3-2
SFTA Historical Groundwater Maximum/Current Maximum Concentrations (µg/L)

COC	Historic Maximum/Location		Current Maximum/Location	
TCE	250	MW-24R	38.4	MW-24R

(Data Source: Tetra Tech, 1 August 2013)

TCE concentration trends are decreasing. The observed concentration decreases may be due to several factors, including natural biological degradation, and also may be positively affected by a groundwater treatment system operated by the Air Force on the abutting property. Groundwater modeling performed by the Air Force shows a portion of the SFTA is within the capture zone of the extraction system, which influences the migration of contaminated groundwater at the SFTA.

3.3.2 History of Contamination

Operations at the SFTA included the fabrication and test prototype equipment for missile guidance and control systems and associated support operations, which included the handling of hazardous materials. After extensive record review, the Navy found no record of hazardous materials discharge.

3.3.3 Initial Response Actions

Following identification of CVOCs in groundwater, the initial response was to conduct periodic groundwater sampling to identify the magnitude and extent of contamination at the SFTA.

As source area investigations did not identify an onsite source and decreasing trends were observed, no additional response actions were performed.

3.3.4 Basis for Taking Remedial Action

Unacceptable human health risks were identified for exposure to TCE in SFTA groundwater. Risks include non-cancer hazards and cancer risk for a hypothetical future onsite residential scenario (groundwater ingestion). Although the reasonably anticipated future land use scenario for NWIRP Bedford property is industrial, the identified residential risks associated with the SFTA warrant mitigation due to the Town of Bedford's APD and the state's GUVD. The LUC RD conservatively includes a component of the LUC to prevent residential development of the facility to mitigate exposure to soil.[16]

3.4 Remedial Actions

This section outlines the selected remedy for the SFTA.

3.4.1 Remedy Selection

The ESD established MNA, LTM, and LUCs as the remedy for the SFTA.

3.4.2 Remedial Action Objectives

The RAOs from the Site 3 ROD applicable to the SFTA are:

- Mitigate identified unacceptable risks to human health associated with the use of SFTA groundwater as a drinking water supply
- Prevent the use of onsite groundwater for human consumption until groundwater cleanup levels have been achieved on site.

The groundwater at the site is designated as high use and value by the MassDEP. Therefore, SDWA MCLs, SDWA non-zero MCLGs, and MMCLs were used to develop the SFTA RG to be achieved throughout the dissolved-phase plume. The ROD RG for the SFTA groundwater was selected as the most stringent standard of the federal and state drinking water MCLs and non-zero MCLGs, as shown in Table 3-3.

[16] No soil source has been identified at the SFTA but in the event residential land use is considered this pathway will be further evaluated, as required by the combined LUC RD for Sites 3 and SFTA.

Table 3-3
Remediation Goals — Southern Flight Test Area

Constituents of Concern Requiring Action	Explanation of Significant Differences Cleanup Level	Established via ROD per ESD
Trichloroethene	5 µg/L	2010 MCL

3.4.3 Remedy Description

Per the March 2014 ESD, the selected remedy for Site 3 was expanded to include components applicable to the SFTA. The following components were identified in the ESD and LUC RD:

- MNA of TCE in bedrock groundwater at the SFTA
- LUCs
- Five-year reviews

3.4.4 Remedy Implementation

LUCs were implemented via ESD in March 2014; LUC elements are summarized in Section 1.5. The Navy will perform all short and long term implementation actions at the SFTA per *The Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-ROD Action* (Department of Defense, 2003), the FFA, the ROD, the ESD, and applicable Navy directives. The Navy may in the future delegate or transfer authority to conduct these actions to another entity as part of property transfer agreements. Annual LUC inspections will be conducted.

MNA has been demonstrated by decreasing groundwater trends based on semiannual monitoring data.

Long Term Monitoring:

Groundwater monitoring has been conducted periodically since approximately 1989; semiannual monitoring has been conducted since 2002. Per the March 2014 SAP Addendum, semiannual monitoring of bedrock groundwater is conducted at select wells at the SFTA to evaluate the effectiveness of natural attenuation of the COC. Monitoring will be conducted until COC concentrations meet the RG.

Wells are currently sampled for TCE and its degradation products cis-1,2 DCE and trans-1,2 DCE. The ESD indicates that a SAP will be developed to sample for the site COC (TCE), geochemical (MNA) parameters, and degradation products.

3.5 Progress Since Last Review

This is the first five-year review of the SFTA.

3.6 Five-Year Review Process

3.6.1 Document Review

The historical documents and events from the 1986 IAS, the RI initiated in the 1990s, through to the ESD that was finalized and signed in 2014, as well as the LUC RD finalized in May 2014 are summarized in Table 3-1 and in Sections 3.2 through 3.4 of this document. The following sections present the relevant site data review and the site inspection associated with the current five-year review period ending in January 2014.

3.6.2 Data Review and Evaluation

The following data have been reviewed for assessment of the SFTA remedies:

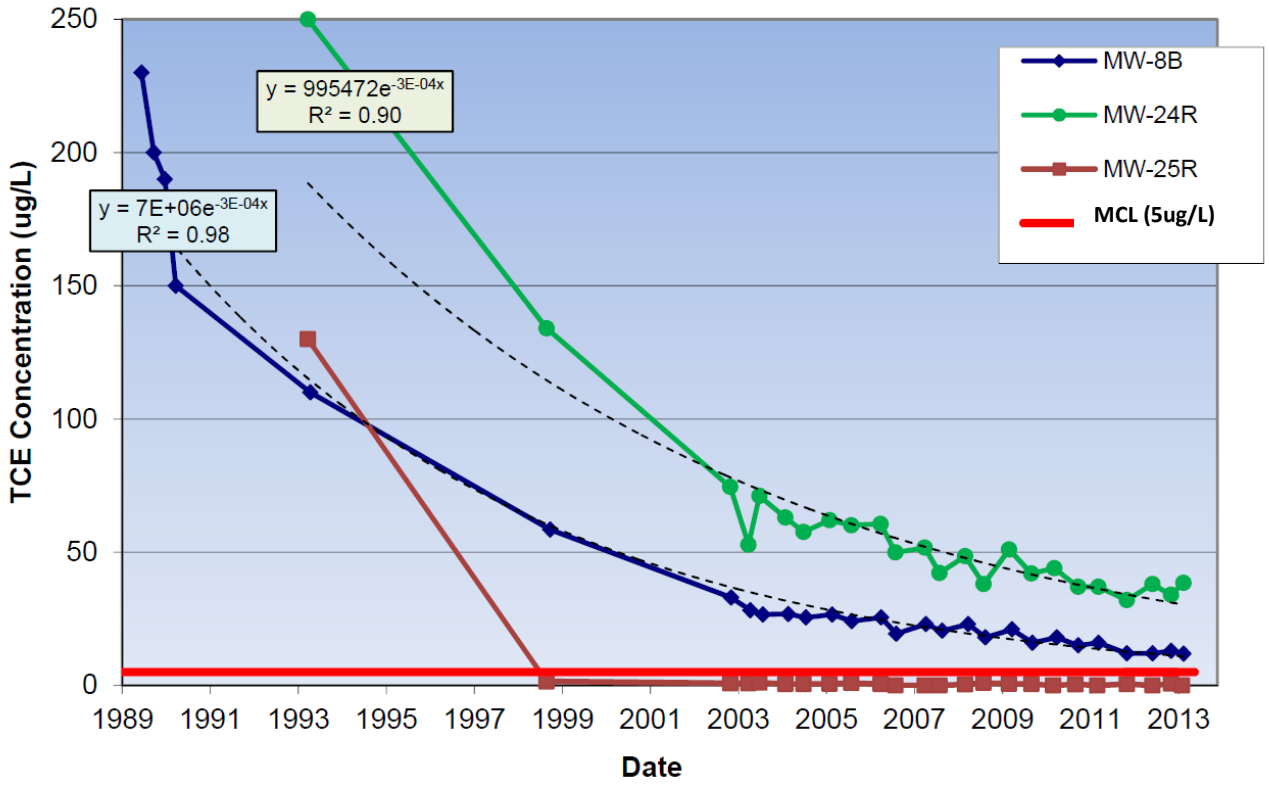
- LTM data (to gauge the effectiveness of MNA)
- SFTA soil gas data

Groundwater Monitoring at SFTA — Long Term Monitoring:

Historically, three wells were sampled on a semiannual frequency for COCs in groundwater (Tetra Tech, 25 October 2012). The sampling event completed in February 2013 (Tetra Tech, 01 May 2013) included five additional wells based on a supplemental SAP prepared for the VI study at the SFTA (Tetra Tech, 01 January 2013). A SAP Addendum was prepared in March 2014 (Tetra Tech, 12 March 2014) which increased the number of wells to six and added MNA parameters.

Groundwater contaminant concentration and trend data are available from 1989 through 2013 in three wells at the SFTA; overall the trend for TCE is downward based on trend graphs, Seasonal Kendall, and Mann-Kendall evaluations. The February 2013 SFTA Groundwater Report includes the cumulative groundwater data collected at SFTA sample locations since 1993; groundwater trends are provided in Appendix F. Figure 3-2 presents groundwater trends over time for TCE in bedrock wells at MW-8B, MW-24R, and MW-25R.

Figure 3-2 Trend Graph for TCE Concentrations in Bedrock Groundwater at SFTA



(Source: Tetra Tech, May 2013)

Degradation by-products indicate that biodegradation of TCE to cis-1,2-DCE is occurring. Concentrations of cis-1,2-DCE remain below MMCLs. Historical sampling data were non-detect for VC; however, concentrations of final end-products such as chloride were found to be highest at MW-24R during the February 2013 sampling event.

Overall bedrock water quality is generally favorable for biotic attenuation of TCE. The DO levels are less than 0.5 mg/L. ORP levels are low enough that a reductive pathway to biodegrade CVOCs is still viable (less than +50 millivolts [mV]). The groundwater pH is within the desired range for natural attenuation through biodegradation. MW-24R exhibited elevated methane, suggesting conditions in this area may be very anaerobic. Other geochemical parameters, such as ferrous iron, also suggest that the aquifer is anaerobic (Tetra Tech, 01 August 2013). Low levels of dissolved organic carbon (less than 20 mg/L) were evidenced and may act to slow the overall rate of attenuation (Tetra Tech, 01 August 2013).

Soil Gas Data

The February 2013 sampling event at SFTA included supplemental soil gas sampling which is reported in the *Supplemental Groundwater and Soil Gas Sampling Report* (Tetra Tech, 01 August 2013). The outcome of the VI analysis demonstrates that should VI occur, the low levels of VOCs in groundwater would not result in unacceptable risk from indoor air exposure, and would be within U.S. EPA applicable incremental lifetime cancer risk and non-cancer hazard index and MassDEP protective requirements.

TCE was detected in six of seven soil gas samples, at a maximum concentration of 4.78 micrograms per cubic meter ($\mu g/m^3$). A 95 percent upper confidence interval for soil gas was calculated based on the 7 sample results. The estimated upper confidence limit and maximum result were compared to a VI screening level estimated from May 2012 U.S. EPA RSLs using an attenuation factor of 0.1 for soil gas and sub-slab gas, based on the U.S. EPA RAGS and U.S. EPA VI guidance. Only one of those samples (SG2) exceeded the adjusted residential screening level of 4.3 $\mu g/m^3$, but it did not exceed the U.S. EPA adjusted industrial screening level of 30 $\mu g/m^3$.

Neither cis-1,2-DCE nor trans-1,2-DCE were detected in soil gas samples. Soil gas concentrations were highest on the west side of the groundwater plume, in soil gas samples SG2 and SG3, which were located adjacent to underground utility lines. Utility lines are believed to connect to a single line heading toward the Flight Test Facility; however, the soil gas sample near that single utility line was found to have only a low concentration of TCE that did not exceed the RSL (Tetra Tech, 01 August 2013).

It should be noted that the attenuation factor used between sub-slab and indoor air in the 2013 evaluation (0.1) was conservative. The *Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air, External Review Draft* (U.S. EPA, 11 April 2013) recommends an attenuation factor of 0.03. Using this attenuation factor, the maximum concentration quantified at the SFTA (4.78 µg/m^3) is significantly below the industrial screening criteria of 100 µg/m^3 for sub-slab soil gas, indicating the pathway is incomplete.

Actual exposure risks are expected to be lower than those discussed above, as existing structures (a) do not coincide with TCE detections, and (b) new construction in the SFTA is unlikely due to the proximity of this area to the Hanscom Air Force Base flight line. Based on the findings of the VI assessment, the Navy is working in partnership with U.S. EPA and MassDEP to update the LUC RD to remove occupancy restrictions at the SFTA, as vapor investigations determined that the pathway was incomplete. Modifications to the LUC RD are anticipated to be completed by the end of 2014.

3.6.3 Site Inspection and Interviews

A site inspection was conducted on 12 August 2013. Representatives of facility management (H&S) and the CLEAN contractor were present. The site inspection included the following activities:

- Tour and inspection of SFTA area and Old Hangar facilities including monitoring wells, parking lots, and fencing.

- Interviews with facility manager (Mr. Bob Santosuosso, H&S) and Jim Ropp (Tetra Tech) regarding operations and status of facilities.

Appendix D includes the Site Inspection Checklist and site figures used as part of the walk through and Appendix E includes the photo log taken during the walk through.

The SFTA is currently not occupied and there is no residential development. The Navy uses the hanger occasionally for Navy SEAL aircraft storage. All wells were located and in good condition. Landscaping around the wells is being maintained and the wells are accessible. Wells are marked with flagging for visibility. Wells have flush-mount manholes. The temporary chain-link fence has been taken down and is laying on the edge of the property. However, the site is within the perimeter fence and security zone of the airport so it is protected from the public.

Supplemental to the site inspection in August 2013, the 2013 Annual LUC Report (Tetra Tech 24 October 2013) identified signs of trespassers including vandalism, fireworks debris, litter, cut fencing, and damaged fencing. The same LUC report also indicated onsite groundwater monitoring wells are missing locks. Repairs will be conducted within the next inspection period as part of routine O&M activities. Repairs will be documented in annual O&M reports. No issues were identified during the LUC inspections to call the protectiveness of the remedy into question.

3.7 Technical Assessment

The technical assessment the SFTA is addressed in this section.

3.7.1 Question A: Is the remedy functioning as intended by the decision documents?

The SFTA remedy (MNA, LUCs, and five-year reviews) is functioning as intended, as described below.

- **Remedial action performance (is the remedy operating as designed?)**
  The well monitoring network is operational and MNA will continue for the SFTA. The LUCs for SFTA are operating as designed and will continue to be evaluated annually, and at present the site facilities remain unoccupied.

- **System operations/O&M**
  SFTA has no mechanical systems requiring operation. The SFTA well monitoring network is operational and will continue to be inspected annually.

- **Opportunities for optimization**
  Following finalization of the ESD in March 2014, the Navy is developing a LTM plan for the SFTA which will optimize the monitoring network as well as include protocols for optimization over the long term.

- **Implementation of institutional controls and other measures**
  No issues were identified during the LUC audits from 2012 or 2013 for the SFTA. Security/fencing repairs were identified in the 2013 LUC inspection report; however, routine O&M addresses these repairs annually following identification of problems (if any) during LUC inspections. Those SFTA buildings which remain (e.g., have not been demolished) are unoccupied and groundwater is not being used for drinking water.

- **Early indicators of potential issues**

  There were no early indicators or potential issues identified that could call the protectiveness of the remedy into question. Perfluorinated compounds (PFCs) have been identified as a potential emerging contaminant and are discussed in Section 3.7.2.

- **Vapor Intrusion Evaluation**

  Based on the VI assessment conducted at the SFTA, no unacceptable exposure to vapor is present.

3.7.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

The following elements were reviewed to evaluate the risk assessments performed for SFTA:

- **Changes in chemical, location, and action specific ARARs and to-be-considered criteria**

  The ARARs listed in the decision documents for SFTA were reviewed for this five-year review, as were newly promulgated federal and state regulations, using the methodology described in Section 2.7.2. The 2014 ESD did not identify any new ARARs or changes to ARARs for the SFTA.

  Location and Action Specific ARARs

  A review of all location- and action-specific ARARs for the SFTA was conducted. No significant changes to ARARs were identified that render the current remedy unprotective.

  Chemical Specific ARARs/Groundwater ARARs

  Table 3-4 presents the groundwater cleanup levels from the SFTA and compares those cleanup levels to the most recently promulgated Massachusetts MCLs. Based on this comparison, there are no changes to the groundwater ARARs that would impact the SFTA boundary definitions or groundwater-specific response actions. Note that TCE degradation products were not identified as having remedial goals in the SFTA ESD; however, it is assumed that degradation products in the monitoring suite (e.g., cis-1,2-DCE) would be evaluated as necessary using Site 3 remediation goals (see Table 2-3), due to the administrative link between the two sites.

Table 3-4
Groundwater Remediation Goals
Southern Flight Test Area (Southern Plume)
NWIRP Bedford, Massachusetts

Constituent of Concern Requiring Action	ESD Groundwater Cleanup Level	ESD Groundwater Cleanup Level Source	2014 MCP GW-1	GW-1 Note
Trichloroethene	5 µg/L	2010 MCL	5 µg/L	MMCL

- **Changes in exposure pathways**

  Firefighter training activities occurred on Hanscom Air Force Base adjacent to the SFTA; it is possible that PFCs were released during the use of aqueous film forming foam. Because of the high solubility of PFCs and their mobility in groundwater it is possible that PFC migration onto the SFTA has occurred. Therefore, a SAP should be prepared to include for sampling and analysis of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). Other than PFCs, new contaminants and/or contaminant sources (including remedy byproducts) are not anticipated.

  Physical site conditions and the CSM have not changed in a way that could affect the protectiveness of the remedy.

- **Changes in toxicity and other contaminant characteristics and risk assessment methods**

  The evaluation of SFTA HHRA documents is discussed in Section 2.7.2. This five-year review concluded that updating risk assessment calculations using current methodology would not change the site remedy at the SFTA because the remedy is contingent upon ARARs and because LUCs are in place preventing residential development.

- **Expected progress towards meeting RAOs**

  The groundwater concentrations demonstrate a decreasing trend and TCE is continuing to attenuate toward cleanup goals. LUCs prevent exposure to contaminated groundwater and restrict property use. The remedy is functioning as intended and progressing towards meeting RGs.

Vapor Intrusion Evaluation

The final VI study at SFTA concluded there is not a complete VI pathway; therefore, the Navy is working in partnership with U.S. EPA and MassDEP to remove building occupancy restrictions from the LUC RD; these changes are anticipated to be complete by the end of 2014.

The VI study identified TCE in six of seven soil gas samples, at a maximum concentration of 4.78 µg/m^3. Using the U.S. EPA's Vapor Intrusion Screening Level (VISL) calculator for indoor air, assuming a target cancer range of 1E-06 and a target hazard quotient of 1.0, the maximum concentration did not exceed the conservative sub-slab industrial soil gas screening level of 30 µg/m^3.[17] Because the calculated risk level, should VI occur, is below the regulatory target range of 1E-04 to 1E-06 for cancer risks and the benchmark of 1.0 for noncancer hazard, the VI pathway does not pose a unacceptable risk at SFTA (Tetra Tech, 01 August 2013).

Compared to the MassDEP screening criterion for TCE, maximum groundwater concentrations in the SFTA are less than 10 times the GW-2 standard, as shown in Table 3-5.

Table 3-5
Southern Flight Test Area
MassDEP Groundwater Screening Criteria for Vapor Intrusion (µg/L)

Constituent of Concern	Maximum Groundwater Concentration (2013)	2014 GW-2 Standard
Trichloroethene	38.5	30

The MNA remedy, with LUCs in place, is protective. The VI study demonstrated that once occupancy restrictions are removed, activities at the SFTA will continue to be protective because there is no vapor threat based on the low soil gas concentrations.

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

Similar to the Site 3 information discussed in Section 2.7.3, no additional information has been identified which could be used to question remedy protectiveness at the SFTA.

3.7.4 Summary of Technical Assessment

The SFTA does not present a current or future risk to human health or the environment. MNA is ongoing. LUCs have been implemented to limit access to groundwater, vapor exposure, and restrict property use.

PFCs, specifically PFOA and PFOS, have been identified as emerging contaminants and have not previously been analyzed. Because of historical firefighting training on the property adjacent to

[17] http://www.epa.gov/oswer/vaporintrusion/guidance.html. It should be noted that the VISL calculator uses a conservative attenuation factor of 0.1 between sub-slab and indoor air. The *Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air, External Review Draft* (U.S. EPA, 11 April 2013) recommends an attenuation factor of 0.03. Even using this less conservative attenuation factor, the maximum concentration quantified at the SFTA is significantly below the screening criteria of 100 µg/m^3, indicating the VI pathway is incomplete.

SFTA, there is a potential for PFOA and PFOS to be present in groundwater. The potential presence of PFCs does not call into question the protectiveness of the remedy; however, it is recommended that a work plan be developed for sampling for PFOA and PFOS.

The 2013 Annual Land Use Control Report (Tetra Tech, 24 October 2013) identified signs of trespassers including vandalism, fireworks debris, litter, cut fencing, and damaged fencing. The same report also indicated onsite groundwater wells and offsite extraction wells are missing locks. Although these site features are not a component of the remedy, repairs should be conducted within the next inspection period per the LUCs inspection recommendations. Repairs will be documented in the annual O&M reports.

3.8 Issues

No issues were identified that would affect the current or future protectiveness of the remedy.

3.9 Recommendations and Follow-up Actions

No issues were identified that would affect the current or future protectiveness of the remedy and therefore, no recommendations have been made.

3.10 Protectiveness Statement

The construction of the remedy at OU 1 SFTA is complete and is protective of human health and the environment. Until such time that remedial goals are achieved, exposure pathways that could result in unacceptable risks are being controlled.

4.0 SITE 4 — BTEX PLUME

4.1 Site 4 Introduction

Site 4 is located in the northern portion of NWIRP and is a BTEX Plume associated with the former Transportation Building's vehicle maintenance activities and its former UST (Figure 4-1). The former Transportation Building was immediately south of the Antenna Range Building (the slab location is shown on the aerial in Figure 1-2). The dissolved-phase BTEX plume in groundwater extends to an off-property wetland area by Elm Brook. The majority of Site 4 is co-located and co-mingled with the Site 3 plume.

Site 4 COCs

- Benzene
- Toluene
- Ethylbenzene
- Xylene
- 2-Methylnaphthalene
- Naphthalene

The Site 4 ROD was finalized and signed in 2009, requiring excavation for soil and MNA for the groundwater plume. A PDI in March 2010 to delineate the extent of BTEX in soil resulted in no additional excavation being warranted and the Navy continued with the MNA portion of the remedy only. Remedial action monitoring activities are ongoing.

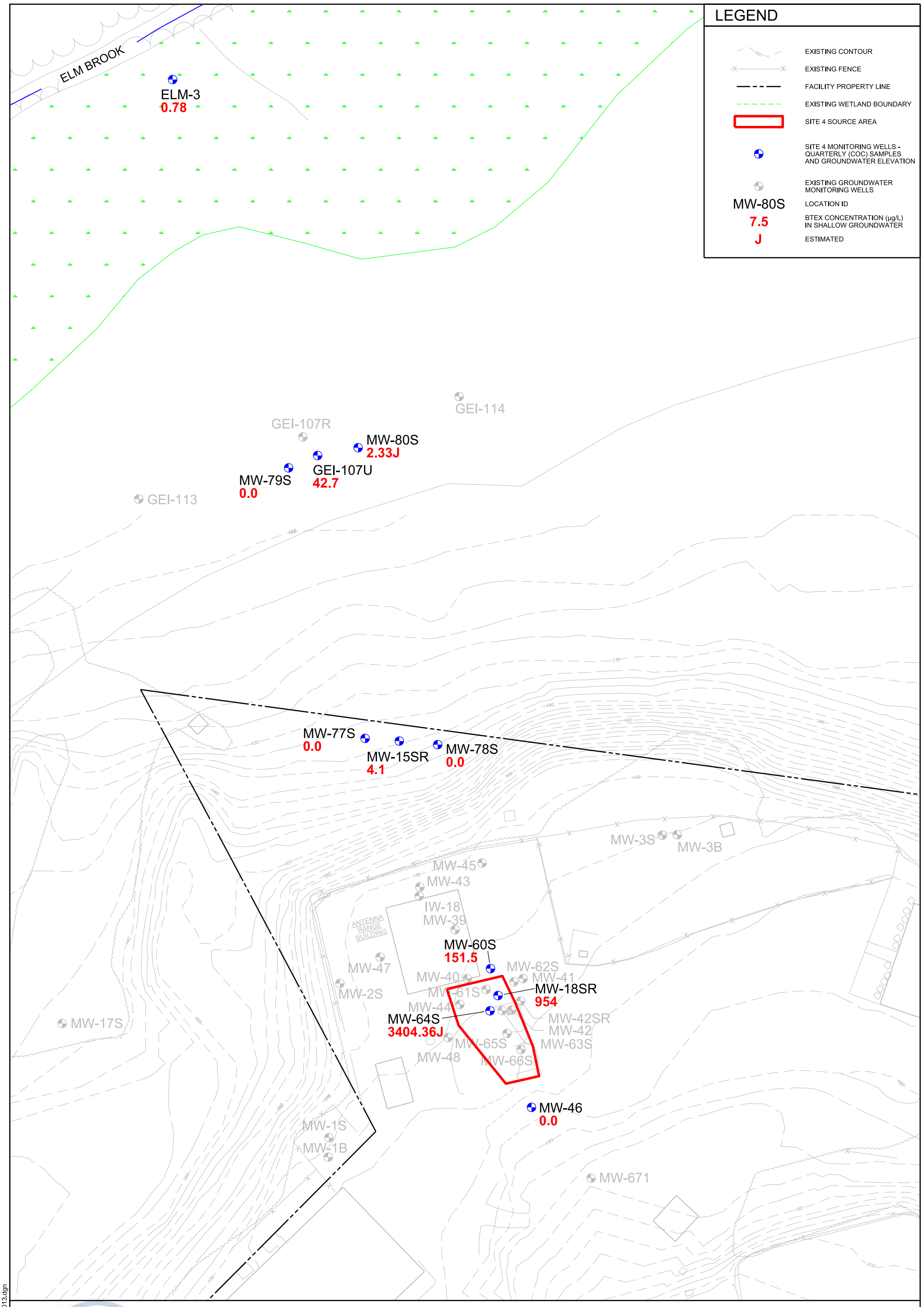
4.2 Site 4 Chronology

Site 4 was first identified as a potential source of contamination in the IAS in 1986. CERCLA investigations were conducted through the 1990s. Investigations identified a narrow BTEX plume in groundwater that migrated to the north down the slope of Hartwells Hill to an off-property wetland area. Dates for major events at the site are presented in Table 4-1.

4.3 Site 4 Background

A ROD for Site 4 was signed in September 2009. Concurrence with the 2009 ROD from MassDEP is presented in Appendix G.

A Draft-Final RD for Site 4 was prepared in August 2010 (Tetra Tech, 19 August 2010). The PDI was conducted in March 2010. Based on the soil and groundwater analytical data collected, the PDI determined that soil concentrations of COCs were low, groundwater contamination had a decreasing trend, and groundwater RGs were nearly achieved. As the purpose of additional source area excavation was to aid in achieving groundwater cleanup goals in a reasonable timeframe via MNA, the excavation was no longer warranted. Because the ROD had sufficient flexibility with regard to additional source excavation, the Navy (in partnership with U.S. EPA and MassDEP) agreed no ROD Amendment or ESD was required in response to this finding.



FILENAME: Figure 3-2 Sept 2013.dgn

AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL JOINT VENTURE

SITE 4
TOTAL BTEX CONCENTRATIONS IN GROUNDWATER
SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

FIGURE 4-1
SITE 4 TOTAL BTEX IN GROUNDWATER
SEPTEMBER 2013
5-YEAR REVIEW
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: R. McCARTHY	DATE: 6/27/2014
DRAWN BY: N. RINEHART	TASK ORDER NUMBER: WE38

Service Layer Credits: Map taken from AGVIQ Environmental Services CH2M HILL Joint Venture

Table 4-1
Site 4 Chronology

Date	Event	Additional Information
1985-1986	Initial Assessment Study (IAS)	In 1985, an IAS was conducted at the Naval Weapons Industrial Reserve Plant (NWIRP) Bedford, which identified a need for further investigation into potential contaminant sources in surface water and groundwater at the site (BCM Eastern, 01 April 1986). Subsequent studies identified the plume that eventually became Site 4.
1988-1989	Underground Storage Tank (UST) Removal Action	The UST and associated piping were subsequently removed in December 1988 and January 1989 along with approximately 75 to 100 cubic yards of contaminated soil. These actions were documented in a 31 January 1989 letter, from Brian Balukonis of Raytheon to Elizabeth Callahan of the Massachusetts Department of Environmental Quality Engineering; the letter stated that further evaluation of this UST should take place under the Installation Restoration (IR) program.
1989-1990	Phase I Remedial Investigation (RI)	The Phase I RI, conducted between 1989 and 1990 by Dames & Moore, determined that volatile organic compounds, including benzene, toluene, ethylbenzene, and xylene (BTEX), were present in onsite groundwater. The investigations also concluded that additional work was required to characterize the nature and extent of contamination.
1993-1997	Phase II RI	A Phase 2 RI was conducted between 1994 and 1997 and a risk assessment conducted during the RI Phase II Addendum Report (Tetra Tech, 01 September 2000) identified no risks in excess of United States Environmental Protection Agency's (U.S. EPA) guidelines for the exposure pathways evaluated. The Phase 2 RI recommended a feasibility study for Site 4.
31 May 1994	National Priorities List (NPL)	U.S. EPA listed NWIRP Bedford on the NPL.
15 October 1998	Groundwater Use Value Determination (GUVD)	The Commonwealth of Massachusetts established an aquifer protection district (APD) at NWIRP Bedford based on a drinking water source groundwater classification per the 15 October 1998 GUVD letter. The GUVD and APD prompted the Navy to conduct a risk evaluation addendum that was completed in 2001 along with the Supplemental Phase II RI.
30 September 1999	Federal Facilities Agreement (FFA)	An FFA was executed by the Navy and U.S. EPA on 30 September 1999. Massachusetts Department of Environmental Protection (MassDEP) is not party to the FFA; however, in accordance with the Comprehensive Environmental Response Compensation and Liability Act and the National Contingency Plan, MassDEP has participated in ongoing discussions and strategy sessions, as well as provided oversight and guidance through their review of the Navy IR Program documents.
2000-2001	Baseline Human Health Risk Assessment Addendum and Ecological Risk Assessment	Subsequent to submitting a final Feasibility Study (FS) in March 2001, the Navy completed an addendum to the 2000 baseline risk assessment presented in the RI Phase II Report. A qualitative evaluation of Vapor Intrusion (VI) pathway was also presented.
2000-2002	Removal Action — In Situ Chemical Oxidation (ISCO)	Three rounds of oxidant injection were conducted from 2000 to 2002 and the changes in groundwater concentrations were monitored. Since benzene has the longest cleanup time and the lowest regulatory standard (5 µg/L), the removal action goal was based on benzene. Modeling of BTEX concentrations in groundwater indicated that reducing benzene concentrations to 300 µg/L or less in the source area would achieve the cleanup goals. Although the ISCO treatment reduced contaminant concentrations, the desired cleanup goal was not achieved throughout the site treatment area (Tetra Tech, August 2008). Therefore, additional remedial measures were deemed appropriate to achieve the Site 4 removal action goal.

Table 4-1
Site 4 Chronology

Date	Event	Additional Information
2003-2004	Removal Action — Electrical Resistance Heating (ERH)	The Navy implemented ERH in an approximate 25 by 50 foot area (target depth: 10 to 28 feet bgs) to continue the Site 4 source area response action. Within the treatment area, BTEX concentrations in groundwater were reduced by 82.2 to 99.7 percent. Monitoring results immediately following the treatment indicated that benzene concentrations were below 50 µg/L in all but one well, MW-66S, which was located outside the treatment area (Tetra Tech, September 2008).
2008	Monitored Natural Attenuation (MNA) Evaluation	Four sampling events determined observed rebound in the Site 4 plume groundwater was due to the release of soil-bound BTEX, which was not removed during the prior source area treatments (Tetra Tech, September 2008). Prior remedial actions were found to have altered groundwater geochemistry and slowed MNA processes.
2008	FS Addendum	The FS was modified to include excavation as an additional source area removal option (Tetra Tech, August 2008).
28 September 2009	Site 4 Record of Decision (ROD)	U.S. EPA signed the Navy ROD on 28 September 2009. The major components of the selected remedy for Site 4 include the following: • Selective excavation of the source area, based on the results of pre-design investigation sampling with onsite treatment of the excavated soil using bioremediation (biopiles) or offsite disposal • Onsite treatment and discharge of water from the excavation (if soil dewatering is required) via the existing groundwater treatment system at NWIRP Bedford • Potential application of enhanced bioremediation in the excavated source area • MNA/Long-term monitoring (LTM) • Land Use Controls • Five-year reviews There have been no remedy modifications (explanations of significant differences or ROD amendments).
2010	Site 4 Remedial Design (RD)	The Navy commenced the Draft RD and conducted a pre-design investigation in March 2010 to delineate the extent of BTEX in source area soil for subsequent excavations. Based on those results, it was determined that additional source area excavation was not warranted to support the MNA portion of the remedial action (Tetra Tech, 12 October 2010).
2011	Site 4 Land Use Controls (LUC) RD	Established LUC performance objectives and monitoring requirements for prohibiting the use of site groundwater, prohibiting residential redevelopment of the site, restricting site building occupancy (includes annual compliance/ inspection and reporting), and maintaining the remedial action components (e.g., monitoring well network).
2011 to present	Site 4 LUC and LTM	Annual Site 4 LUC inspections started in 2011 and quarterly Site 4 groundwater LTM reports started in 2012. Monitoring well locations that represent upgradient groundwater, the COC source area, mid-plume locations (i.e., downgradient of the source area), and the plume fringe are collected on a quarterly and semiannual basis for benzene, toluene, ethylbenzene, and 2-methylnaphthalene in order to determine when groundwater cleanup has been achieved. Total xylenes and naphthalene data are collected for informational purposes. MNA parameters are sampled semiannually from a subset of the wells, with a focus on the plume centerline, but also at selected upgradient, downgradient, and lateral locations to evaluate the potential for natural attenuation of COC concentrations in groundwater. Groundwater contaminant concentration and trend data are available from 1993 through 2013 in many wells. Overall the trend for benzene and total BTEX is downward in all but a few locations (near source). Issues with the LUC inspections are limited to minor repairs; the facilities remain unoccupied.

The Navy, U.S. EPA and MassDEP agreed, per meeting minutes from 20 April 2011 that the "remedy in-place" status may be considered accomplished after the first sampling event when

MNA parameters were collected in September 2011. The 2012 Site Management Plan (Tetra Tech, 01 September 2011) formally documented this decision for the Navy and the U.S. EPA in accordance with the FFA.

The Navy is currently conducting the MNA remedy at Site 4 and installed additional monitoring wells in September 2012 to verify that the BTEX groundwater plume is reaching cleanup goals (Tetra Tech, September 2013). The Site 4 LUC RD was drafted in August 2011 and included a prohibition of building occupancy in addition to restrictions on residential use, on intrusive activities/excavations, and groundwater use; annual LUC inspections began in December 2011. LTM, MNA evaluation of groundwater, and surface water monitoring began in 1997.

4.3.1 General Site Description

Site 4 consists of a dissolved-phase plume of BTEX, naphthalene, and 2-methylnaphthalene in shallow overburden groundwater (Table 4-2). Historically, the 0.75-acre plume extended from its source area located in the northern portion of NWIRP by the Antenna Range Building and the former Transportation Building into an off-property wooded wetland area. The Navy has completed remedial actions in a 2,500-square foot source area including tank removal and excavation, in situ chemical oxidation (ISCO), and electrical resistance heating (ERH). Current groundwater monitoring data and trends indicate that the extent of the Site 4 plume has diminished over time. Groundwater sampling results through September 2013 for shallow overburden groundwater, potentiometric contours, and total BTEX isocontours are presented in Appendix H.

Table 4-2
Site 4 Historical/Current Groundwater Maximum Concentrations (µg/L)

Constituents of Concern	Historical Maximum/Location		Current Maximum/Location	
Benzene	3,200	MW-18S	28	GEI-107U
Toluene	49,000	MW-18S	23	MW-18SR
Ethylbenzene	78,000	MW-18S	1,400	MW-64S
Xylene	40,000	MW-18S	2,000	MW-64S
2-Methylnaphthalene	1,300	MW-18S	34	MW-18SR
Naphthalene	2,500	MW-18S	120	MW-18SR

(Data Source: AGVIQ/CH2MHILL 19 December 2013)

4.3.2 History of Contamination

The contamination at Site 4 is due to a combination of former Transportation Building operations and a leaking UST (as noted previously, the Transportation Building was located immediately south

of the Antenna Range Building; both are shown on Figure 1-2). The Transportation Building was constructed in 1961 and was demolished in November 2001. The building was used for equipment storage and vehicle maintenance. Based on the observation of oil staining, it is possible that some waste petroleum may have been released to the ground from garage operations. The Site 4 plume is also due to a leaking pump from a 7,600-gallon UST located adjacent to the former Transportation Building. In 1984, the UST failed a tightness test; the amount and duration of the discharge is unknown. Initial response actions were implemented in December 1988 and January 1989.

4.3.3 Initial Response Actions

First Removal Action: The UST and associated piping were removed in December 1988 and January 1989 along with approximately 75 to 100 cubic yards of contaminated soil. During the tank removal, soil in the vicinity of the UST was removed vertically down to the water table (located approximately 18.5 feet bgs), and over an area extending to the edge of the former Transportation Building. It is likely that contaminated soil remained below the foundation; however, to avoid structural impacts, the excavation did not extend beneath the building. After the removal action, the state indicated further investigation of the UST was warranted.

Second Removal Action: In 2000, the Navy proactively implemented ISCO in the Site 4 source area in an effort to expedite COC reduction. Since benzene has the lowest regulatory standard (5 µg/L), the removal action goal was based on benzene. Modeling of BTEX concentrations in groundwater indicated that reducing benzene concentrations to 300 µg/L or less in the source area would significantly expedite achieving groundwater RGs. The timeframe of achieving RGs was not specified (Tetra Tech, September 2008).

ISCO was conducted from 2000 to 2002 and the changes in groundwater COC concentrations were monitored. The remedial action was implemented in three phases:

- Phase 1 — from November 2000 through January 2001, concentrating on the area extending from the UST to MW-18S; injections were followed by two rounds of performance monitoring. While the majority of wells exhibited a decrease in BTEX concentrations, rebound was noted in MW-18S.
- Phase 2 — from June through December 2001, supplemental injections and performance monitoring was performed. Four wells remained above the performance monitoring goal: MW-18S, MW-42, MW-44, and MW-45.

- Phase 3 — a final ISCO treatment was performed in February 2002, again followed by two rounds of supplemental performance monitoring. Four source area wells (MW-18S, MW-40, MW-42, and MW-44) and one well on the edge of the source area (MW-45), remained above the 300 µg/L removal action goal.[18] Supplemental source delineations after treatment identified an additional well, MW-65, above the goal.

Although ISCO reduced contaminant concentrations, the desired cleanup goal was not achieved throughout the site treatment area (Tetra Tech, August 2008). Therefore, additional remedial measures were taken.

Third Removal Action: In 2003, the Navy conducted a third removal action involving in situ thermal treatment of the Site 4 source area. The Navy implemented ERH in an approximate 25- by 50-foot area (target depth, 10 to 28 feet bgs) to continue the Site 4 source area response action. The objective for the Site 4 ERH treatment was to achieve a benzene concentration of 50 µg/L in groundwater. The desired temperature of approximately 100 degrees Celsius was achieved and maintained for 16 days. Within the treatment area, BTEX concentrations in groundwater were reduced by 82.2 to 99.7 percent. Monitoring results immediately following the treatment indicated that benzene concentrations were below 50 µg/L in all but one well (MW-66S, located outside the treatment area) (Tetra Tech, 2008).

Monitored Natural Attenuation Assessment: An MNA assessment report was issued in September 2008. During four sampling events conducted from 2005 to 2007, total BTEX concentrations in source area well MW-18SR were relatively stable at approximately 1,850 µg/L, with both benzene (up to 86.3 µg/L) and ethylbenzene (up to 806 µg/L) exceeding RGs (5 µg/L and 700 µg/L, respectively). Subsequent groundwater monitoring events through 2009 indicated that BTEX concentrations rebounded since the thermal treatment. It was determined at that time that some of the observed rebound in groundwater BTEX concentrations was due to the release of soil-bound BTEX, which was not removed during the source area treatments. The MNA assessment concluded that degradation in the source area had been less effective after the removal actions (excavation, ISCO, and ERH), possibly due to repeated short-term disturbances to the geochemical environment (Tetra Tech, September 2008). Microbial activity in the source area was expected to become re-established over the long term.

[18] In an effort to enhance treatment in the vicinity of the source area, the Transportation Building was demolished in November 2001 prior to the final phase of this removal action.

The MNA evaluation concluded that BTEX degradation had occurred under aerobic conditions in the past, but currently was occurring via iron and manganese reduction processes, though localized wells (e.g., MW-18S/SR) exhibited more deeply anaerobic conditions.[19] Calculated attenuation and biodecay rates suggested that biological degradation accounted for 33 percent of the concentration reductions observed along the BTEX plume axis (Tetra Tech, 2008 September).

4.3.4 Basis for Taking Remedial Action

The HHRA and subsequent addenda indicated that potential risks would exceed both carcinogenic and non-carcinogenic regulatory risk thresholds if, in the future, groundwater within the plume were to be used as drinking water. Although the reasonably anticipated future land use scenario for NWIRP Bedford property is industrial, the HHRA's approach was warranted due to the Town of Bedford's APD and the state's GUVD. Onsite soil was found to meet remedial goals for industrial workers under dermal contact and ingestion scenarios, and was deemed protective for current and expected future use (industrial) scenarios. The residential soil exposure scenario was not evaluated; however, LUCs prevent residential use of the property

4.4 Remedial Actions

This section outlines the selected remedy for Site 4.

4.4.1 Remedy Selection

U.S. EPA signed the Navy's Site 4 ROD on 28 September 2009. There have been no remedy modifications (explanations of significant differences or ROD amendments).

4.4.2 Remedial Action Objectives

The ROD identified the following RAOs for Site 4:

1. Eliminate potential future risks to humans using groundwater from Site 4 as a drinking water supply by restoring the aquifer to drinking water quality by reducing COC concentrations to below federal and state MCLs and federal non-zero MCLGs, or if an MCL or MCLG is not available for a chemical, reducing COC concentrations to below a site-specific risk-based cleanup level.
2. Minimize or eliminate the migration of COCs from the source area to the groundwater plume by reducing COC concentrations in the source area.

[19] Both methane and hydrogen data from MW-18S/SR suggested methanogenic conditions.

The groundwater at Site 4 is designated as high use and value by the MassDEP. Therefore, SDWA MCLs, SDWA non-zero MCLGs, and MMCLs were used to develop RGs. ROD remediation goals for Site 4 groundwater were selected as the more stringent standards of the federal and state drinking water MCLs and non-zero MCLGs, as shown in Table 4-3.

Table 4-3
Groundwater Remediation Goals — Site 4

Constituent of Concern Requiring Action	Record of Decision Cleanup Level	Record of Decision Note
Benzene	5 µg/L	2009 MCL
Ethylbenzene	1,000 µg/L	2009 MCL
Toluene	700 µg/L	2009 MCL
2-Methylnaphthalene	150 µg/L	2001 RBC

Xylene and naphthalene were not identified as COCs during the risk assessment, and therefore did not have RGs established in the ROD. However, they are monitored for informational purposes during LTM and are compared to ARARs identified in the ROD, as shown below:

- Xylene — 10,000 µg/L (2009 MCL)
- Naphthalene — 140 µg/L (Massachusetts Office of Research and Standards Guideline)

4.4.3 Remedy Description

RAs at Site 4 were identified in the 2009 Site 4 ROD. These actions consisted of the following components:

- Selective excavation of the source area, based on the results of PDI sampling with onsite treatment of the excavated soil using bioremediation (biopiles) or offsite disposal
- Onsite treatment and discharge of water from the excavation (if soil dewatering was required) via the existing groundwater treatment system at NWIRP Bedford
- Potential application of enhanced bioremediation in the excavated source area
- MNA/LTM
- LUCs
- Five-year reviews

4.4.4 Remedy Implementation

Pre-Design Testing: The Navy commenced the Draft RD and conducted a PDI in March 2010 to delineate the extent of BTEX in source area soil. The March 2010 sampling event confirmed that source area COC concentrations have been significantly reduced in soil and were not greater than target benchmarks. Based on those results, it was determined that additional source area excavation was not warranted; this decision is documented in the 2012 Site Management Plan (Tetra Tech, 01 September 2011) and Partnering Team minutes from 12 October 2010 (Tetra Tech, 16 February 2011).

Long Term Monitoring: The Navy implemented the monitoring (LTM/MNA) portion of the RA and per the 2009 ROD; compliance with cleanup goals is anticipated within 5 to 10 years. Quarterly monitoring of the Site 4 groundwater plume began in 2012; however data are available for some locations since 1993. The most recent event at the time of report preparation was held in September 2013 (AGVIQ-CH2MHill, 28 January 2014). Every other year, the annual report also includes a more detailed assessment of MNA to verify that COC concentrations are attenuating at a rate that is acceptable to the project team and to more accurately predict timeframes for site remediation. The 2013 LTM Report was being developed at the time of this five-year review.

4.5 Progress since Last Review

This is the first five-year review of Site 4.

4.6 Five-Year Review Process

4.6.1 Document Review

The historical documents and events from the 1986 IAS, the RI initiated in the 1990s, through to the ROD that was finalized and signed in 2009, the RD from 2010 to 2012, and implementation of the RA in 2012 as summarized in Table 4-1 and in Sections 4.2 through 4.4. The following sections present the relevant site data review and the site inspection associated with the current five-year review period ending in January 2014.

4.6.2 Data Review and Evaluation

LTM data were evaluated to assess remedy performance.

Semi-annual groundwater sampling was completed from 2002 through 2012, when a formal LTM/MNA program was initiated. Starting in 2012, monitoring well locations that represent upgradient groundwater, the COC source area, mid-plume locations (i.e., downgradient of the source area), and the plume fringe were collected quarterly (select wells are sampled less

frequently) for benzene, toluene, ethylbenzene, and 2-methylnaphthalene in order to determine when groundwater cleanup has been achieved. Total xylenes and naphthalene data were also collected for informational purposes. MNA parameters are sampled semiannually from a subset of the wells, with a focus on the plume centerline, but also at selected upgradient, downgradient, and lateral locations to evaluate the potential for natural attenuation of COC concentrations in groundwater.

Groundwater trends from 1997 through 2013 for Site 4 are available in Appendix H. The September 2013 Site 4 Groundwater Report (AGVIQ-CH2MHill, 28 January 2014) includes the cumulative groundwater data collected at Site 4 sample locations since 1997 through the third quarter sampling event for 2013. Groundwater is sampled quarterly. Once per year, the monitoring reports include more detailed evaluations consistent with the Navy's guidance for monitoring reports.

Groundwater RGs were exceeded in three wells during the September 2013 sampling event: GEI-107U, MW-18SR, and MW-64S.

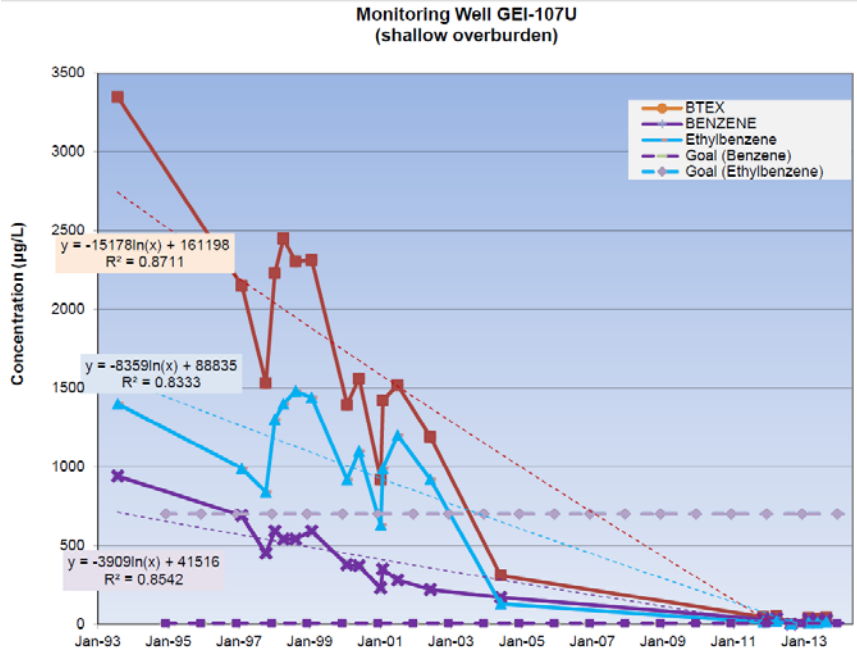
- At downgradient well GEI-107U, shown in Figure 4-2, the detected concentration of benzene exceeded the cleanup goal (5 µg/L) with a concentration of 28 µg/L. The total BTEX concentration at GEI-107U was 42.7 µg/L.

- At source area well MW-18SR, shown in Figure 4-3, the detected concentration of benzene exceeded the cleanup goal (5 µg/L) with a concentration of 11 µg/L. The total BTEX concentration at MW-18SR was 954 µg/L.[20]

- At source area well MW-64S, shown in Figure 4-4, the detected concentration of ethylbenzene exceeded the cleanup goal (1,000 µg/L) with a concentration of 1,400 µg/L. Benzene was detected at 0.76 µg/L and the total BTEX concentration at MW-64S was 3,404 µg/L.

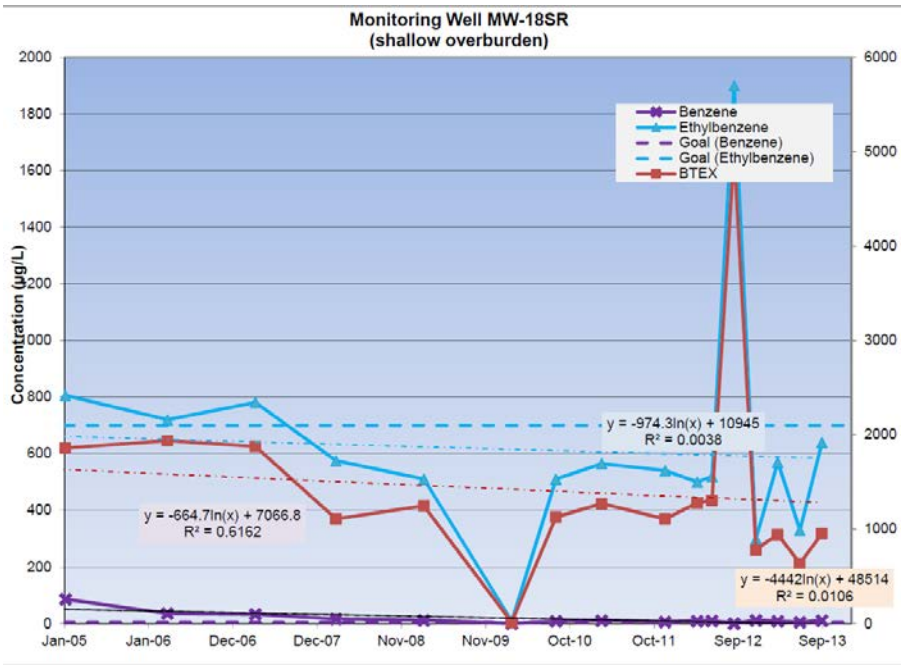
[20] Please note that in Figure 4-3, BTEX is shown on a secondary Y-axis to better demonstrate trends without losing data resolution.

Figure 4-2 Groundwater BTEX Trends GEI-107U 1997-2013



(Source: AGVIQ-CH2MHill, 28 January 2014)

Figure 4-3 Groundwater BTEX Trends MW-18SR Since 2005-2013

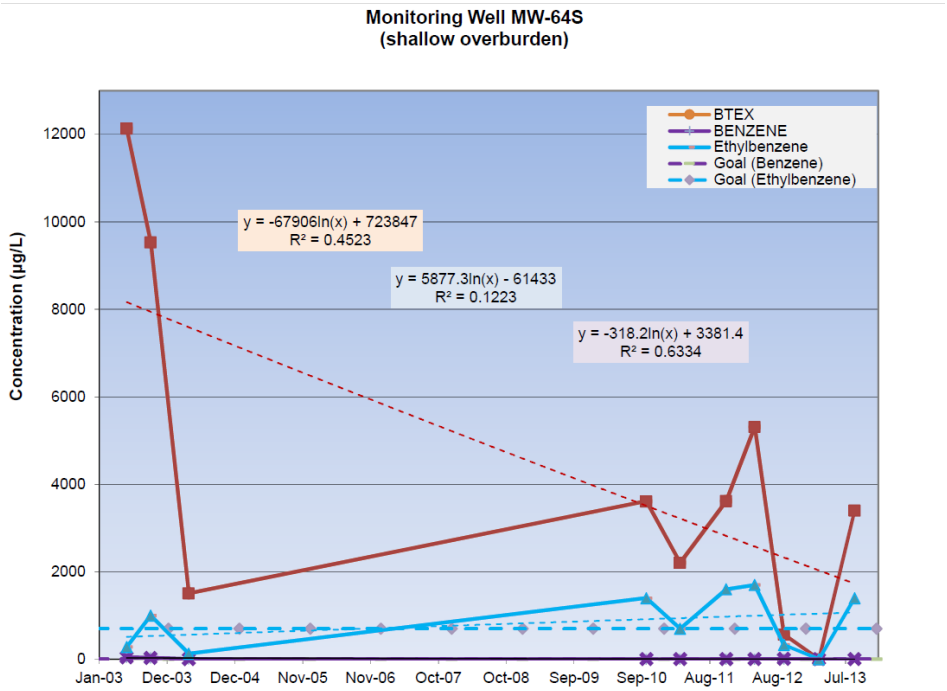


(Source: AGVIQ-CH2MHill, 28 January 2014)

Note:

BTEX is shown on a secondary Y-axis to better demonstrate trends without losing data resolution.

Figure 4-4 Groundwater BTEX Trends MW-64 2003-2013



(Source: AGVIQ-CH2MHill, 28 January 2014)

However, at mid-plume well MW-15SR, shown in Figure 4-5, the detected concentration of ethylbenzene and toluene were 2.4 µg/L and 1.7 µg/L, respectively. Benzene was not detected and the total BTEX concentration at MW-15SR was 4.1 µg/L.

Graphical analyses of BTEX concentration trends show that COC concentrations are generally decreasing in wells GEI-107U, MW-18SR, MW-64S, and MW-15SR. Continued monitoring is warranted throughout the plume area.

Table 4-4 summarizes the final purge volume, purge time, temperature, pH, specific conductivity, DO, ORP, turbidity, and flow rate for each of the Site 4 wells sampled during the September 2013 sampling event. Readings at monitoring well MW-64S in the Site 4 source area exhibited a low DO concentration (0.08 mg/L) and negative ORP value (-154.6 mV). Well MW-18SR, the other source area well sampled, also exhibited a low DO concentration (0.09 mg/L) and negative ORP (-81.8 mV). These parameters are consistent with past findings in the Site 4 source area, which suggest that anaerobic degradation of BTEX is occurring and that current geochemical conditions in the source area (ORP less than -50 mV) confirm mildly reducing conditions favorable for BTEX degradation.[21] Dissolved manganese and ferrous iron were measured in the field; carbon dioxide, total and dissolved iron, total and dissolved manganese, methane, nitrate, nitrite, sulfate, and sulfide were analyzed in the laboratory (AGVIQ-CH2MHill, 28 January 2014).

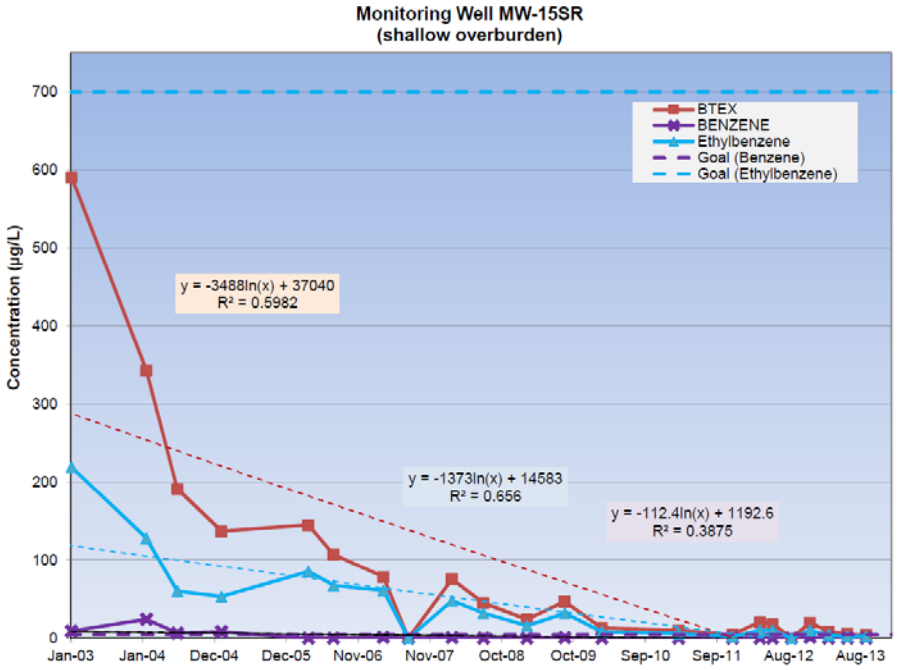
4.6.3 Site Inspection and Interviews

A site inspection was conducted on 12 August 2013. Representatives of facility management (H&S) and the CLEAN contractor were present. The site inspection included the following activities:

- Tour of onsite buildings and evaluation of LUCs (signs of occupancy)
- Tour and inspection of Site 4 monitoring wells, parking lots, fencing
- Interviews with the facility manager (Mr. Bob Santosuosso, H&S) and Jim Ropp (TetraTech) regarding operations and status of facilities

[21] The MNA evaluation (Tetra Tech, August 2008) indicated that BTEX degradation was occurring via iron and manganese reduction.

Figure 4-5 Groundwater BTEX Trends MW-15SR 2003-2013



(Source: AGVIQ-CH2MHill, 28 January 2014)

Table 4-4
Site 4 Groundwater Quality Data — September 2013

Well	Total Purge Volume (Liters)	Total Purge Time (minutes)	Color	pH	Specific Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature (°C)	Oxidation-Reduction Potential (mV)
ELM-3	12.5	45	Clear	5.98	0.137	1.46	0.36	12.93	4.70
GEI-107U	6	30	Clear	6.13	0.513	1.66	2.00	11.07	-20.40
MW-15SR	1.5	18	Very turbid	6.10	0.336	>1000	0.85	13.83	24.20
MW-18SR	5.4	30	Clear	6.59	0.505	1.02	0.09	14.29	-81.80
MW-46	14	98	Clear	6.16	0.881	6.34	0.25	17.07	32.50
MW-60S	6	31	Clear	6.25	0.355	7.47	0.31	14.35	-12.40
MW-64S	11	35	Clear	6.70	0.570	7.92	0.08	13.86	-154.60
MW-77S	9.5	56	Clear	5.96	0.353	1.13	1.27	12.35	45.20
MW-78S	4.75	34	Clear	5.94	0.133	3.78	1.63	13.66	47.10
MW-79S	14.5	51	Clear	5.96	0.295	0.36	0.61	12.95	-1.80
MW-80S	14.5	50	Clear	6.00	0.360	1.48	0.85	12.96	99.60

(Source: AGVIQ-CH2MHill, 28 January 2014)

Appendix D includes the Site Inspection Checklist and site figures used as part of the walk through and Appendix E includes the photo log taken during the walk through.

While some Site 4 wells are in poor condition (e.g., missing bolts or cracked well cover) these wells are not included in the Site 4 monitoring program. All Site 4 wells monitored during LTM have been identified as being in serviceable condition and data from the monitoring well network has not been compromised. The Navy will make all appropriate repairs to the monitoring well network to ensure the highest quality data continues to be obtained during LTM.

The Site 4 wells are difficult to locate due to landscaping not being maintained; several have been overgrown with bushes, vines, and grasses. Most wells are in flush-mount manholes; those located in the woods and along the edges of the parking lot are in standpipes. The standpipes in the parking lot are surrounded with steel bollards.

No residential development is taking place and there are no occupants in any of the buildings. Groundwater is not being used as drinking water. No issues were identified during the Site 4 inspection in August 2013 that would call the protectiveness of the remedy into question.

Supplemental to the site inspection in August 2013, the 2013 Annual LUC Report (Tetra Tech, 24 October 2013) identified signs of trespassers, including vandalism, fireworks debris, litter, cut fencing, and damaged fencing. The same LUC report also indicated onsite groundwater wells are missing locks. Repairs will be conducted within the next inspection period as part of routine O&M activities. Repairs will be documented in annual O&M reports. No issues were identified during the LUC inspections to call the protectiveness of the remedy into question.

4.7 Technical Assessment

Technical assessment of Site 4 is addressed in this section.

4.7.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy for Site 4 included removal actions, MNA, LUCs, and five-year reviews. The remedy is functioning as intended, as described below.

- **Remedial action performance (is the remedy operating as designed?)**

  Excavation was identified as the ROD remedy for soil, but the FS, the ROD, and design documents acknowledged that previous removal actions were not accounted for in the risk evaluation. RD investigations confirmed that soil samples met remedial goals under an industrial worker dermal contact and ingestion scenario. Based on those results, it was determined that additional source area excavation was not warranted; this decision is documented in the 2012 Site Management Plan (Tetra Tech, 01 September 2011) and Partnering Team minutes from 12 October 2010 (Tetra Tech, 16 February 2011).

  The well monitoring network is operational and MNA will continue for Site 4. The LUCs for Site 4 are operating as designed, continue to be evaluated annually, and at present the site facilities remain unoccupied.

- **System operations/O&M**

  Site 4 has no mechanical systems requiring operation. The well monitoring network is operational and will continue to be inspected annually for Site 4.

- **Opportunities for optimization**

  As with any LTM program, there should be an ongoing LTM optimization effort to evaluate reductions in sampling frequency, sampling parameters, and sampling locations at Site 4.

- **Implementation of institutional controls and other measures**

  No issues were identified during the LUC audits from 2012 or 2013 for Site 4; routine O&M addresses repairs following identification of problems (if any) during annual LUC inspection. The Site 4 buildings remain unoccupied. Site 4 groundwater is not being used for potable uses, no residential development or new construction involving excavation has occurred.

- **Early indicators of potential issues**

  There were no early indicators or potential issues identified that could call the protectiveness of the remedy into question.

- **Vapor Intrusion Evaluation**

  No VI assessments have been performed to date at Site 4; however, based on the concentrations of VOCs in groundwater a complete vapor pathway is not likely. The plume is co-mingled with the Site 3 plume which contains CVOCs above their respective VI screening levels; VI concerns due to Site 3 COCs are expected to govern within the co-mingled plume. The existing LUC restricts building occupancy, thereby mitigating any potential vapor exposure within Site 4 boundaries.

4.7.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

The following elements were reviewed to evaluate the risk assessments performed for Site 4:

- **Changes in chemical, location, and action specific ARARs and to-be-considered criteria**

  The ARARs listed in the decision documents for Site 4 were reviewed for this five-year review, as were newly promulgated federal and state regulations, using the methodology described in Section 2.7.2.

  Location and Action Specific ARARs

  A review of all location- and action-specific ARARs for the Site 4 was conducted. No significant changes to ARARs were identified that render the current remedy unprotective.

  Chemical Specific ARARs/Groundwater ARARs

  Table 4-5 presents the groundwater cleanup levels from the Site 4 ROD and compares those cleanup levels to the most recently promulgated Massachusetts MCLs. Based on this comparison, there are no changes to the groundwater ARARs that would impact the Site 4 boundary definitions or groundwater-specific response actions. Note that the Site 3/Site 4 plumes are co-mingled, and therefore CVOCs may be present in this area; Site 3 RGs would apply to CVOCs within the Site 4 plume. As noted in Section 4.4.2, neither xylene nor naphthalene were identified as COCs in the ROD and therefore do not have RGs; however, these constituents are monitored for informational purposes and compared to ARARs identified in the ROD. These ARARs (xylene 10,000 µg/L, naphthalene 140 µg/L) were also reviewed, and have not changed since ROD issuance.

Table 4-5
Groundwater Remediation Goals
Site 4 — BTEX Plume
NWIRP Bedford, Massachusetts

Constituent of Concern Requiring Action	ROD Groundwater Cleanup Level	ROD Groundwater Cleanup Level Source	2014 MCP GW-1	GW-1 Note
Benzene	5 µg/L	2009 MCL	5 µg/L	MMCL
Ethylbenzene	700 µg/L	2009 MCL	700 µg/L	MMCL
Toluene	1,000 µg/L	2009 MCL	1,000 µg/L	MMCL
2-Methylnaphthalene	150 µg/L	2001 RBC	10 µg/L	PQL

Surface Water Criteria — Elm Brook

While surface water does not currently pose an unacceptable risk to human health and the environment, surface water is monitored as part of the LTM plan due to historical groundwater-to-surface water discharges. Table 4-6 presents the surface water ARARs from 2009, and compares them to current NRWQC. There are no changes to the surface water ARARs that would impact Site 4 groundwater response actions.

Table 4-6
Surface Water ARARs
Site 4 — BTEX Plume
NWIRP Bedford, Massachusetts

Constituent of Concern Requiring Action	ROD Groundwater Cleanup Level	2009 Surface Water ARAR	ARAR Source	HH NRWQC 2009*	Last NRWQC Update
Benzene	5 µg/L	51 µg/L	NRWQC	51 µg/L	HH 2002
Ethylbenzene	1,000 µg/L	2,100 µg/L	NRWQC	2,100 µg/L	HH 2003
Toluene	700 µg/L	15,000 µg/L	NRWQC	15,000 µg/L	HH 2003
Xylene	10,000 µg/L	—	—	—	—
2-methylnaphthalene	150 µg/L	—	—	—	—
Naphthalene	140 µg/L	140 µg/L	ORSG	—	—

Note:
* Recommended criteria may change per external review daft of NRWQC which has not been finalized (comment period ended August 13, 2014)

- **Changes in exposure pathways**

  No emerging contaminants have been identified at Site 4. Physical site conditions and the CSM have not changed in a way that could affect the protectiveness of the remedy.

- **Changes in toxicity and other contaminant characteristics and risk assessment methods**

  The evaluation of Site 4 HHRA documents is discussed in Section 2.7.2. This five-year review concluded that updating risk assessment calculations using current methodology would not change the site remedy at Site 4 because the remedy is contingent upon ARARs and because LUCs are in place preventing building occupancy and residential development.

- **Expected progress towards meeting RAOs**

  The groundwater analytical data at Site 4 demonstrates a decreasing trend and groundwater is continuing to attenuate toward cleanup goals. LUCs prevent consumption of contaminated groundwater and restrict property use. The remedy is functioning as intended and progressing towards meeting RGs.

Vapor Intrusion Evaluation

Maximum VOC concentrations in Site 4 groundwater do not exceed 10 times MassDEP screening levels for VI into indoor air (MCP GW-2 standard), as shown in Table 4-7. Data do not indicate a complete pathway.[22] No VI assessments have been performed at Site 4 to date; however, based on current Site 4 groundwater concentrations, no VI assessments are warranted. However, the plume is co-mingled with Site 3 groundwater, which contains CVOCs, which have lower VI thresholds (see Section 2.7.2). LUCs remain at Site 4 to prohibit building occupancy.

Table 4-7
Site 4 Vapor Intrusion Screening
MassDEP Groundwater Screening Criteria (µg/L)

Constituent of Concern	Maximum Site 4 Groundwater Concentration (2013)	2014 MCP GW-2
Benzene	28	1,000
Ethylbenzene	23	20,000
Toluene	1,400	50,000
Xylene	2,000	3,000
2-Methylnaphthalene	34	2,000
Naphthalene	120	700

[22] U.S. EPA *Guidance for Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites, External Review Draft* (U.S. EPA, April 2013) indicates that due biological and other attenuation factors, the potential threat of VI due to petroleum is generally minimal where dissolved phase constituents are separated from overlying buildings by more than 6 feet of clean, biologically active soil. Given the low concentrations present at Site 4, and the ongoing evidence of MNA, the overall potential for VI is deemed to be low.

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

Similar to the Site 3 information discussed in Section 2.7.3, no additional information has been identified which could be used to question remedy protectiveness at Site 4.

4.7.4 Summary of Technical Assessment

Site 4 does not present a current or future risk to human health or the environment. MNA is ongoing. LUCs have been implemented to limit soil, groundwater, and vapor exposure, and restrict property use.

4.8 Issues

No issues were identified that would affect the current or future protectiveness of the remedy.

4.9 Recommendations and Follow-up Actions

No issues were identified that would affect the current or future protectiveness of the remedy and therefore, no recommendations have been made.

4.10 Protectiveness Statement

The construction of the remedy at OU 4 Site 4 is complete and is protective of human health and the environment. Until such time that remedial goals are achieved, exposure pathways that could result in unacceptable risks are being controlled.

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Appendix A

Copy of Publication of Notices for the Five Year Review

Copy of Publication of Notices for the Five Year Review
Bedford Minuteman on 10 October 2013

The EA is available for public review at The Town of Lincoln Town Office at 16 Lincoln Road, at the FAA New England Regional Office at 12 New England Executive Park, Burlington, MA and on the Massport website at www.massport.com. You may request a digital copy of the document via a CD, or have a paper copy be mailed to you by contacting Kimberly Peace at (603) 669-5555 ext. 151 or email at kpeace@hoyletanner.com.

Your comments may be provided orally or in writing (phone, facsimile, mail, or email), and should be received no later than November 1, 2013. Please make your comments as specific as possible as they relate to the proposed action, and include your name, address, and if possible, telephone number and email address. All comments should be sent to the following: via mail, Kimberly Peace, Hoyle, Tanner & Associates, Inc., 150 Dow Street, Manchester, NH, 03101, via phone at (603) 669-5555 ext. 151 or email at kpeace@hoyletanner.com.

An informational meeting to discuss the project and the EA is scheduled for Wednesday, October 16, 2013 at the Hanscom Field Civil Air Terminal (CAT) Room 115, at 200 Hanscom Drive, Bedford, Massachusetts at 6:00 pm.

AD#13015833
Bedford Minuteman 10/10/13

DONOVAN ESTATE
LEGAL NOTICE
Commonwealth of Massachusetts
The Trial Court
Probate and Family Court
MIDDLESEX Division
208 Cambridge Street
Cambridge, MA 02141
(617) 768-5800
Docket No. MI13P4492EA

CITATION ON PETITION FOR FORMAL ADJUDICATION

Estate of: Michael Donovan

Date of Death: 12/12/2012

To all interested persons: A Petition has been filed by: **James Donovan of Watertown, MA** requesting that the Court enter a formal Decree and Order of testacy and for such other relief as requested in the Petition.

And also requesting that: **James Donovan of Watertown, MA** be appointed as Personal Representative(s) of said estate to serve **Without Surety** on the bond.

You have the right to obtain a copy of the Petition from the Petitioner or at the Court. You have a right to object to this proceeding. To do so, you or your attorney must file a written appearance and objection at this Court before: 10:00 a.m. on 10/22/2013

This is NOT a hearing date, but a deadline by which you must file a written appearance and objection if you object to this proceeding. If you fail to file a timely written appearance and objection followed by an Affidavit of Objections within thirty (30) days of the return date, action may be taken without further notice to you.

The estate is being administered under formal procedure by the Personal Representative under the Massachusetts Uniform Probate Code without supervision by the Court. Inventory and accounts are not required to be filed with the Court, but recipients are entitled to notice regarding the administration from the Personal Representative and can petition the Court in any matter relating to the estate, including distribution of assets and expenses of administration.

WITNESS, Hon. Peter C DiGangi, First Justice of this Court.

Date: September 24, 2013

Tara E. DeCristofaro
Register of Probate

AD#13015342
Bedford Minuteman 10/10/13

from the Personal Representative and can petition the Court in any matter relating to the estate, including distribution of assets and expenses of administration.

WITNESS, Hon. Peter C DiGangi, First Justice of this Court.

Date: September 24, 2013

Tara E. DeCristofaro
Register of Probate

AD#13015337
Bedford Minuteman 10/10/13

NWIRP
LEGAL NOTICE
UNITED STATES

The United States Navy Announces
NOTICE TO CONDUCT
First Five-Year Review Report
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT (NWIRP)
BEDFORD, MASSACHUSETTS

The United States Navy (Navy) in coordination with the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MassDEP) will initiate the **First Five-Year Review Report** for Environmental Restoration (ER) activities at NWIRP Bedford.

This report will be prepared by the Navy as part of the Environmental Restoration Program (ERP) for the Department of the Navy (DoN), following EPA guidelines under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Navy will conduct the five-year review with the evaluation of pending, completed, and ongoing remedial actions implemented at ER sites at NWIRP Bedford. This five-year review report will include the 3 ER sites where remedial activities have been ongoing since September 2009 and areas where site-related contaminants remain at levels above those that would allow for unrestricted use.

Navy and CERCLA guidelines call for this ERP review every 5 years to ensure protection of human and ecological communities in the area. The First Five-Year Review Report will be completed in September 2014.

For more information, please call Mr. Tom Kreidel, the Naval Facilities Engineering Command, Mid-Atlantic (NAVFAC MIDLANT) Public Affairs Officer, at (757) 341-1410 or contact Ms. Maritza Montegross, NAVFAC MIDLANT, 9742 Maryland Avenue, Norfolk, VA 23511.

AD#13010980
Bedford Minuteman 10/10/13

BILAFER ESTATE
LEGAL NOTICE
Commonwealth of Massachusetts
The Trial Court
Probate and Family Court
Middlesex Division
208 Cambridge Street
East Cambridge, MA 02141
(617) 768-5800

Docket No. MI13P4259EA

INFORMAL PROBATE PUBLICATION NOTICE

Estate of: Robert J. Bilafer

Date of Death: 5/22/2013

To all persons interested in the above-captioned estate, by Petition of Petitioner **Nancy J. Bilafer of Bedford MA**

Nancy J. Bilafer of Bedford MA has been informally appointed as the Personal Representative of the estate to serve without surety on the bond.

The estate is being administered under informal procedure by the Personal Representative under the Massachusetts Uniform Probate Code without supervision by the Court.

HEARING ON THURSDAY, OCTOBER 24, 2013, IN THE LOWER LEVEL CONFERENCE ROOM, TOWN HALL, 10 MUDGE WAY, BEDFORD, MASSACHUSETTS.

THE MEETING WILL BEGIN AT 7:30 P.M., AND THE FOLLOWING CASE(S) WILL BE HEARD:

Hazel Wood Hopkins, for Safety Partners, at 19 Crosby Drive, seeks a Special Permit per Article 39.5 Section 5(7)(a) to locate wall sign above first floor of building.

Anyone wishing to be heard on this matter should be present at the designated time and place. The above applications and plans are on file at the Code Enforcement Department, Town Hall, 10 Mudge Way, for review during normal business hours. A business meeting will follow.

Carol Amick, Clerk

AD#13017376
Bedford Minuteman 10/10, 10/17/13

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82 GREAT ROAD
LEGAL NOTICE

THE BEDFORD ZONING BOARD OF APPEALS WILL HOLD A PUBLIC HEARING ON THURSDAY, OCTOBER 24, 2013, IN THE LOWER LEVEL CONFERENCE ROOM, TOWN HALL, 10 MUDGE WAY, BEDFORD, MASSACHUSETTS.

THE MEETING WILL BEGIN AT 7:30 P.M., AND THE FOLLOWING CASE(S) WILL BE HEARD:

Ken's NY Deli, at 82 Great Road, seeks a Special Permit per Article 39.5 Section 2 of the Sign By-Law to illuminate awning sign.

Anyone wishing to be heard on this matter should be present at the designated time and place. The above applications and plans are on file at the Code Enforcement Department, Town Hall, 10 Mudge Way, for review during normal business hours. A business meeting will follow.

Carol Amick, Clerk

AD#13017386
Bedford Minuteman 10/10, 10/17/13

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330 SOUTH ROAD
LEGAL NOTICE

THE BEDFORD ZONING BOARD OF APPEALS WILL HOLD A PUBLIC HEARING ON THURSDAY, OCTOBER 24, 2013, IN THE LOWER LEVEL CONFERENCE ROOM, TOWN HALL, 10 MUDGE WAY, BEDFORD, MASSACHUSETTS.

THE MEETING WILL BEGIN AT 7:30 P.M., AND THE FOLLOWING CASE(S) WILL BE HEARD:

Jennifer Soilis, at 330 South Road, seeks a modification to Special Permit #050-93 to allow commercial kitchen for wholesale baking.

Anyone wishing to be heard on this matter should be present at the designated time and place. The above applications and plans are on file at the Code Enforcement Department, Town Hall, 10 Mudge Way, for review during normal business hours. A business meeting will follow.

Carol Amick, Clerk

AD#13017381
Bedford Minuteman 10/10, 10/17/13

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Copy of Publication of Notices for the Five Year Review
Lexington Minuteman on 3 October 2013

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E. DeCristofaro
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Court. but recipients are entitled to notice regarding the administration from the Personal Representative and can petition the Court in any matter relating to the estate, including distribution of assets and expenses of administration.

WITNESS, Hon. Peter C DiGangi, First Justice of this Court.

Date: September 23, 2013

Tara E. DeCristofaro
Register of Probate

AD#13011176
Lexington Minuteman 10/3/13

FIVE YEAR PLAN REVIEW
LEGAL NOTICE
UNITED STATES
The United States Navy
Announces
NOTICE TO CONDUCT
First Five-Year Review Report
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT (NWIRP)
BEDFORD, MASSACHUSETTS

The United States Navy (Navy) in coordination with the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MassDEP) will initiate the **First Five-Year Review Report** for Environmental Restoration (ER) activities at NWIRP Bedford.

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For more information, please call Mr. Tom Kreidel, the Naval Facilities Engineering Command, Mid-Atlantic (NAVFAC MIDLANT) Public Affairs Officer, at (757) 341-1410 or contact Ms. Maritza Montegross, NAVFAC MIDLANT, 9742 Maryland Avenue, Norfolk, VA 23511.

AD#13007116
Lexington Minuteman 10/3/13

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48 OUTLOOK DRIVE
LEGAL NOTICE

The BOARD OF APPEALS will hold a public hearing on THURSDAY, October 10, 2013, in the Selectmen's Meeting Room, 1625 Massachusetts Avenue, at 7:40 PM, on the petition of Attorney John Farrington for Ruth E. Sukeforth for 5 Variances in accordance with the Zoning By-Law (Chapter 135 of the Code of Lexington) section Section 135-9.2.2.2 and section 4.1.1, Table 2, Schedule of Dimensional Controls to allow a minimum lot frontage of 50 ft instead of the required 125 ft., allow a minimum lot area of 10,500 sq. ft. instead of the required 15,500 sq. ft., allow a left side yard setback of 7.8 ft. instead of the required 15 ft, allow a right side yard setback of 3.6 ft. instead of the required 15 ft. and to allow a front yard setback of 25'2" instead of the required 30 ft.

At the hearing, any party, whether entitled to notice thereof or not, may appear in person or be represented

LEGAL NOTICE

The BOARD OF APPEALS will hold a public hearing on THURSDAY, October 10, 2013, in the Selectmen's Meeting Room, 1625 Massachusetts Avenue, at 7:40 PM, on the petition of Attorney John Farrington for Ruth E. Sukeforth for 4 Variances in accordance with the Zoning By-Law (Chapter 135 of the Code of Lexington) section Section 135-9.2.2.2 and section 4.1.1, Table of Dimensional Controls to allow a minimum lot frontage of 60 ft instead of the required 125 ft, allow a minimum lot area of 12,600 sq. ft. instead of the req 15,500 sq. ft. and to allow 2-side yard setbacks of 10 ft. instead of the required 15 ft.

At the hearing, any party, whether entitled to notice thereof or not, may appear in person or be represented by agent or attorney.

Carolyn C. Wilson, Chairman
Zoning Board of Appeals

AD#13007077
Lexington Minuteman 9/26, 10/3/13

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411 WALTHAM STREET (2)
LEGAL NOTICE

The BOARD OF APPEALS will hold a public hearing on THURSDAY, October 10, 2013, in the Selectmen's Meeting Room, 1625 Massachusetts Avenue, at 7:35 PM, on the petition of J & T Enterprises of Massachusetts (DBA Crushed Grapes) for a Special Permit in accordance with the Zoning By-Law (Chapter 135 of the Code of Lexington) section 135-9.4.2 and 135-5.2.10 to allow placement of 2 temporary signs; hanging banner and a sandwich sign placed at entrance of shopping center.

At the hearing, any party, whether entitled to notice thereof or not, may appear in person or be represented by agent or attorney.

Carolyn C. Wilson, Chairman
Zoning Board of Appeals

AD#13007074
Lexington Minuteman 9/26, 10/3/13

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411 WALTHAM STREET (1)
LEGAL NOTICE

The BOARD OF APPEALS will hold a public hearing on THURSDAY, October 10, 2013, in the Selectmen's Meeting Room, 1625 Massachusetts Avenue, at 7:30 PM, on the petition of J & T Enterprises of Massachusetts (DBA Crushed Grapes) for a Special Permit in accordance with the Zoning By-Law (Chapter 135 of the Code of Lexington) sections 135-9.4.2 and 135-3.0, Table 1: Permitted Uses, Line I.1.04 to allow a package liquor store, with no comsumption on the premises.

At the hearing, any party, whether entitled to notice thereof or not, may appear in person or be represented by agent or attorney.

Carolyn C. Wilson, Chairman
Zoning Board of Appeals

AD#13007070
Lexington Minuteman 9/26, 10/3/13

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110 BEDFORD STREET
LEGAL NOTICE
HISTORICAL COMMISSION

The Lexington Historical Commission will hold a Public Hearing on Thursday, October 17, 2013 in the Selectmen's Meeting Room, 1625 Massachusetts Avenue at 7:30 PM on the application of Mr. Robert Burge of Lexington Development Realty Trust, representing Owner, Mr. & Mrs. Adam Taylor, with respect to Partial Building Demolition, located at 110 Bedford Street.

At the hearing, any party, whether entitled to notice thereof, or not, may appear in person or be represented by

Kohan, with respect to partial building demolition located at 37 Grove Street.

At the hearing, any party, whether entitled to notice thereof, or not, may appear in person or be represented by an agent or attorney.

David R. Kelland, Chair
Lexington Historical Commission

AD#13011073
Lexington Minuteman 10/3/13

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47 WOBURN STREET
LEGAL NOTICE
HISTORICAL COMMISSION

The Lexington Historical Commission will hold a Public Hearing on Thursday, October 17, 2013 in the Selectmen's Meeting Room, 1625 Massachusetts Avenue at 7:30 PM on the application of David & Jennifer Parsons, with respect to roof line change located at 47 Woburn Street.

At the hearing, any party, whether entitled to notice thereof, or not, may appear in person or be represented by an agent or attorney.

David R. Kelland, Chair
Lexington Historical Commission

AD#13004808
Lexington Minuteman 10/3/13

To Place A Legal Ad Call Dawn at (781) 433-7959

be held Saturday, Oct. 5, 8 p.m., at the Lexington High School auditorium, 251 Waltham St. For more information visit carylecture-series.org.

Bike to the Farmers' Market Day

The Friends of Lexington Bikeways will be hosting the bike corral at the Farmers' Market on Tuesday, Oct. 8, from 2 - 6:30 p.m. Cyclists who arrive at the corral and check their bikes will receive a coupon good for $2 at any market booth. Look for the Friends of Lexington Bikeways tent and come on by to talk with us about bicycling in Lexington, about our stewardship programs, and pick up a free Bikeway map. The Farmers' Market is held at the corner of Woburn Road and Fletcher Avenue.

Preschool program open house

LexFun! Early Education Open House will be held on Wednesday, Oct. 9, 7 to 9 p.m. at Cary Memorial Building, 1605 Massachusetts Ave. This is a chance to explore Lexington's preschool & childcare programs. The public is invited to learn about the many diverse programs, including in-home care, offered in the community. Directors and teachers from many of Lexington's preschool and childcare centers will be available to answer questions and provide detailed program information. This evening is a must for any parent interested in finding a preschool or childcare center for the 2014-2015 school year. Admission is free. For more information, contact Kate Finnegan, 301-785-1447 or kate.finnegan11@gmail.com.

Expert teaches the history of stonewalls

On Wednesday, Oct. 9, Kevin Gardner will talk about the history, aesthetics and philosophy of free standing stonewalls, while demonstrating this craft.

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Appendix B

Site 3 Groundwater and Surface Water Trend Data and Analysis 1997-2013

The September 2013 (AGVIQ-CH2MHill, 17 December 2013) Site 3 Groundwater Report includes the cumulative groundwater data collected at Site 3 sample locations since 1997. Groundwater is sampled semi-annually and surface water is sampled annually. The attachments in this Appendix (B) include extracted tables and figures that demonstrate the groundwater water trends for the COCs at Site 3. Trend analysis includes curve fit information (usually log fit) where applicable. Statistical analysis includes Seasonal Kendal and Mann-Kendall evaluations presented in tabular format.

Site 3 Groundwater Data Tables

Site 3 Groundwater Monitoring Report — September 2013

(AGVIQ-CH2MHill, 17 December 2013)

TABLE 3-3
GROUNDWATER QUALITY DATA
GROUNDWATER MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Well	Flow Rate (L/min)	Duration (min)	Total Volume (L)	pH	Specific Conductance (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temperature (°C)	ORP (mV)
BG-1B	0.3	42	19.4	10.99	0.278	1.75	2.03	15.34	-20.2
EW-01	0.2	18	7.5	5.85	0.176	0.31	4.7	15.31	170.5
EW-04	0.25	18	5.25	6.07	0.253	2.72	2.25	15.87	178.6
EW-15	0.4	36	14	5.58	0.189	1.89	3.41	16.49	32
EW-21	0.2	45	7.5	5.71	0.213	1.47	2.6	13.11	84.7
OW-2	0.2	56	9.25	6.13	0.123	11.4	8.43	12.6	58
STM-2	0.125	25	3.9	6.32	0.403	39.21	1.47	10.53	-44
STM-5R	0.2	35	5	6.23	0.131	0.57	4.92	17.62	162.4
MW-1B	0.15	80	12	7.75	0.231	1.2	0.41	12.53	68.3
MW-3B	0.2	99	10	7.88	0.206	1.27	0.52	12.6	73
MW-6B	0.15	83	14.5	0.89	0.168	29.9	5.42	12.81	174.2
MW-10B	0.25	49	10.5	6.86	0.103	4.78	1.55	12.49	58.7
MW-12S	0.3	37	16.5	6.01	0.041	1.41	1.25	23:07	187.2
MW-12R	0.1	105	5.0	7.08	0.114	5.56	0.85	17.37	101.7
MW-13S	0.25	63	13.5	5.93	0.742	0.58	3.47	15.43	59.8
MW-13R	0.3	20	9.5	7.10	0.498	0.17	0.42	16.66	-6.3
MW-14R	0.3	75	19	8.33	0.096	0.0	0.86	18.08	138.4
MW-19RR	0.125	69	7.75	7.48	0.28	0.26	0.78	11.13	68.8
MW-20R	0.2	50	11.5	10.64	0.282	1.48	1.17	13.35	3.2
MW-21R	0.25	107	20	11.47	0.658	1.65	2.49	13.47	8.8
MW-22R	0.25	25	5.5	11.58	0.468	7.494	1.58	13.53	-33.9
MW-26R	0.2	93	7.5	8.04	0.203	63.4	12.82	10.26	68.3

°C = degrees Celsius
DO = dissolved oxygen
L = liters
min = minutes
mg/L = milligrams per liter
ml/min = milliliters per minute
mS/cm = millisiemens per centimeter
mV = millivolts
NTU = nephelometric turbidity units
ORP = oxidation-reduction potential
S.C. = specific conductivity
Temp = temperature

TABLE 3-4
GROUNDWATER SAMPLING ANALYTICAL RESULTS FOR SITE 3 CONTAMINANTS OF CONCERN
GROUNDWATER MONITORING PROGRAM - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

	SAMPLE ID			BED03-GW-BG1B-0913		BED03-GW-DUP02-0913		BED03-GW-EW1-0913		BED03-GW-EW4-0913		BED03-GW-EW15-0913		BED03-GW-EW21-0913		BED03-GW-DUP01-0913		BED03-GW-MW1B-0913		BED03-GW-MW3B-0913		BED03-GW-MW6B-0913		BED03-GW-MW10B-0913		BED03-GW-MW12R-0913		BED03-GW-MW12S-0913		BED03-GW-MW13R-0913		BED03-GW-MW13S-0913	
	LOCATION ID			BG-1B		BG-1B		EW-1		EW-4		EW-15		EW-21		EW-21		MW-1B		MW-3B		MW-6B		MW-10B		MW-12R		MW-12S		MW-13R		MW-13S	
	SAMPLE DATE	**GW**	**SW**	9/23/2013		9/23/2013		9/23/2013		9/23/2013		9/23/2013		9/23/2013		9/23/2013		9/23/2013		9/24/2013		9/23/2013		9/24/2013		9/30/2013		9/24/2013		9/24/2013		9/24/2013	
FRACTION (UNITS)	SAMPLE CODE	**PAL**	**PAL**	NORMAL		DUPLICATE		NORMAL		NORMAL		NORMAL		NORMAL		DUPLICATE		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
VOLATILES (UG/L)	1,1,2-Trichloroethane	3	16	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	**5.6**	
	1,1-Dichloroethane	70	70	0.5	U	0.5	U	**0.75**	**J**	**1.9**		**6.2**		**11**		**11**		**0.53**	**J**	0.5	U	0.5	U	0.5	U	**24**		**2.3**		**73**		**200**	
	1,1-Dichloroethene	7	7,100	**0.92**	**J**	**1.1**		**0.82**	**J**	**2.1**		**15**		**39**		**38**		**1.1**		0.5	U	0.5	U	0.5	U	**91**		**17**		**82**		**590**	
	1,2-Dichloroethane	5	37	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
	cis-1,2-Dichloroethene	70	-	**110**		**110**		**2.5**		**9**		**20**		**30**		**30**		0.5	U	0.5	U	**1.1**		0.5	U	**35**		**21**		**350**		**1,500**	
	Tetrachloroethene	5	3.3	1.0	U	1.0	U	**1.6**		**1.7**		**9.5**		**17**		**17**		1.0	U	1.0	U	1.0	U	1.0	U	**12**		**3.3**		**2.6**		**200**	
	Trichloroethene	5	30	**98**		**100**		**22**		**29**		**190**		**230**		**240**		**4.0**		0.5	U	**0.66**	**J**	0.5	U	**320**		**92**	**J**	**350**		**3,400**	
	Vinyl chloride	2	2.4	**2.8**		**3.1**		0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	**8.3**		**22**	
	TOTAL 1,2-DICHLOROETHENE			110		110		2.5		9		20		30		30		0.5	U	0.5	U	1.1		0.5	U	35		21		350		1,500	
	TOTAL CHLORINATED VOCS			211.72	J	214.2		27.67	J	43.7		240.7		327		336		5.63	J	1.0	U	1.76	J	1.0	U	482		135.6	J	865.9		5,918	
	TOTAL VOCS			211.72	J	214.2		27.67	J	43.7		240.7		327		336		5.63	J	1.0	U	1.76	J	1.0	U	482		135.6	J	865.9		5,918	
VOLATILE GASES (UG/L)	ETHANE			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		1.2	U	NA		NA		NA	
	ETHENE			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		1.5	U	NA		NA		NA	
	METHANE			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		**140**	**B**	NA		NA		NA	
METALS (UG/L)	IRON			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		**816**		NA		NA		NA	
	MANGANESE			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		**34.7**	**J**	NA		NA		NA	
MISCELLANEOUS PARAMETERS (MG/L)	ALKALINITY			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		**32**		NA		NA		NA	
	CHLORIDE			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		**15.9**		NA		NA		NA	
	NITRATE-N			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		**0.202**		NA		NA		NA	
	NITRITE-N			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		0.1	U	NA		NA		NA	
	SULFATE			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		**2.63**		NA		NA		NA	
	SULFIDE			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		0.03	UJ	NA		NA		NA	
FILTERED MISCELLANEOUS (MG/L)	TOTAL DISSOLVED ORGANIC CARBON			NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		**2.7**	**J**	NA		NA		NA	

Notes:

Bold values indicate a detected concentration.

Shaded values indicate concentrations which exceed cleanup goals.

mg/L = milligram(s) per liter

µg/L = microgram(s) per liter

GW = Groundwater sample

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

NS = not analyzed for compound.

PAL = Project Action Limit

SW = Surface water sample

B - Attributable to blank contamination. Available as a non-detect.

J - Analyte present. Value may or may not be accurate or precise

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit. Not detected substantially above the level reported in laboratory or field blanks.

UJ = The analyte was not deemed above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

TABLE 3-4
GROUNDWATER SAMPLING ANALYTICAL RESULTS FOR SITE 3 CONTAMINANTS OF CONCERN
GROUNDWATER MONITORING PROGRAM - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

	SAMPLE ID			BED03-GW-MW14R-0913		BED03-GW-MW19RR-0913		BED03-GW-MW20R-0913		BED03-GW-MW21R-0913		BED03-GW-DUP03-092513		BED03-GW-MW22R-0913		BED03-GW-MW26R-0913		BED03-GW-OW2-0913		BED03-GW-STM2-0913		BED03-GW-STM5R-0913	
	LOCATION ID			MW-14R		MW-19RR		MW-20R		MW-21R		MW-21R		MW-22R		MW-26R		OW-2		STM-2		STM-5R	
	SAMPLE DATE	**GW**	**SW**	9/24/2013		9/24/2013		9/25/2013		9/25/2013		9/25/2013		9/23/2013		9/24/2013		9/25/2013		9/25/2013		9/25/2013	
FRACTION (UNITS)	SAMPLE CODE	**PAL**	**PAL**	NORMAL		NORMAL		NORMAL		NORMAL		DUPLICATE		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
VOLATILES (UG/L)	1,1,2-Trichloroethane	3	16	1.0	U	1.0	U	1.0	UJ	1.0	U	1.0	U	1.0	U	1.0	U	1.0	UJ	2.0	UJ	1.0	U
	1,1-Dichloroethane	70	70	0.5	U	**0.91**	**J**	**0.89**	**J**	**76**		**75**		0.5	U	0.5	U	**0.94**	**J**	**24**	**J**	0.5	U
	1,1-Dichloroethene	7	7,100	0.5	U	0.5	U	0.5	UJ	**180**		**180**		**1.0**		0.5	U	**1.7**	**J**	**43**	**J**	0.5	U
	1,2-Dichloroethane	5	37	0.5	U	0.5	U	**4.4**	**J**	0.5	U	0.5	U	0.5	U	0.5	U	0.5	UJ	1.0	UJ	0.5	U
	cis-1,2-Dichloroethene	70	-	**0.65**	**J**	**7.2**		**2.7**	**J**	**120**		**120**		0.5	U	0.5	U	**2.2**	**J**	**32**	**J**	0.5	U
	Tetrachloroethene	5	3.3	1.0	U	1.0	U	1.0	UJ	**63**		**63**		1.0	U	1.0	U	**1.5**	**B**	**15**	**J**	1.0	U
	Trichloroethene	5	30	**15**		**2.8**		**0.99**	**J**	**780**		**770**		**2.3**		**0.68**	**J**	**20**	**J**	**200**	**J**	0.5	U
	Vinyl chloride	2	2.4	0.5	U	0.5	U	0.5	UJ	**2.1**		**2.1**		0.5	U	0.5	U	0.5	UJ	1.0	UJ	0.5	U
	TOTAL 1,2-DICHLOROETHENE			0.65	J	7.2		2.7	J	120		120		0.5	U	0.5	U	2.2	J	32		0.5	U
	TOTAL CHLORINATED VOCS			15.65	J	10.91	J	8.98	J	1,221.1		1,210.1		3.3		0.68	J	26.3	J	314	J	1.00	U
	TOTAL VOCS			15.65	J	10.91	J	8.98	J	1,221.1		1,210.1		3.3		0.68	J	26.3	J	314	J	1.00	U
VOLATILE GASES (UG/L)	ETHANE			NA		NA		NA		**23**	J	**1.8**	**J**	NA		NA		NA		NA		**6.6**	
	ETHENE			NA		NA		NA		**37**	J	**9.5**	**J**	NA		NA		NA		NA		**6.3**	**J**
	METHANE			NA		NA		NA		**130**		**110**		NA		NA		NA		NA		**26**	
METALS (UG/L)	IRON			NA		NA		NA		50	U	50	U	NA		NA		NA		NA		**131**	**J**
	MANGANESE			NA		NA		NA		15	U	15	U	NA		NA		NA		NA		**23.5**	**J**
MISCELLANEOUS PARAMETERS (MG/L)	ALKALINITY			NA		NA		NA		**150**		**160**		NA		NA		NA		NA		**54**	
	CHLORIDE			NA		NA		NA		**74.3**		**74.4**		NA		NA		NA		NA		**0.44**	**J**
	NITRATE-N			NA		NA		NA		0.1	U	0.1	U	NA		NA		NA		NA		0.1	U
	NITRITE-N			NA		NA		NA		0.1	U	0.1	U	NA		NA		NA		NA		0.1	U
	SULFATE			NA		NA		NA		**13**		**12.8**		NA		NA		NA		NA		**13**	
	SULFIDE			NA		NA		NA		0.03	UJ	0.03	UJ	NA		NA		NA		NA		0.03	UJ
FILTERED MISCELLANEOUS (MG/L)	TOTAL DISSOLVED ORGANIC CARBON			NA		NA		NA		5	U	5	U	NA		NA		NA		NA		**2.9**	**J**

Notes:

Bold values indicate a detected concentration.

Shaded values indicate concentrations which exceed cleanup goals.

mg/L = milligram(s) per liter

µg/L = microgram(s) per liter

GW = Groundwater sample

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

NS = not analyzed for compound.

PAL = Project Action Limit

SW = Surface water sample

B - Attributable to blank contamination. Available as a non-detect.

J - Analyte present. Value may or may not be accurate or precise

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit. Not detected substantially above the level reported in laboratory or field blanks.

UJ = The analyte was not deemed above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

TABLE 3-5
ANALYTICAL RESULTS FOR MNA PARAMETERS
GROUNDWATER MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Parameter	Unit	MW-12R	MW-21R	STM-5R
ALKALINITY	mg/L	32	150	54
CHLORIDE	mg/L	15.9	74.3	0.44 J
TOTAL IRON	µg/L	816	50 U	131 J
DISSOLVED IRON	µg/L	107 J	50 U	148 J
TOTAL MANGANESE	µg/L	34.7 J	15 U	23.5 J
DISSOLVED MANGANESE	µg/L	12.3 J	15 U	29.4 J
METHANE	µg/L	140 B	130	26
ETHANE	µg/L	1.2 U	23 J	6.6
ETHENE	µg/L	1.5 U	37 J	6.3 J
NITRATE	mg/L	0.202	0.1 U	0.1 U
NITRITE	mg/L	0.1 U	0.1 U	0.1 U
DO (field measured)	mg/L	0.85	2.49	4.92
ORP (field measured)	mV	101.7	8.8	162.4
SULFATE	mg/L	2.63	13	13
SULFIDE	mg/L	0.03 UJ	0.03 UJ	0.03 UJ
TOTAL ORGANIC CARBON	mg/L	2.7 J	5 U	2.9 J

Notes:
J = estimated
mg/L = milligrams per liter
mV = millivolts
U = non detect
UJ = non detect, estimated

Site 3 Groundwater Analysis Tables

Site 3 Groundwater Monitoring Report — September 2013

(AGVIQ-CH2MHill, 17 December 2013)

TABLE 3-6
COMPARISON OF SEPTEMBER 2013 TOTAL CVOC CONCENTRATIONS TO HISTORICAL DATA
GROUNDWATER MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Well	Number of Times Well Was Sampled Between Q1 - Q35	Baseline (Feb 1997) Total CVOC (ppb)	Q1 - Q35 Average Total CVOC (ppb)	September 2013 (Q36) Total COCs (a) (ppb)	Is September 2013 ≤ Historical Average?	Is September 2013 ≤ Baseline?
BG-1B	10	NS	291.20	211.72	Yes	NA
BG-1S	3	NS	4.67	NS	NA	NA
ELM-1S	33	9.0	6.66	NS	NA	NA
ELM-2	30	1.0	0.07	NS	NA	NA
EW-1	31	830	54.41	27.67	Yes	Yes
EW-4	6	585	83.29	43.7	Yes	Yes
EW-10	20	48,400	175.00	NS	NA	NA
EW-15	35	487	274.92	240.7	Yes	Yes
EW-19	19	641	178.46	NS	NA	NA
EW-21	35	3,428	362.35	327.0	Yes	Yes
EW-23	19	0.0	1.23	NS	NA	NA
MW-1B	22	0.0	1.46	5.63	**No**	**No**
MW-1S	16	0.0	1.86	NS	NA	NA
MW-3B	7	0.0	0.0	0.0	Yes	Yes
MW-6B	5	NS	0.48	1.76	**No**	NA
MW-10B	9	0.0	0.0	0.0	Yes	Yes
MW-12I	16	7,731	2,562.89	NS	NA	NA
MW-12R	28	1,526	685.93	482.0	Yes	Yes
MW-12S	34	10,114	3,051.65	135.6	Yes	Yes
MW-13R	11	2,924	1,035.74	865.9	Yes	Yes
MW-13S	33	27,581	17,033.05	5,918	Yes	Yes
MW-14R	12	309	122.46	15.65	Yes	Yes
MW-15SR	15	NS	2.10	NS	NA	NA
MW-19RR	16	NS	14.20	10.91	Yes	NA
MW-20I	2	NS	468.40	NS	NA	NA
MW-20R	9	0.0	41.38	8.98	Yes	**No**
MW-20S	2	NS	158.40	NS	NA	NA
MW-21R	9	2,398	1,410.49	1,221.1	Yes	Yes
MW-21S	16	6,436	3,692.80	NS	NA	NA
MW-22R	7	NS	2.71	3.30	**No**	NA
MW-26R	8	NS	0.13	0.68	**No**	NA
MW-32I	19	NS	280.54	NS	NA	NA
MW-32S	16	NS	8.55	NS	NA	NA
MW-33I	19	NS	239.14	NS	NA	NA
MW-33S	16	NS	67.57	NS	NA	NA
MW-52I	2	NS	37,845	NS	NA	NA
MW-67I	2	NS	98.55	NS	NA	NA
MW-68I	2	NS	301.75	NS	NA	NA
MW-72I	2	NS	34.44	NS	NA	NA
MW-73I	2	NS	121.30	NS	NA	NA
MW-76S [2]	1	NA	NA	NS	NA	NA
OW-2	29	433	15.92	26.34	**No**	Yes
OW-3	17	NS	144.42	NS	NA	NA
STM-1S	33	2.0	5.43	NS	NA	NA
STM-2	35	187	61.52	314.0	**No**	**No**
STM-5R	22	0.0	0.18	0.0	Yes	Yes
STM-5S	21	2,296	1,269.32	NS	NA	NA

Notes:

Bold/shaded Indicates September 2013 total CVOC concentration exceeds either Baseline or Q1-Q35 average value

(1) "Total COC" values from September 2013 represent a shorter analyte list than the "total CVOCs" as reported from Q1-Q31, but the results are presented herein as a relative comparison because, based on previous sampling data, the Site 3 COCs comprise over 98 percent of the total CVOC concentrations.

(2) Historical 'average' value only representative of one data point (Q35)

COC = contaminant of concern

CVOC = chlorinated volatile organic compound

Non-detect values are shown as zero.

NA = Not Applicable

NS = Not Sampled

ppb = parts per billion (ug/L)

TABLE 3-7
MANN KENDALL TREND EVALUATION
GROUNDWATER MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Well	Parameter	Calculated Probability *	Decision Using Significance Level of 0.05	Decision Using Significance Level of 0.01	Number of Detects	Number of Results	Percent Detects
Season 1 (Jan - Jun) Mann-Kendall Statistics							
BG-1B	Total VOCs	0.27400	No Significant Change	No Significant Change	10	10	100
EW-1	Total VOCs	*Insufficient Events Available*			1	1	100
EW-15	Total VOCs	0.03923	Significantly Decreasing	No Significant Change	13	13	100
EW-21	Total VOCs	0.54669	No Significant Change	No Significant Change	13	13	100
EW-4	Total VOCs	*Insufficient Events Available*			1	1	100
MW-12R	Total VOCs	0.03923	Significantly Decreasing	No Significant Change	13	13	100
MW-12S	Total VOCs	0.36245	No Significant Change	No Significant Change	13	13	100
MW-13R	Total VOCs	0.19100	No Significant Change	No Significant Change	9	9	100
MW-13S	Total VOCs	0.14553	No Significant Change	No Significant Change	13	13	100
MW-14R	Total VOCs	0.50000	No Significant Change	No Significant Change	7	7	100
MW-19RR	Total VOCs	0.00126	Significantly Decreasing	Significantly Decreasing	11	11	100
MW-1B	Total VOCs	0.37115	No Significant Change	No Significant Change	10	10	100
MW-20R	Total VOCs	0.28100	No Significant Change	No Significant Change	7	7	100
MW-21R	Total VOCs	0.18376	No Significant Change	No Significant Change	7	7	100
MW-22R	Total VOCs	0.03575	Significantly Decreasing	No Significant Change	7	7	100
MW-26R	Total VOCs	0.50000	No Significant Change	No Significant Change	2	7	29
MW-6B	Total VOCs	0.29750	No Significant Change	No Significant Change	3	6	50
OW-2	Total VOCs	0.12700	No Significant Change	No Significant Change	6	11	55
STM-2	Total VOCs	0.31710	No Significant Change	No Significant Change	13	13	100
STM-5R	Total VOCs	0.40325	No Significant Change	No Significant Change	2	10	20

* the probability that observed patterns in data appear are consistent with an assumption that there are no trends in the data over time.

TABLE 3-8
SUMMARY OF TOTAL CVOC REGRESSION DATA
GROUNDWATER MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

	Total CVOCs/COCs (µg/L) (a)																									
Event	BG-1B	BG-1S	ELM-1S	ELM-2	EW-01	EW-04	EW-07	EW-10	EW-15	EW-19	EW-21	EW-23	MW-1B	MW-3B	MW-6B	MW-10B	MW-12I	MW-12R	MW-12S	MW-13R	MW-13S	MW-14R	MW-15SR	MW-19RR	MW-20I	MW-20R
Feb-97			9.0	1.0	830	585	27,500	48,400	487	641	3,428	0.0	0.0	0.0		0.0	7,731	1,526	10,114	2,924	27,581	309				0.0
Nov-97			24.5	0.0	166	201	248	203	451	383	1,388	1	0.0	0.0		0.0		2,274	5,310	1,843	29,910	304				1.0
Feb-98			12	0.0	93	167	309	305	513	381	1,476	3.6	0.0	0.0		0.0		562	5,640	1,517	16,270	229				1.2
May-98			12	0.0	102		360	480	568	308	503	4.2	0.0					1,231	7,900			253				
Sep-98			0.0	0.0	115		232.7	398.5	371.9	388.6	1,427.6	0	0.0				12,081	678	11,080		15,835	244.1				
Mar-99			6.2	0.0	22.9		265	232.1	403.1	232.9	955.5	0	0.0				6,579.9	337.3	3,904.6		19,995	309				
May-99			9.88	0.0					316.3		362.3								4,425.6		14,152					
Aug-99			8.2	0.0					163.3		93								3,358.7		12,409.6					
Nov-99			9.39	0.0					316.1		1,867.1								1,996.8		22,006					
Feb-00			8.3	0.0	4.3		47.6	66.9	254.3	294.5	674.5	0.0	0.0				488.1	511.6	2,962.4		11,900					
Aug-00			13.2	0.0	226.3				372.1		611.6								6,877.5		12,679					
Feb-01			5.0	0.0	94		49	242	378	57	1,125	0.0	0.0				2,299		1,890		14,100					
Aug-01			4.0	0.0	116				412		28							927	3,930		9,554					
Feb-02			3.0	0.0	3.0		53	43	174	47	120	0.0					1,240									
Aug-02			3.0	0.0	3.0				371		5								4,913		20,108					
Feb-03			6.8	0.0	42.7		54.4	236.7	243.5	146.6	539	0.0	0.46				0.0	95.3	1,559.5		14,821.1		1.43			
Jul-03			8.47	0.0	17.8				337.8		103.4							130	6,733.5		13,700					
Feb-04			5.34	0.0	15.2		35	94.9	193.7	67.4	6.6	0.0	0.0				417.1	636.9	835.6		13,287.5		2.05	5.59		
Jul-04			5.1	0.0	60.2				248.3		38.6							604.7	4,438.3		11,699.6		3.4			
Feb-05			4.1	0.0	66.8		66.4	154.2	197.4	79.8	3.4	0.3	0.4				2.7	42.3	4.1		13,440.4		0.75	5.8		
Aug-05			7.8		38				224.8		31.8							330.6	3,288.9		14,200			10.69		
Apr-06			3.1	0.0	35.1		79.3	49.3	275.5	138.1	10.3	0.0	4.6				0.75	73.3	566.9		12,259.3		10.1	14		
Aug-06	221		4.8	0.0	28.7				247.8		16.1		0.9			0.0		833	2,643.4	349.98	16,544.6	3.6	3.38	15.7		3.0
Apr-07			3.7	0.0	60.4		182.2	149.2	182.3	63.5	113.3	0.0	1.4				12,724.9	2,078.5	1,859.2		23,000		0.59	20.23		
Aug-07	268.7		3.6	0.0	17.7				197.9		8.1					0.0		1570	3421.4	313.86	14,193	28.31	0.0	21.1		4.64
Mar-08			3.45	0.53	66		169.7	199.7	238	146.3	81.7	2.73	1.5				3,647.5	974.5	91.8		15,200		8.16	22.85		
Aug-08	269.9		8.42	0.0	86.9				196		30.3		1.4	0.0	0.0	0.0		1,180	1,280.2	454.1	14,600	10.69	0.47	15.5		7.55
Mar-09			4.7	0.0	56		170	160	227.5	202	185	1.0	3.6				64.9	290.3	1,490.7		17,765.5		0.0	18.4		
Sep-09	321		7.4	0.0				45.3	240		73		2.9	0.0	1.05	0.0		99	792.8	407.8	20,578	17.5	0.5	12.4		11
Mar-10			5.7	0.0	23.8		107	57	190	148	173	2.7	3.1				0.5	61.4	2.4		15,222		0.0	12.4		
Sep-10	329		4.8		6.9				182		18		2.7	0.0	0.0	0.0		1,230	3,650	1,030	21,900	13.5		14.2		8.0
Mar-11	381		4.6		6.0		166	173	152	9.0	136	5.0	2.8				16.3	152	108		15,400			15.9		
Nov-11	275	3.3			46.8	39			185		141		4.17	0.0	0.0	0.0		205	166	1,250	15,700	23.8		11.7		10.3
Mar-12	283.8	5.4	5.31	1.1	20.1	3.7	68.8	69.7	238.8	114.6	281.6	0.0					1,442.6	1,191.4	2,650.7	1,029.9	27,334		0.0		318.4	
Sep-12	185.4				9.9	19.46			127.2		6.22		2.24		0.0	1.35	0	879.2	3980	1919	25,350	33		10.79		
Mar-13	377.2	5.3	4.0	0.57	36.17	69.6	167.4	140.4	232.5	183.4	49.2	2.85					1.0	27.67	4.22	1278.45	26,977		0.61		618.4	
Sep-13	211.72				27.67	43.7			240.7		327		5.63	0.0	1.76	0.0		482	135.6	865.9	5,918	15.65		10.91		8.98
R^2	0.83				0.19	0.62	0.12	0.25	0.53	0.29	0.37						0.19	0.080	0.449	0.266	0.002	0.885		0.056		
	log.				log.	exp.	exp.	exp.	log.	exp.	log.						log.	exp.	log.	log.	log.	log.		exp.		

Notes:
Regression data were not calculated for wells with mostly trace/non-detect values or which have few data points.
Non-detect results are assigned a value of zero.
(1) Although the "total COC" values from November 2011 through present respresent a shorter analyte list than the "total CVOCs" from previous sampling events (Q1 through Q31), the results are presented herein as a relative comparison because, based on previous sampling data, the Site 3 COCs comprise over 98 percent of the total CVOC concentrations.
exp. = exponential regression
log. = logarithmic regression
R^2 = regression coefficient of determination for total CVOCs

TABLE 3-8
SUMMARY OF TOTAL CVOC REGRESSION DATA
GROUNDWATER MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

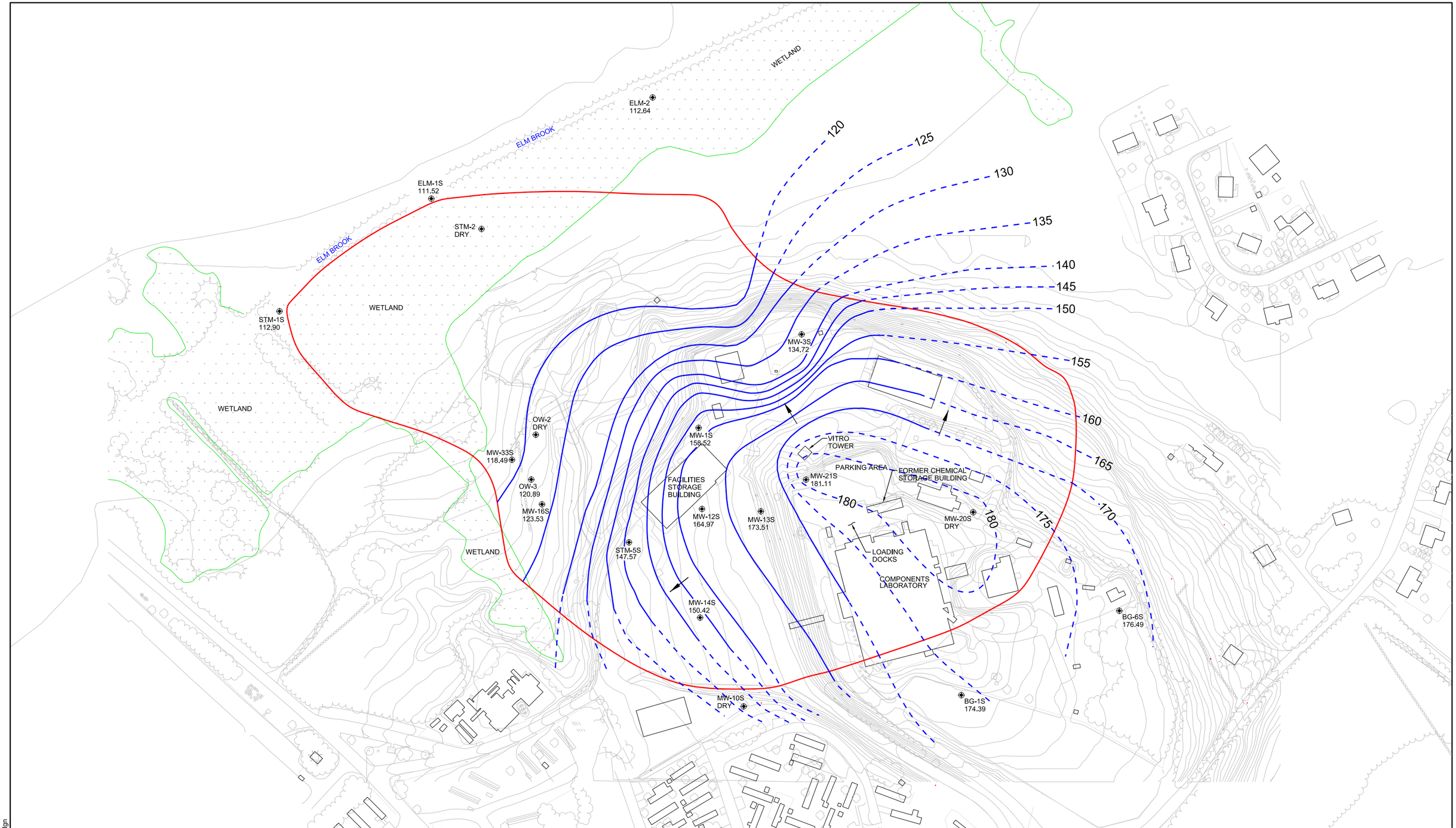
Event	MW-20S	MW-21R	MW-21S	MW-22R	MW-26R	MW-32I	MW-32S	MW-33I	MW-33S	MW-52I	MW-67I	MW-68I	MW-72I	MW-73I	MW-76S	OW-2	OW-3	STM-1S	STM-2	STM-5R	STM-5S
Feb-97		2,398	6,436													433		2.0	187	0.0	2296
Nov-97		2,656	7,780													194		0.0	297	0.0	1969
Feb-98		1,390	7,554													10.8		0.0	414	0.0	2927
May-98																1.0	393	2.0	247	0.0	3037
Sep-98						639.4	51.3	352.4	373.6							84.1	246.2	0.9	226.9	0.0	1531
Mar-99			4,592.2			628.4	44.1	404.8	11.92							10.4	157.7	15.5	106.9	0.0	1633.1
May-99					0.0	543.9		335.3										18.6	89.5		1873.7
Aug-99						722.5		334.8										25.6	242.9		1719.7
Nov-99						494.2		241.6										14.6	82.5		1073.1
Feb-00			5,353.4			551.9	0.0	267.3	10.6							0.0	66.1	17.1	67.8	0.0	1034
Aug-00																47.1		16.7	42.4		
Feb-01			4,052			292	0.0	244	4.0							0.0	80	12	27	0.0	1402
Aug-01																25		8.0	38		
Feb-02						301	0.0	316	141							0.0	65	9.0	16		
Aug-02																		3.0	63		
Feb-03			3,071			140.5	0.0	232.2	0.2							0.3	89.9	5.3	13.4	0.0	1840
Jul-03																2.61		6.76	10.49		
Feb-04			4,426.2			208	0.0	225.5	169							0.41	51.75	3.73	11.21	0.0	1279.1
Jul-04																13.9		2.8	10		
Feb-05			4,119			147.8	0.35	165.5	7.5							0.0	193.1	2.0	7.4	0.0	949.2
Aug-05																7.59		2.16	15.17		
Apr-06			2,594.9			118.5	0.0	180	29.7							0.0	67.1	0.0	3.2	1.1	927.1
Aug-06		1,658.2		1.2	0.0											9.62		1.87	8.4	0.0	
Apr-07			3,000.4			146	0.0	193.1	0.0							0.0	126.3	0.0	14.06	0.0	150.2
Aug-07		1,186.3		4.0	1.0													2.0	23.38		
Mar-08			2,670			109.2	0.89	176.8	0.0							0.0	172.5	1.34	7.08	0.0	1164.73
Aug-08		1,190		4.9	0.0											0.0		1.37	6.85	0.0	
Mar-09			1,959.9			66	0.6	143	11.9							0.0	169	1.6	6.7	2.3	272.2
Sep-09		1,082.9		3.1	0.0											12.5		1.0	11.5	0.0	
Mar-10			2,207.4			70	16.8	188	0.0							0.7	172	1.2	3	0.0	18
Sep-10		1,150		1.6	0.0													0.5	13.2	0.6	
Mar-11			1,870			70	16.5	182	3.4							0.0	195	2.1	6.7	0.0	450
Nov-11		1,240		1.81	0.0											0.5			5.86	0.0	
Mar-12	149.0		1,306			35.1	3.0	153.1	109.9	20788	105.1	170.5	64.38	231		3.5	41	0.58	3.25		364
Sep-12	325.7		1,141.0	2.34	2.34	0											37.52		7.97	0.0	0.0
Mar-13	167.8		2,528.3			45.8	3.3	208.3	208.4	54,902	92.0	433.0	4.5	11.6	7558.2	0.0	169.5	0.0	3.6		1041.62
Sep-13		1221.1		3.3	0.68											26.3			314	0.0	
R^2		0.659	0.84			0.9437		0.6771	0.025							0.178	0.041		0.511		0.621
		exp.	exp.			exp.		exp.	exp.							log.	log.		exp.		log.

Notes:
Regression data were not calculated for wells with mostly trace/non-detect values or which have few data points.
Non-detect results are assigned a value of zero.
(1) Although the "total COC" values from November 2011 through present respresent a shorter analyte list than the "total CVOCs" from previous sampling events (Q1 through Q31), the results are presented herein as a relative comparison because, based on previous sampling data, the Site 3 COCs comprise over 98 percent of the total CVOC concentrations.
exp. = exponential regression
log. = logarithmic regression
R^2 = regression coefficient of determination for total CVOCs

Site 3 Groundwater Potentiometric Maps

Site 3 Groundwater Monitoring Report — September 2013

(AGVIQ-CH2MHill, 17 December 2013)



LEGEND

- GROUNDWATER MONITORING WELLS
- 123.45 GROUNDWATER ELEVATION (ft MSL)
- INTERPRETED GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION
- 200 TOPOGRAPHIC LINE
- SITE 3

N

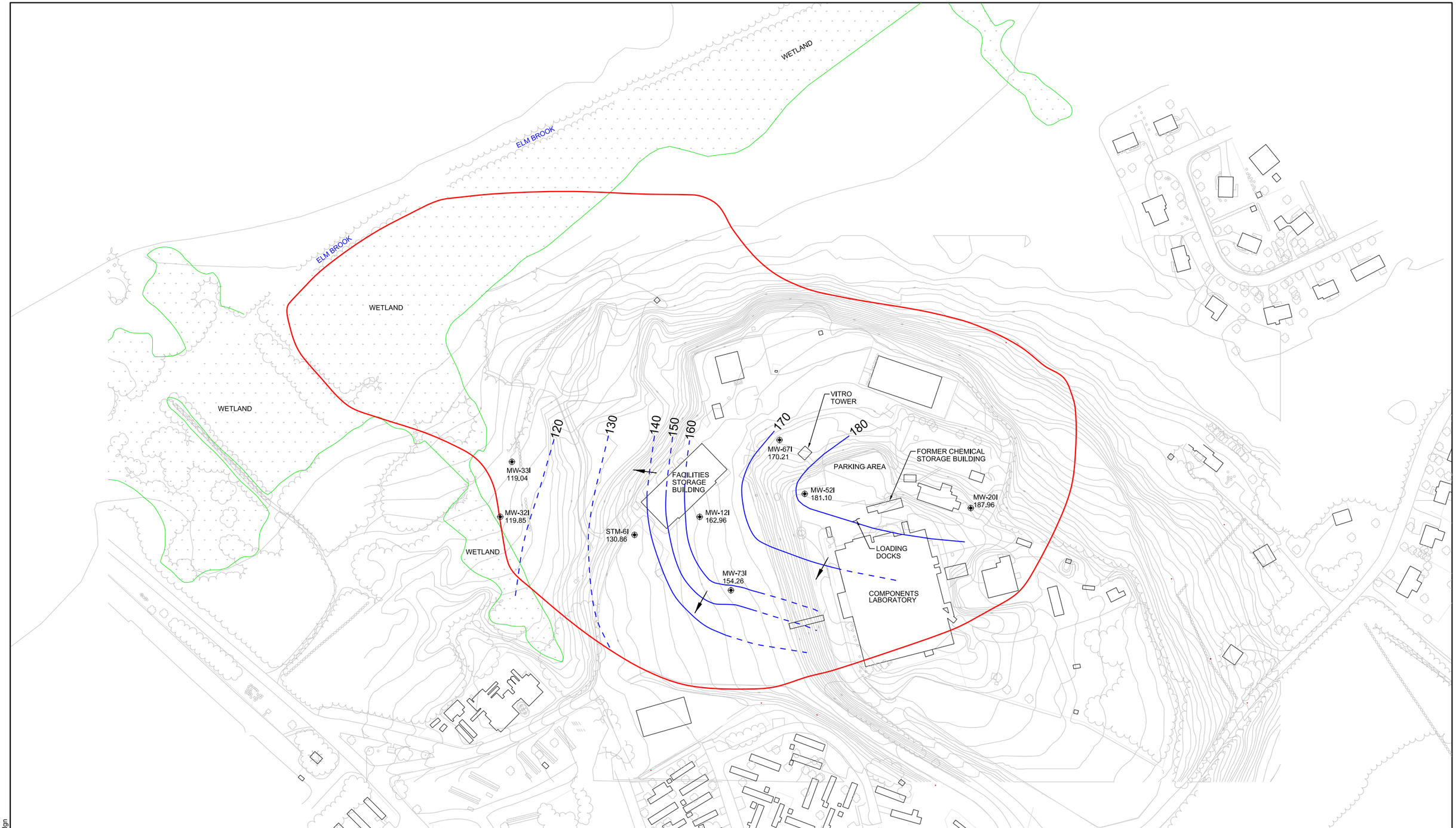
0 100 200 300
SCALE IN FEET

AGVIQ
AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL
JOINT VENTURE

FIGURE 3-1
INTERPRETED GROUNDWATER CONTOURS
SHALLOW OVERBURDEN, SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

FILENAME: Figure 3-1 Sept 2013.dgn

423171.04



LEGEND

- GROUNDWATER MONITORING WELLS
- 123.45 — GROUNDWATER ELEVATION (ft MSL)
- INTERPRETED GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION
- 200 — TOPOGRAPHIC LINE
- SITE 3

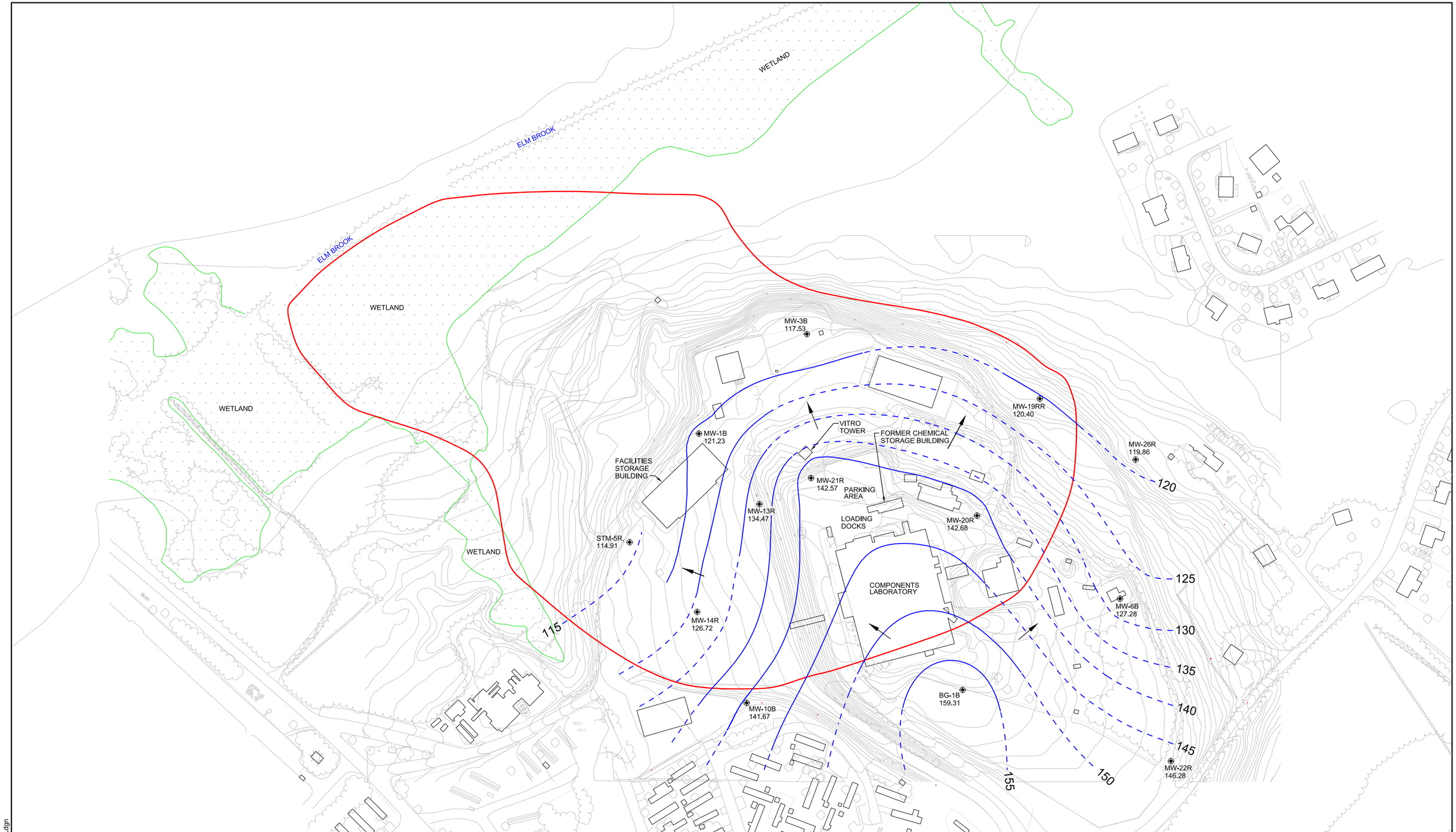
AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL JOINT VENTURE

N

0 100 200 300
SCALE IN FEET

FIGURE 3-2
INTERPRETED GROUNDWATER CONTOURS
DEEP OVERBURDEN, SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

FILENAME: Figure 3-2 Sept 2013.dgn
423171.04



LEGEND

◈	GROUNDWATER MONITORING WELLS
123.45	GROUNDWATER ELEVATION (ft MSL)
	INTERPRETED GROUNDWATER CONTOUR
→	GROUNDWATER FLOW DIRECTION
200	TOPOGRAPHIC LINE
	SITE 3

AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL JOINT VENTURE

N

0 100 200 300
SCALE IN FEET

FIGURE 3-3
INTERPRETED GROUNDWATER CONTOURS
BEDROCK, SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

FILENAME: Figure 3-3 Sept 2013.dgn

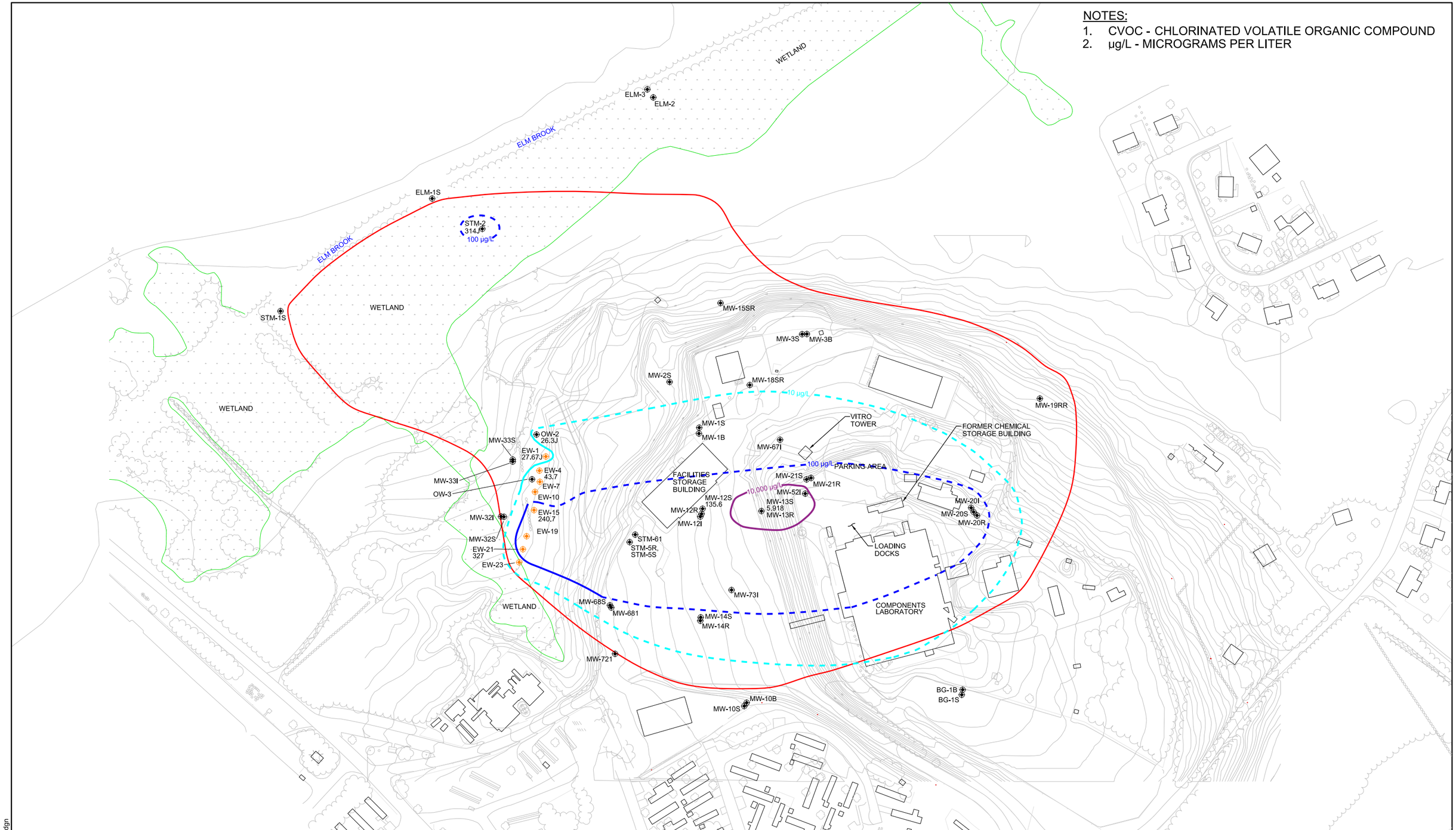
423171.04

Site 3 Groundwater CVOC Isocontours

Site 3 Groundwater Monitoring Report — September 2013

(AGVIQ-CH2MHill, 17 December 2013)

NOTES:
1. CVOC - CHLORINATED VOLATILE ORGANIC COMPOUND
2. µg/L - MICROGRAMS PER LITER



LEGEND

- GROUNDWATER MONITORING WELLS
- EXTRACTION WELLS
- "J" ESTIMATED
- 200 TOPOGRAPHIC LINE
- SITE 3

INTERPRETED LINE OF EQUAL TOTAL CVOC CONCENTRATION (µg/L)

- 10,000
- 1,000
- 100
- 10

N

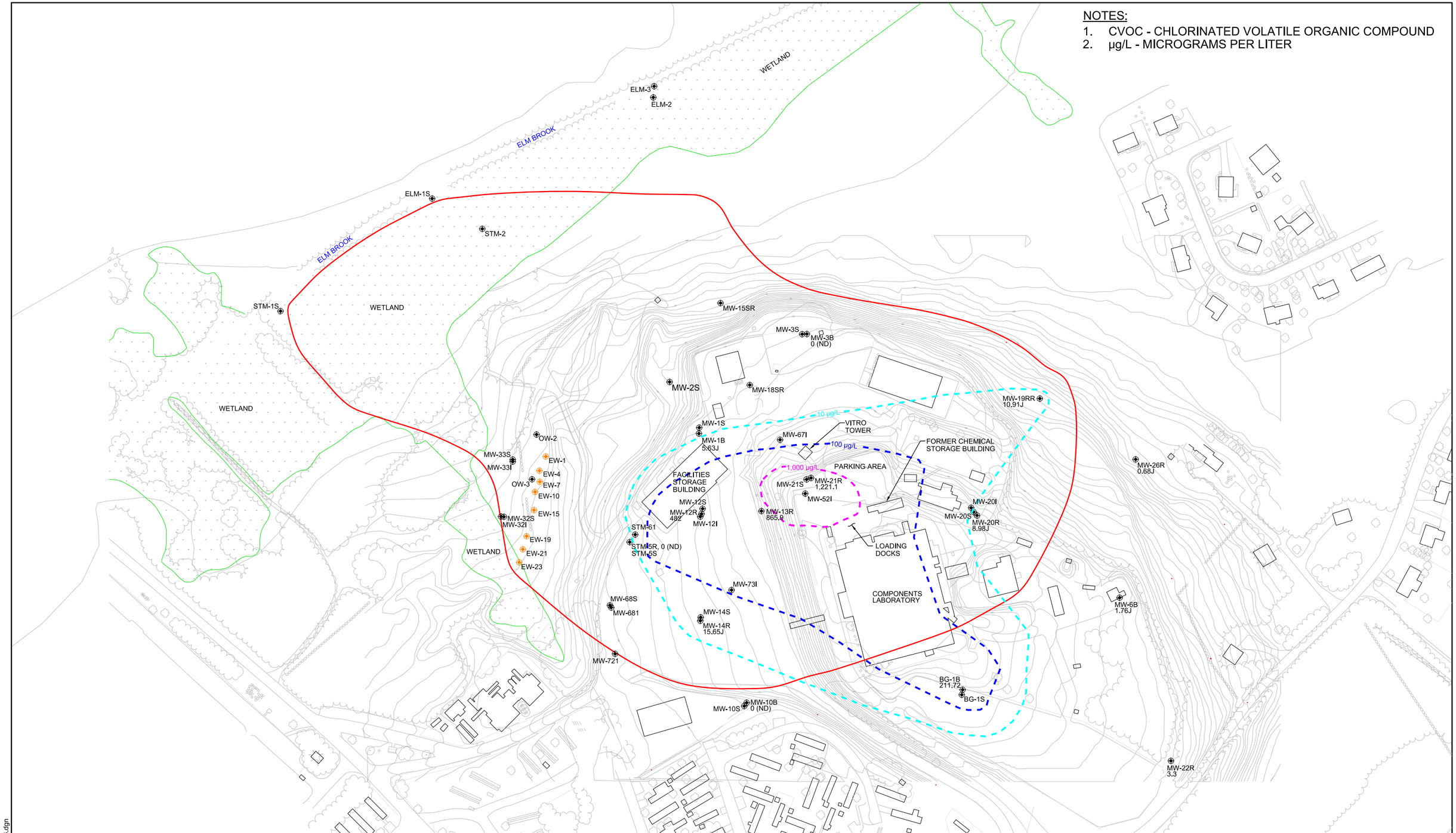
0 100 200 300
SCALE IN FEET

AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL JOINT VENTURE

FIGURE 3-4
INTERPRETED TOTAL CVOC CONCENTRATIONS
IN SHALLOW OVERBURDEN
GROUNDWATER, SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

FILENAME: Figure 3-4 Sept 2013.dgn
423171.04

NOTES:
1. CVOC - CHLORINATED VOLATILE ORGANIC COMPOUND
2. µg/L - MICROGRAMS PER LITER



AGVIQ
AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL
JOINT VENTURE

LEGEND

- GROUNDWATER MONITORING WELLS
- EXTRACTION WELLS
- "J" ESTIMATED
- 200 TOPOGRAPHIC LINE
- SITE 3

INTERPRETED LINE OF EQUAL TOTAL CVOC CONCENTRATION (µg/L)

- 10,000
- 1,000
- 100
- 10

N

0 100 200 300
SCALE IN FEET

FIGURE 3-5
INTERPRETED TOTAL CVOC CONCENTRATIONS
IN BEDROCK GROUNDWATER, SEPTEMBER 2012
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

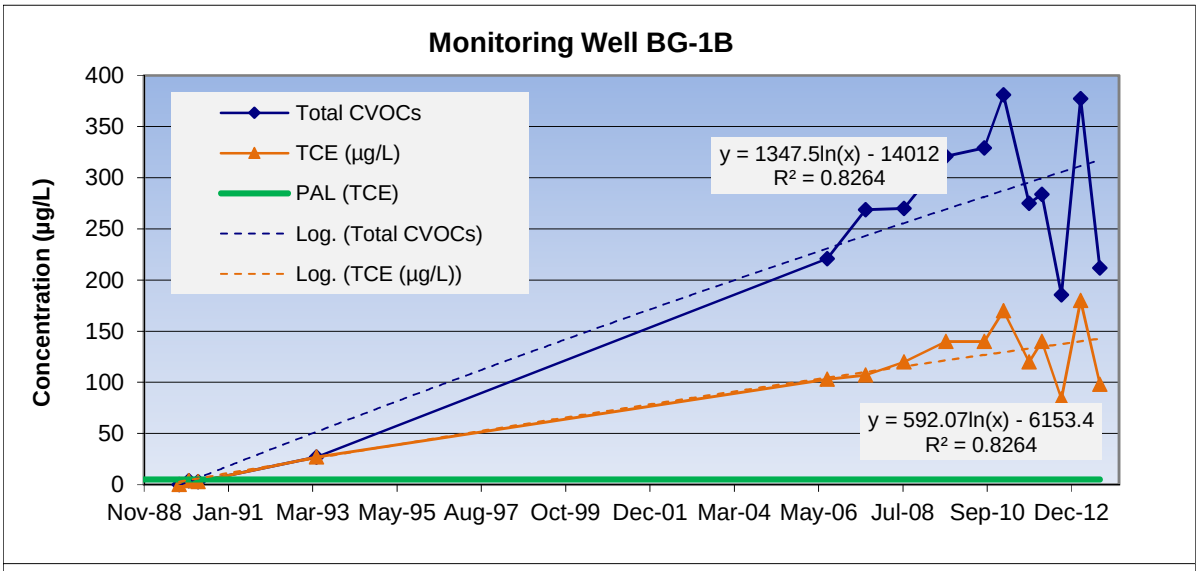
FILENAME: Figure 3-5 Sept 2013.dgn
423171.04

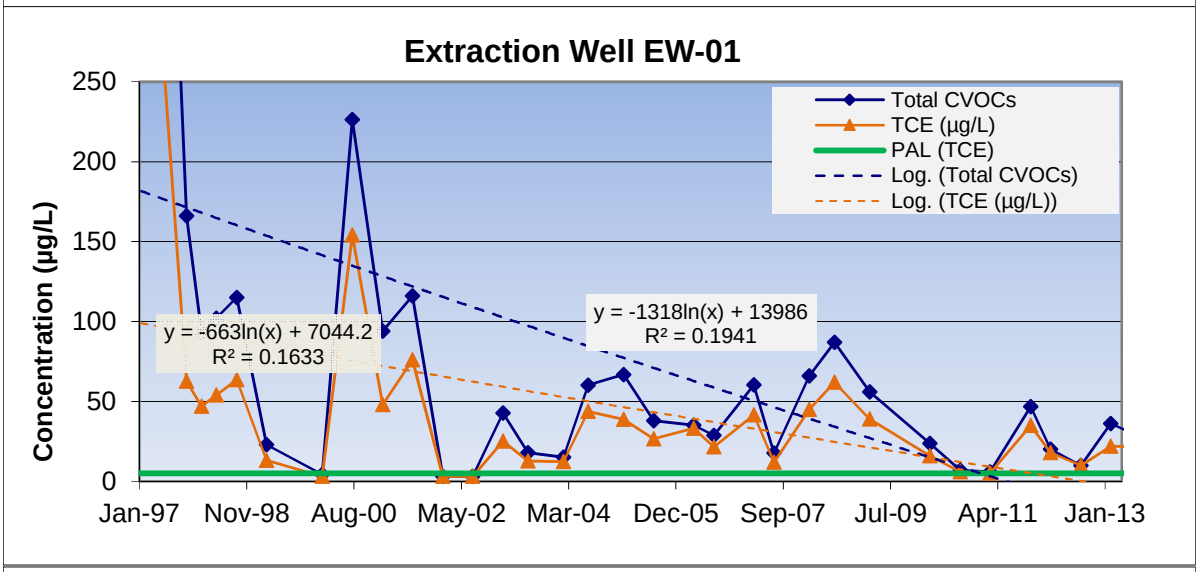
Site 3 Groundwater CVOC Trend Plots

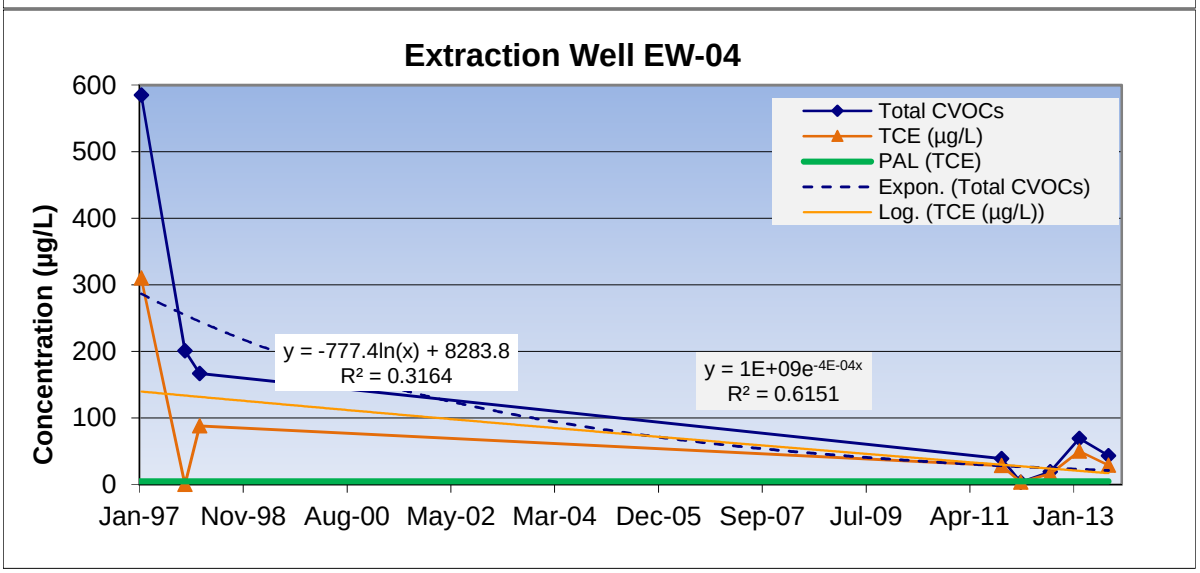
Site 3 Groundwater Monitoring Report — September 2013

(AGVIQ-CH2MHill, 17 December 2013)

FIGURE 3-6
TOTAL CVOC AND TCE TREND GRAPHS – SITE 3 WELLS ON NAVY PROPERTY, SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT, BEDFORD, MASSACHUSETTS

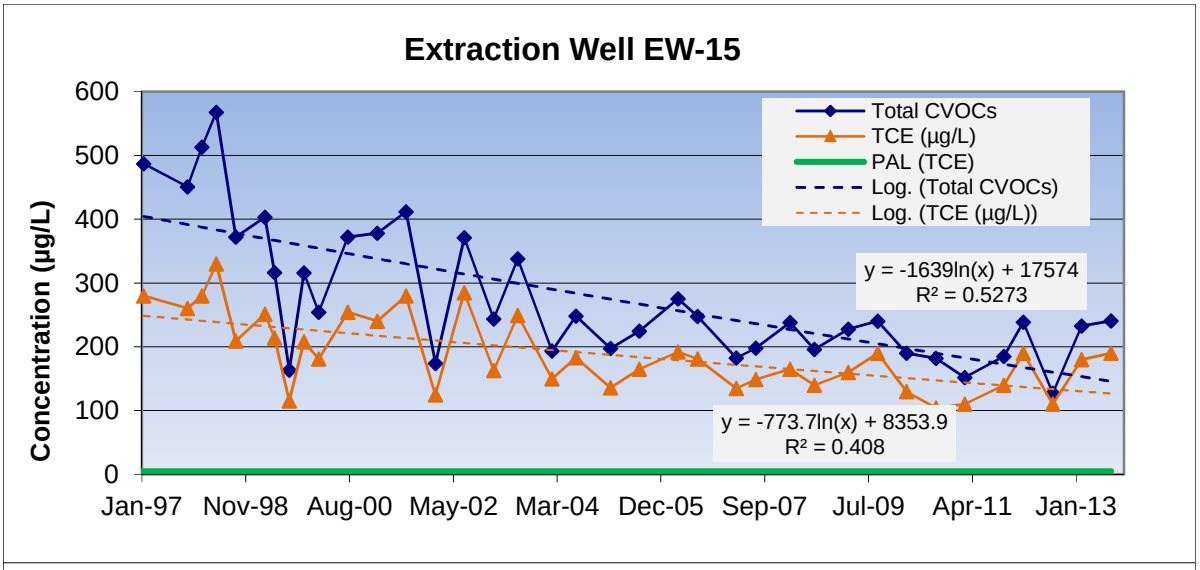


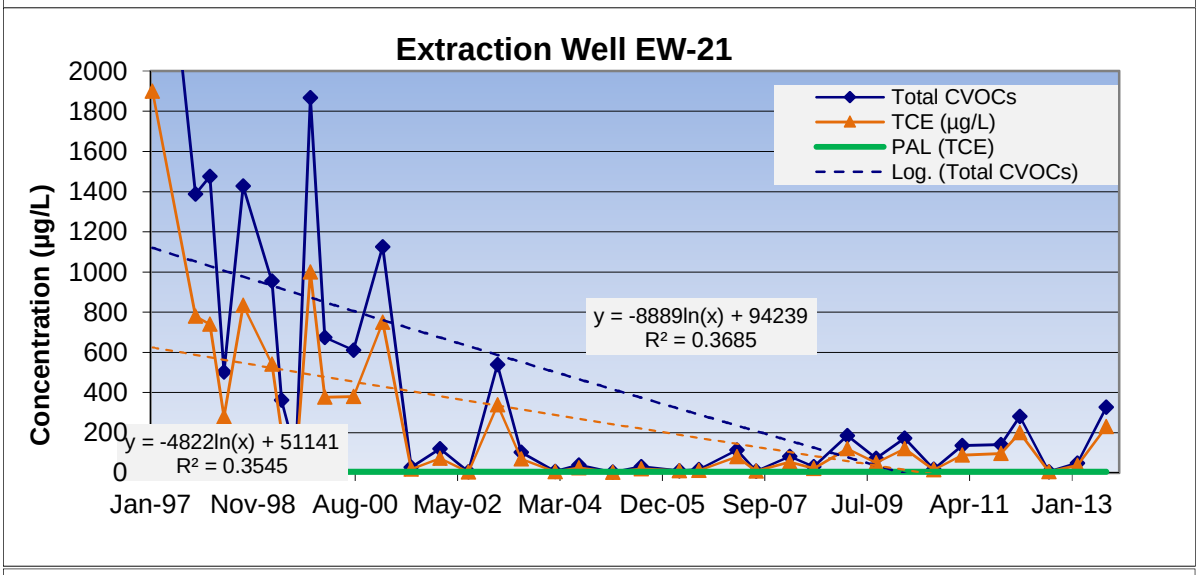




Note: November 2011 - March 2013 data points represent total COCs rather than total CVOCs; however, past sampling data indicate that this comprises over 98% of total CVOCs at Site 3.

FIGURE 3-6
TOTAL CVOC AND TCE TREND GRAPHS – SITE 3 WELLS ON NAVY PROPERTY, SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT, BEDFORD, MASSACHUSETTS





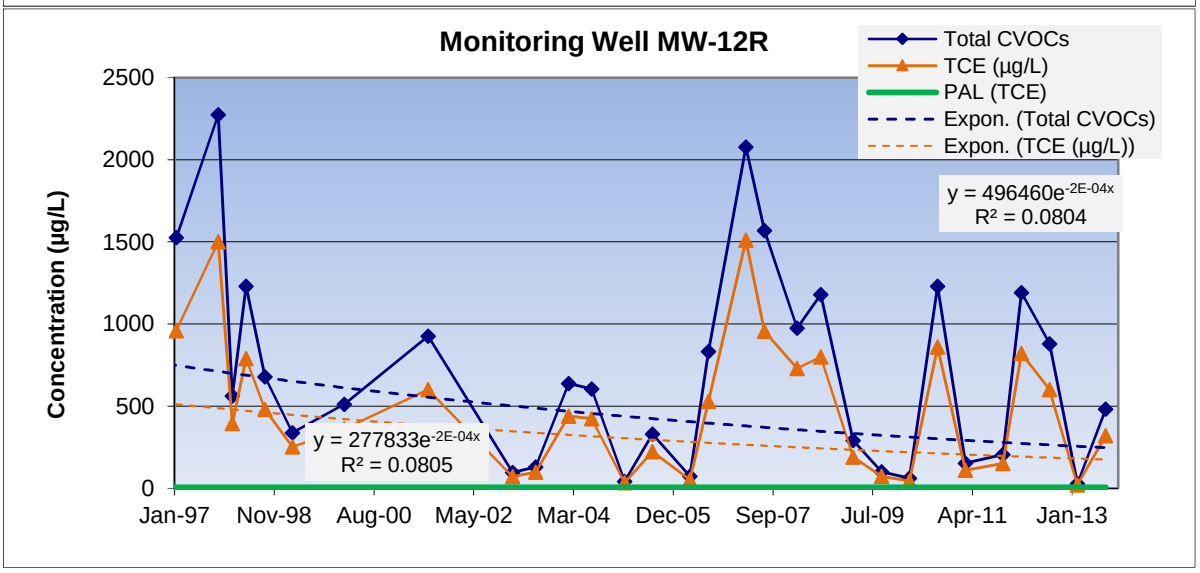


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FIGURE 3-6
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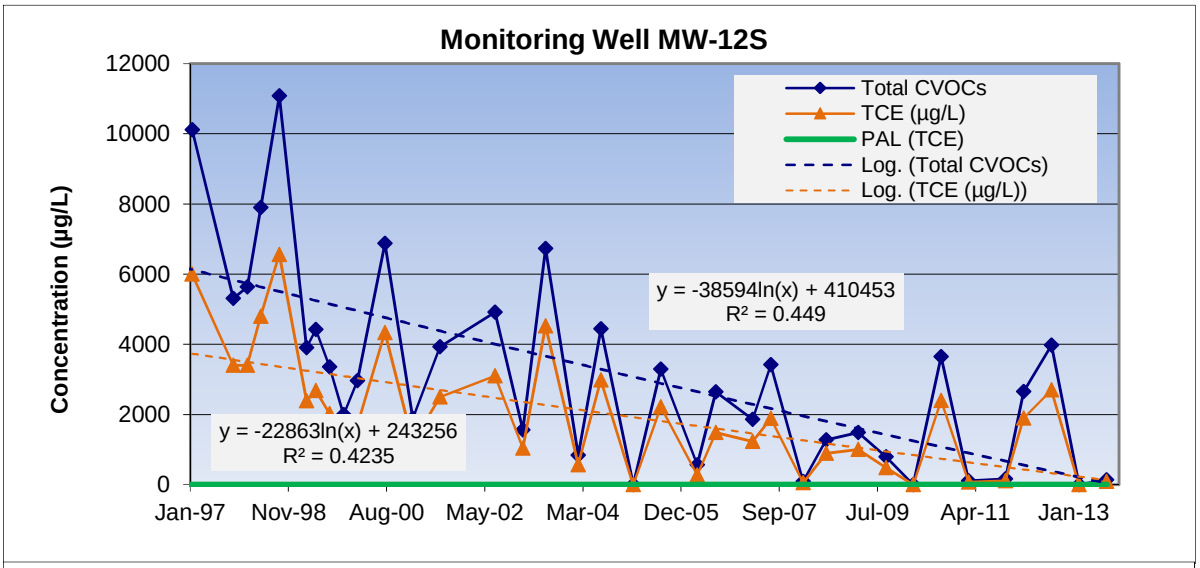
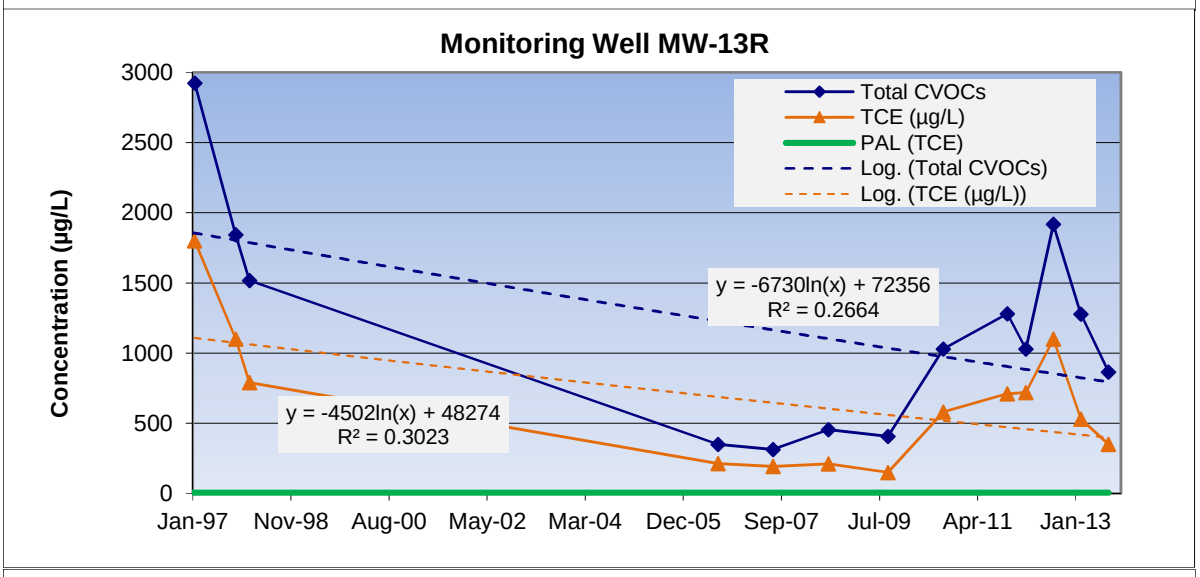
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT, BEDFORD, MASSACHUSETTS





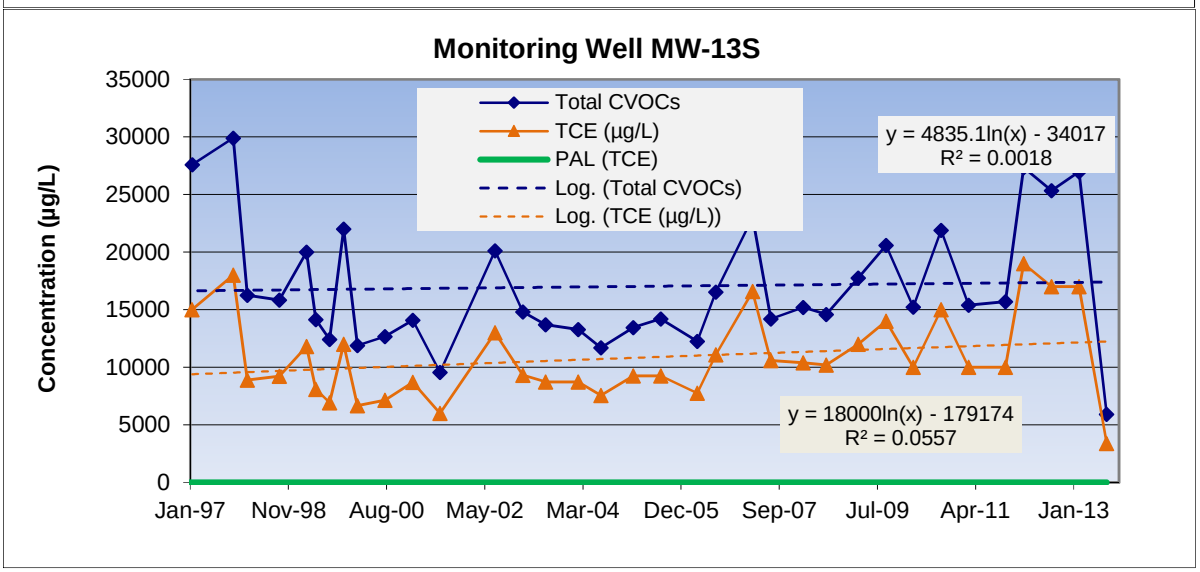


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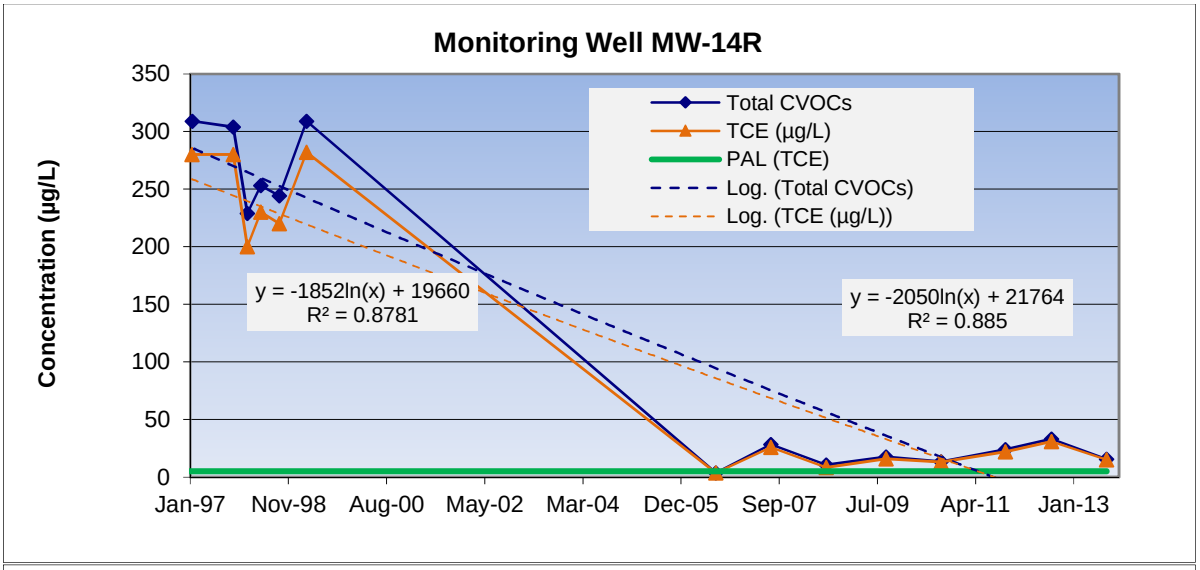
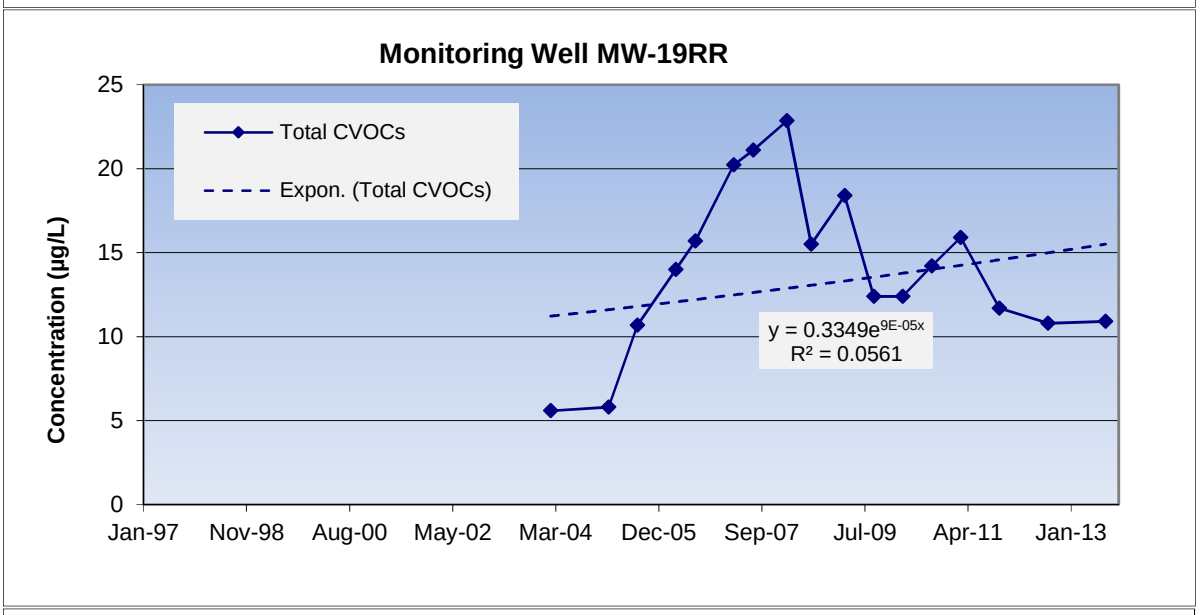
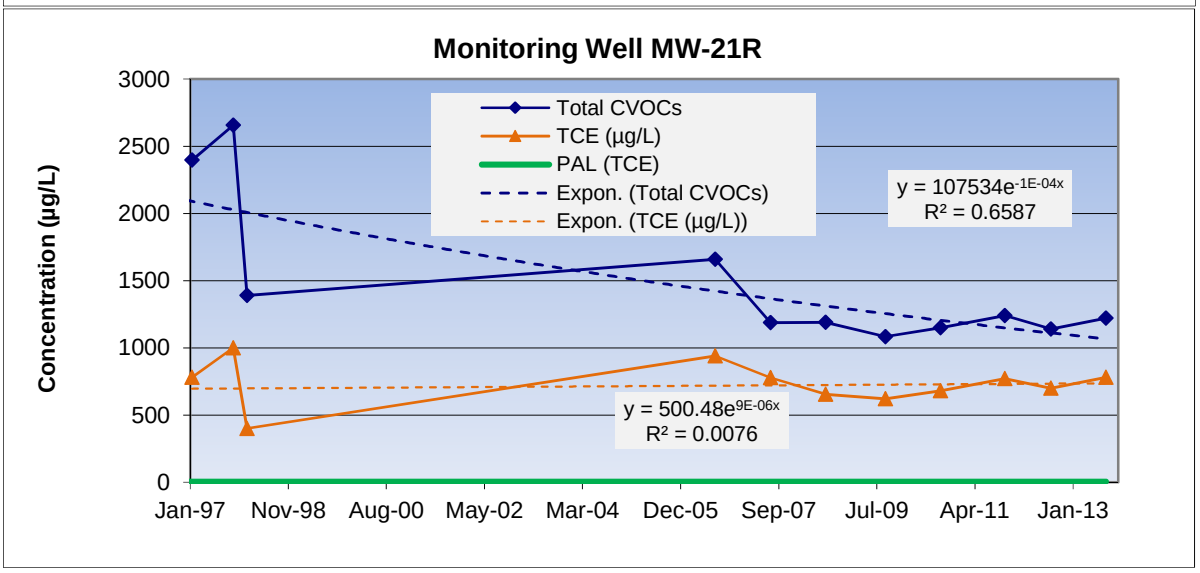
FIGURE 3-6
TOTAL CVOC AND TCE TREND GRAPHS – SITE 3 WELLS ON NAVY PROPERTY, SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT, BEDFORD, MASSACHUSETTS

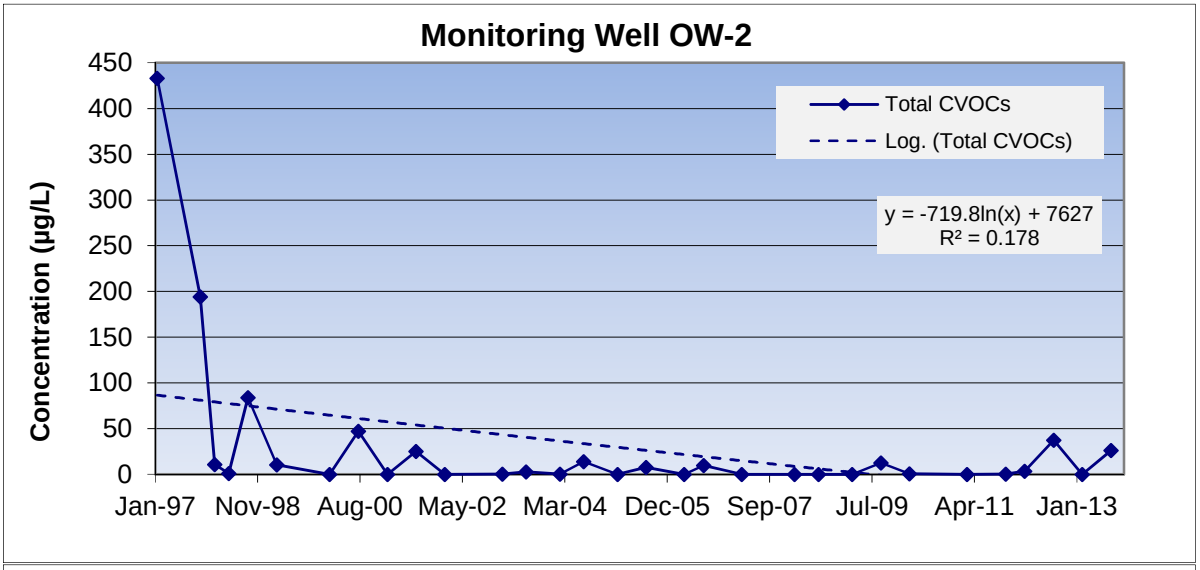


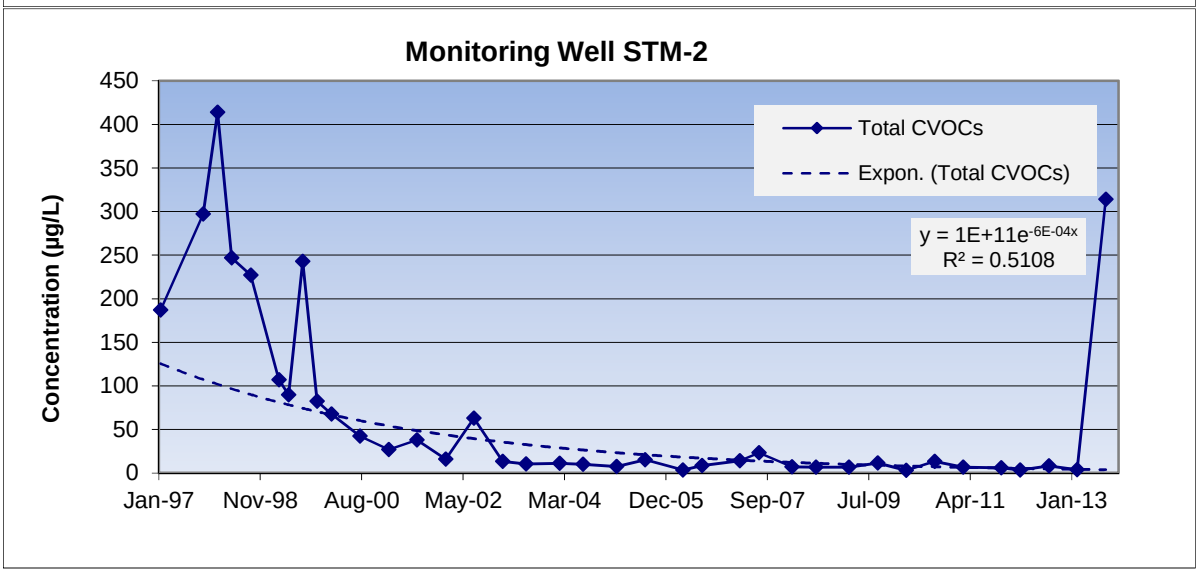




Note: November 2011 - March 2013 data points represent total COCs rather than total CVOCs; however, past sampling data indicate that this comprises over 98% of total CVOCs at Site 3.

FIGURE 3-6
TOTAL CVOC AND TCE TREND GRAPHS – SITE 3 WELLS ON NAVY PROPERTY, SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT, BEDFORD, MASSACHUSETTS





Note: November 2011 - March 2013 data points represent total COCs rather than total CVOCs; however, past sampling data indicate that this comprises over 98% of total CVOCs at Site 3.

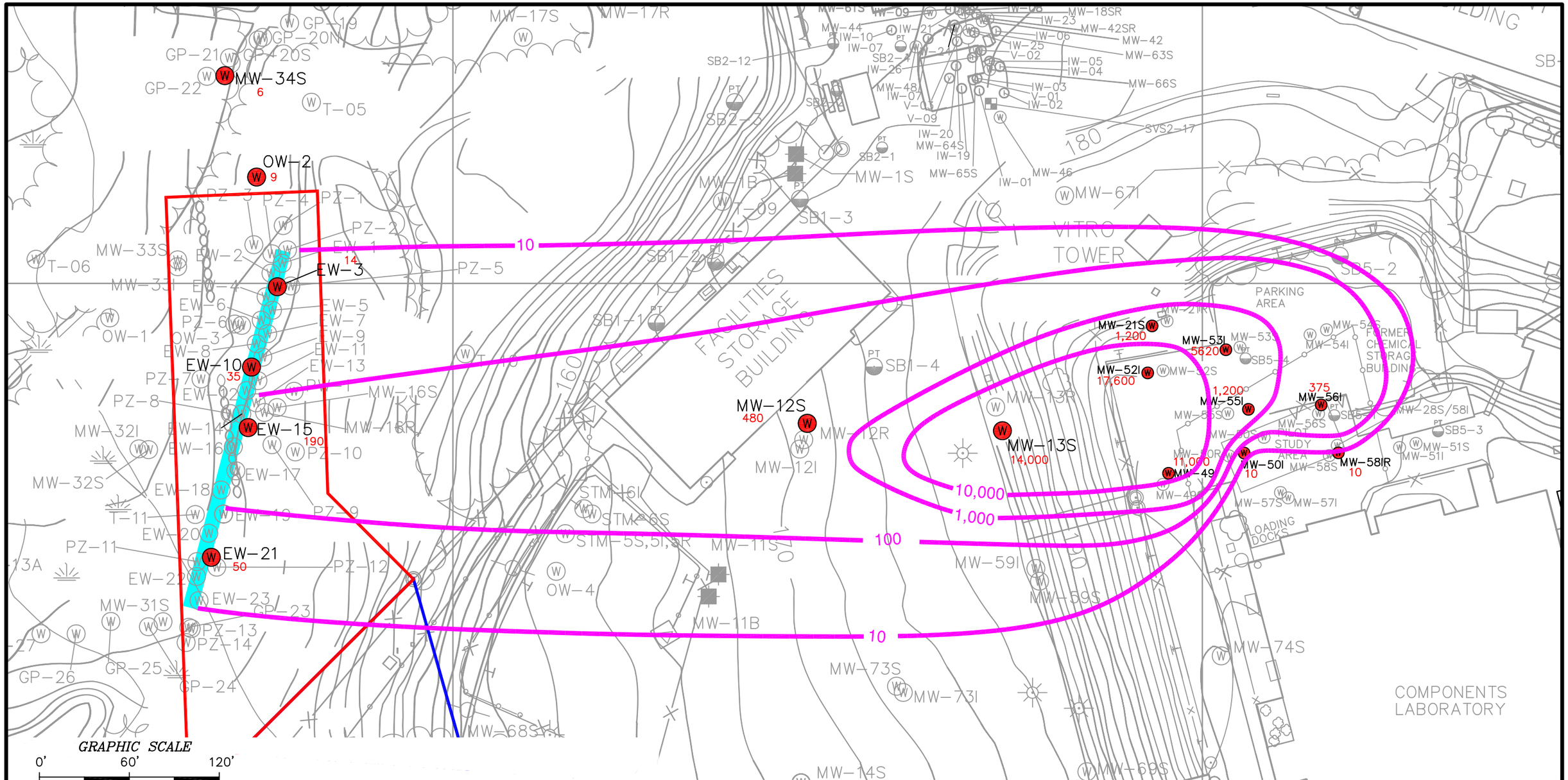
Appendix C

Site 3 GWETS System Design and Performance Information

Site 3 GWETS System Location and Plume Figure

Feasibility Study for Site 3 — Chlorinated Solvent Plume

(Tetra Tech, 01 June 2010)



MW-13S MONITORING WELL AND IDENTIFIER

2,300 TCE CONCENTRATION (2009–2010) (µg/L)

TCE CONTOUR (2009–2010) (µg/L)

IRA EXTRACTION SYSTEM

TETRA TECH
WWW.TETRATECH.COM
55 JONSPIN ROAD
WILMINGTON MA, 01887
T: (978) 474–8400 | F: (978) 474–8499

TCE (µg/L) IN GROUNDWATER (2009-2010)
SITE 3 FS
NWIRP BEDFORD, MASSACHUSETTS

DATE:	06/17/10
PROJECT NO.:	GN5676
DESIGNED BY:	J. ROPP
DRAWN BY:	D.W. MACDOUGALL
CHECKED BY:	J. ROPP
FIGURE NUMBER:	2–9

FILE: \5676\0611\NWIRP_SITE_3_TCE_CONTOUR_MAP.DWG

COPYRIGHT TETRA TECH INC.

Site 3 GWETS November 2013 System Operation Report

November 2013 Monthly Operations Report

(H&S Environmental, 18 December 2013)

H&S ENVIRONMENTAL
...an 8(a), SDB, woman-owned company

18 December 2013

Naval Facilities Engineering Command Mid-Atlantic
9742 Maryland Ave, Building Z-144
Norfolk, Virginia 23511-3095
Attn: Ms. Maritza L. Montegross (Code: OPNEEV)

Subject: US NAVY CONTRACT NO. N40085-12-D-1717
CONTRACT TASK ORDER 0001
FORMER NAVAL WEAPONS INDUSTRIAL RESERVE PLANT (NWIRP) BEDFORD, MA
NOVEMBER 2013 MONTHLY OPERATIONS REPORT

Ms. Montegross:

This report provides a summary of operation and maintenance (O&M) activities at the Naval Weapons Industrial Reserve Plant (NWIRP) Groundwater Extraction Treatment System (GWETS) during the reporting period from 1 November 2013 through 2 December 2013.

During this reporting period, the system operated for a total of 720 hours with 24 hours of scheduled down time related to a routine liquid phase carbon change out event performed on 20 November 2013. Approximately 273,633 gallons of groundwater were treated at an average flow rate of 6.3 gallons per minute (gpm). Operational data and non-routine O&M activities performed during this reporting period are detailed in **Table 1**. **Table 2** presents extraction well performance during this reporting period. As indicated in **Table 2**, all extraction wells were operating normally during the reporting period.

Five treatment system samples were collected on 4 November 2013. One sample was collected from each of the following locations: plant influent (BF-INF), influent of the first liquid-phase granular activated carbon (LGAC) unit (BFGAC-INF), midfluent between the first and second LGAC units (BFGAC-MID), effluent of the second LGAC unit (BFGAC-EFF), and plant effluent (BF-EFF). All samples were submitted to Accutest Laboratories of Marlborough, MA under a chain of custody and analyzed for Volatile Organic Compounds (VOCs) by USEPA Method 8260B, metals (iron and manganese) by USEPA Method 6010C, total dissolved solids (TDS) by USEPA Method 160.1, total suspended solids (TSS) by USEPA Method 160.2, and pH by USEPA Method 150.1. Analytical results of the five treatment system samples are presented in **Table 3**.

VOCs of concern at the site consist of 1,1-dichlorothene (1,1-DCA), 1,1-dichlorothene (1,1-DCE), tetracholoroethene (PCE), trichloroethene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA). Concentrations of these VOCs in the system influent (BF-INF) (**Table 3)** were used to calculate contaminant mass removal by the GWETS **(Table 4)**. As indicated in **Table 4**, a total of 0.35 lbs

of VOCs were removed by the GWETS in November 2013, and cumulatively, 132.76 lbs of VOCs have been removed since start up of the GWETS in 1997.

Concentrations of constituents detected in the plant effluent (BF-EFF), along with their associated discharge limits, are also presented in **Table 3.** TDS was detected in the plant effluent at a concentration of 253 mg/L. This is a historic condition that dates back to the start of the treatment system in 1997, as the current system is not designed to remove TDS. No organic compounds were detected above discharge limits in the plant effluent in November 2013, indicating that all VOCs of concern are being effectively removed by the GWETS.

The following attachments are provided for reference with this report:

- Attachment A provides graphical presentations of contaminant concentrations versus time. Influent concentrations of VOCs of concern are presented, as are influent and effluent concentrations of iron, manganese, and TDS. Overall influent concentrations remained consistent with that of the previous monitoring period and overall trends appear to be decreasing.

- Attachment B graphically presents the monthly flow of the GWETS (as total influent flow) from system start up in 1997 through 2 December 2013. Also included is the monthly precipitation during this reporting period. Overall, the monthly flow was in the normal operating range.

- Attachment C graphically presents contaminant mass removal by the GWETS over time (based on influent concentrations and flow rates). Total contaminant mass removal for this reporting period as well as cumulative mass removed from system start up in 1997 through 2 December 2013 are presented.

- Attachment D contains laboratory analytical data.

Please contact me at 484-880-1896 or pschauble@hsenv.com with any questions or concerns regarding this report.

Sincerely,
H&S Environmental, Inc.

Patrick Schauble, P.E.
Senior Project Manager

Cc: Mr. Matt Audet (USEPA)
Mr. James Ropp (TtNUS)
Mr. David Gallagher (MADEP)
Plant Copy - NWIRP Bedford

TABLES

Table 1
Monthly Operations Summary
Naval Weapons Industrial Reserve Plant
Bedford, Massachusetts
November 2013

Item	Quantity	Unit
Influent Volume (1)	273,633	Gallons
Effluent Volume (3)	84,702	Gallons
Hours Operational (2)	720	Hours
Average Flow Rate	6.3	gpm
% Time On-Line	96.8	%
Hrs Downtime	24	Hours
Influent pH	6.0	S.U.
Effluent pH	7.0	S.U.
Caustic Usage	14	Gallons
Polymer Type	NA	
Stock Solution Strength	NA	
Polymer Dosage	NA	ppm
Polymer Usage	NA	Gallons
Multimedia Filter Backwash	4,857	Gallons
Bag Filter Usage	0	Bags
Carbon Backwash	0	Times
Carbon Changeout	11/20/2013	Date
Carbon Changeout	2,000	Pounds
Sludge Volume in TA-5	NA	Gallons
Sludge Dewatered	NA	Gallons
Sludge Dewatered	NA	Drums

Notes:
gpm = gallons per minute
S.U. = Standard units
ppm = parts per million
(1) Influent flow total calculated from PC-3 flow meter
(2) Hours operational calculated from 1 November 2013 through 2 December 2013
(3) Water is taken from the effluent holding tank and used for injection activities

Operational Notes

Date	Note
1-Nov-13	Reset monthly totalizers.
4-Nov-13	Collected monthly samples.
12-Nov-13	Checked all pumps.
19-Nov-13	Shut down wells and drained carbon in preparation for LGAC changeout.
20-Nov-13	Change out both LGACs. Rebedded with virgin carbon. Restarted system (downtime approx 24 hrs).
2-Dec-13	Reset monthly totalizers.
Weekly	Backwashed each multimedia filter.
	Cleaned / calibrated pH probes.
	Checked / filled caustic tanks.
	Cleaned PC-1 strainers.
	Checked / inspected pump house.

Table 2
Extraction Well Performance Summary
Naval Weapons Industrial Reserve Plant
Bedford, Massachusetts
November 2013

Well ID	Date[1] 11/1/2013 (gal)	Date[1] 12/2/2013 (gal)	Comments
EW-1	1	2,776	The extraction well is operating normally.
EW-2	4	1,125	The extraction well is operating normally.
EW-3	0	101	Totalizer malfunction on 12/3/13.
EW-4	3	384	The extraction well is operating normally.
EW-5	9	525	The extraction well is operating normally.
EW-6	9	775	The extraction well is operating normally.
EW-7	5	285	The extraction well is operating normally.
EW-8	4	431	The extraction well is operating normally.
EW-9	2	439	The extraction well is operating normally.
EW-10	2	688	The extraction well is operating normally.
EW-11	5	158	The extraction well is operating normally.
EW-12	2,066	3,482	The extraction well is operating normally.
EW-13	33	192	The extraction well is operating normally.
EW-14	47	4,548	The extraction well is operating normally.
EW-15	26	78	The extraction well is operating normally.
EW-16	30	41	The extraction well is operating normally.
EW-17	4,770	8,821	The extraction well is operating normally.
EW-18	1,820	635	The extraction well is operating normally.
EW-19	26,230	26,715	The extraction well is operating normally.
EW-20	273	37,065	The extraction well is operating normally.
EW-21	105,682	34,881	The extraction well is operating normally.
EW-22	74,095	93,504	The extraction well is operating normally.
EW-23	14,151	6,043	The extraction well is operating normally.

Notes:
(1) Reading taken at totalizer on date indicated. Totalizer is then reset to zero.

Table 3
Analytical Data Summary
Monthly Treatment Plant Samples
Naval Weapons Industrial Reserve Plant
Bedford, Massachusetts
4 November 2013

Analyte	Discharge Limits (1)	BF-INF	(2)	units	BFGAC-INF	(2)	units	BFGAC-MID	(2)	units	BFGAC-EFF	(2)	units	BF-EFF	(2)	units
VOLATILE ORGANIC COMPOUNDS																
1,1-Dichloroethane (1,1-DCA)	NC	**5.3**		µg/L	**2.9**		µg/L	**3.3**		µg/L	**1.5**		µg/L	**1.2**		µg/L
1,1-Dichloroethene (1,1-DCE)	7 µg/L	**17.0**		µg/L	**6.1**		µg/L	**3.6**		µg/L	0.67	U	µg/L	0.67	U	µg/L
cis-1,2-Dichloroethene (cis-1,2-DCE)	NC	**13.8**		µg/L	**8.1**		µg/L	**4.7**		µg/L	0.54	U	µg/L	0.54	U	µg/L
Tetrachloroethene (PCE)	5 µg/L	**8.9**		µg/L	**3.9**		µg/L	0.61	U	µg/L	0.61	U	µg/L	0.61	U	µg/L
1,1,1-Trichloroethane (1,1,1-TCA)	200 µg/L	**2.4**		µg/L	**0.97**		µg/L	0.94	U	µg/L	0.94	U	µg/L	0.94	U	µg/L
Trichloroethene (TCE)	5 µg/L	**124**		µg/L	**58.3**		µg/L	0.45	U	µg/L	0.45	U	µg/L	0.45	U	µg/L
METALS																
Iron	0.050 mg/L	0.0200	U	mg/L	0.0200	U	mg/L	0.0200	U	mg/L	0.0200	U	mg/L	0.0200	U	mg/L
Manganese	0.050 mg/L	**0.0208**		mg/L	0.00081	U	mg/L	0.00081	U	mg/L	0.00081	U	mg/L	0.00081	U	mg/L
Total Dissolved Solids (TDS)	25 mg/L	**159**		mg/L	**259**		mg/L	**249**		mg/L	**258**		mg/L	**253**		mg/L
Total Suspended Solids (TSS)	10 mg/L	4.0	U	mg/L	4.0	U	mg/L	4.0	U	mg/L	4.0	U	mg/L	4.0	U	mg/L
pH	6.5 S.U.	**6.0**		S.U.	**7.0**		S.U.	**6.3**		S.U.	**7.0**		S.U.	**7.0**		S.U.

Notes:

µg/L = micrograms per liter
mg/L = milligrams per liter
NC = no criteria established
S.U. = standard units
All VOC target compounds were analyzed for and reported in the laboratory data package. Only detected analytes are listed in the above table;
no other VOCs were detected unless noted.
Bold indicates analyte detections.
(1) Denotes upper discharge limit for each analyte, with the exception of pH which is a lower discharge limit.
(2) Data Qualifiers:
U = non-detect; analyte was analyzed for but not detected at a value greater than the method detection limit. MDL indicated followed by "U" qualifier.
J = estimated value; result is less than the reporting limit, but greater than the method detection limit.
B = metals estimated value; result is less than the reporting limit, but greater than the method detection limit.

Table 4
Mass Removal Summary for VOCs of Concern
Naval Weapons Industrial Reserve Plant
Bedford, Massachusetts
November 2013

Constituent	Current Monthly Conc. (µg/L)	Current Monthly Influent Flow (gal)	Monthly Mass (lbs)	Cumulative Mass (lbs)
1,1-Dichloroethene (1,1-DCE)	17.0	273,633	0.04	17.58
Tetrachloroethene (PCE)	8.9		0.02	8.47
1,1,1-Trichloroethane (1,1,1-TCA)	2.4		0.01	11.53
Trichloroethene (TCE)	124		0.28	95.18
Total VOCs	---		0.35	132.76

Notes:

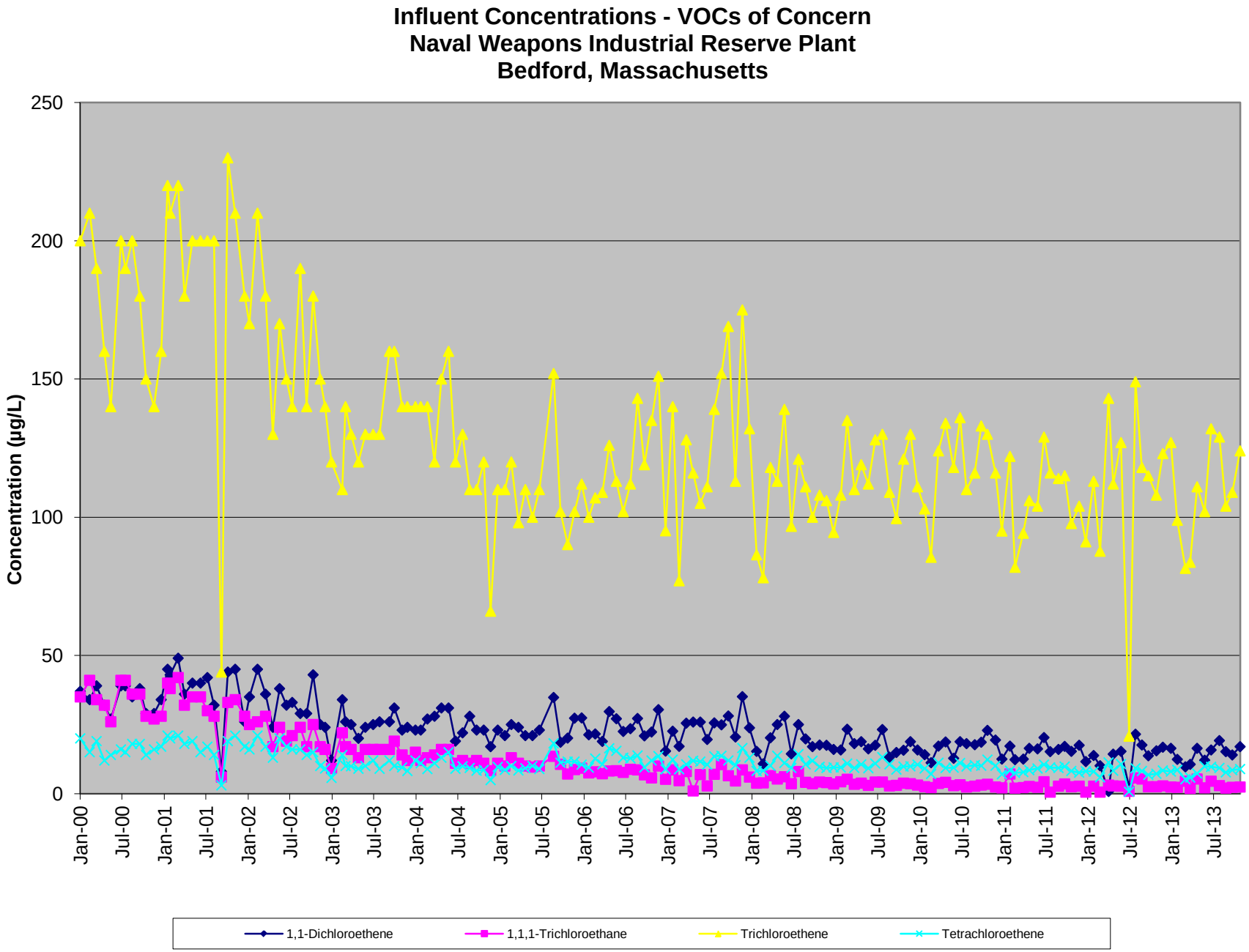
Removal (lb) = Concentration (µg/L) x Flow (gal) x $\frac{2.2 \text{ lbs}}{1{,}000 \text{ g}}$ x $\frac{1 \text{ g}}{1\text{x}10^{6} \text{ ug}}$ x $\frac{3.785 \text{ L}}{1 \text{ gal}}$

µg/L - micrograms per liter
lbs - pounds
gal - gallons
g - gram

Site 3 GWETS November 2013 Operations Summary Trend Plots

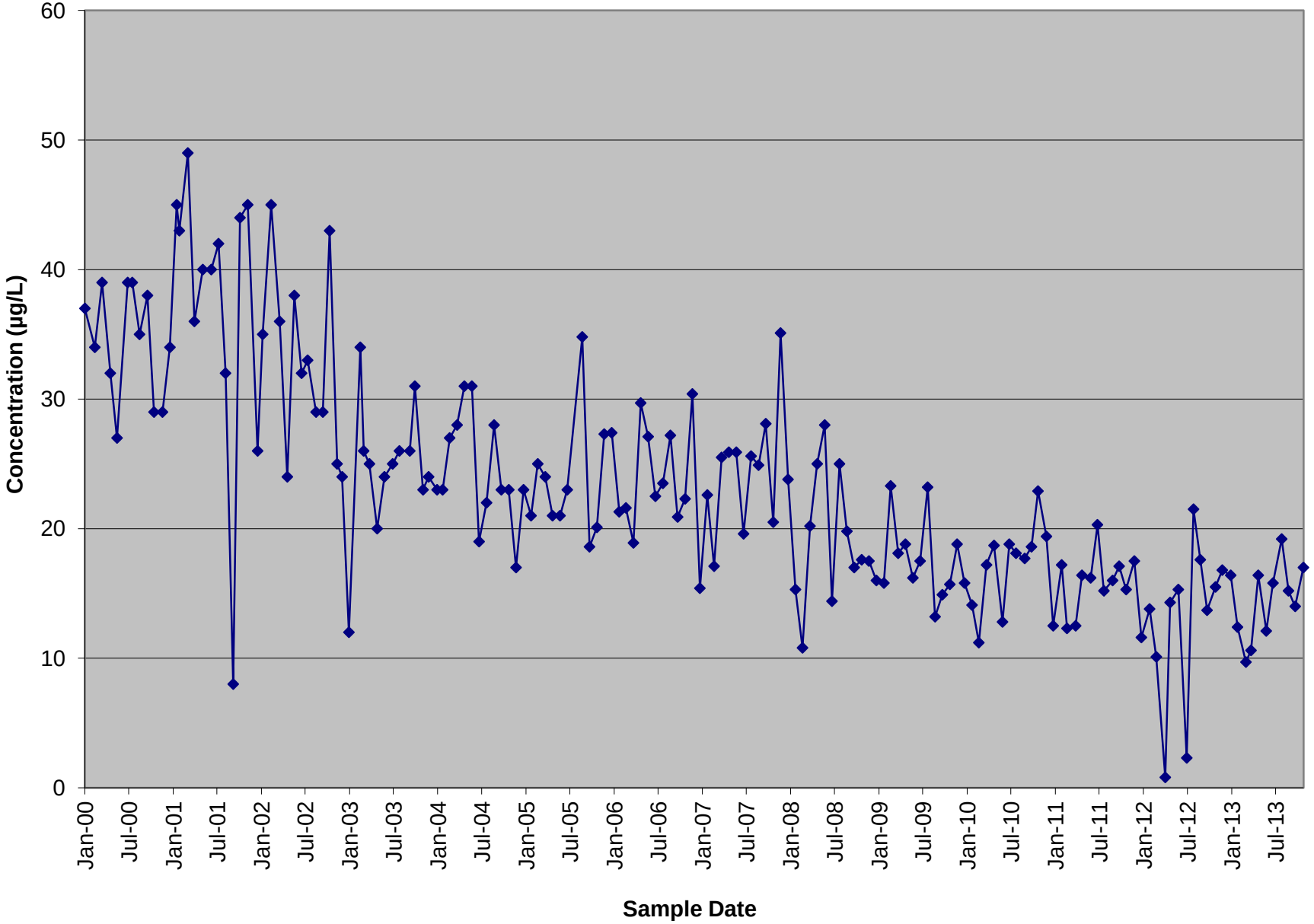
November 2013 Monthly Operations Report

(H&S Environmental, 18 December 2013)



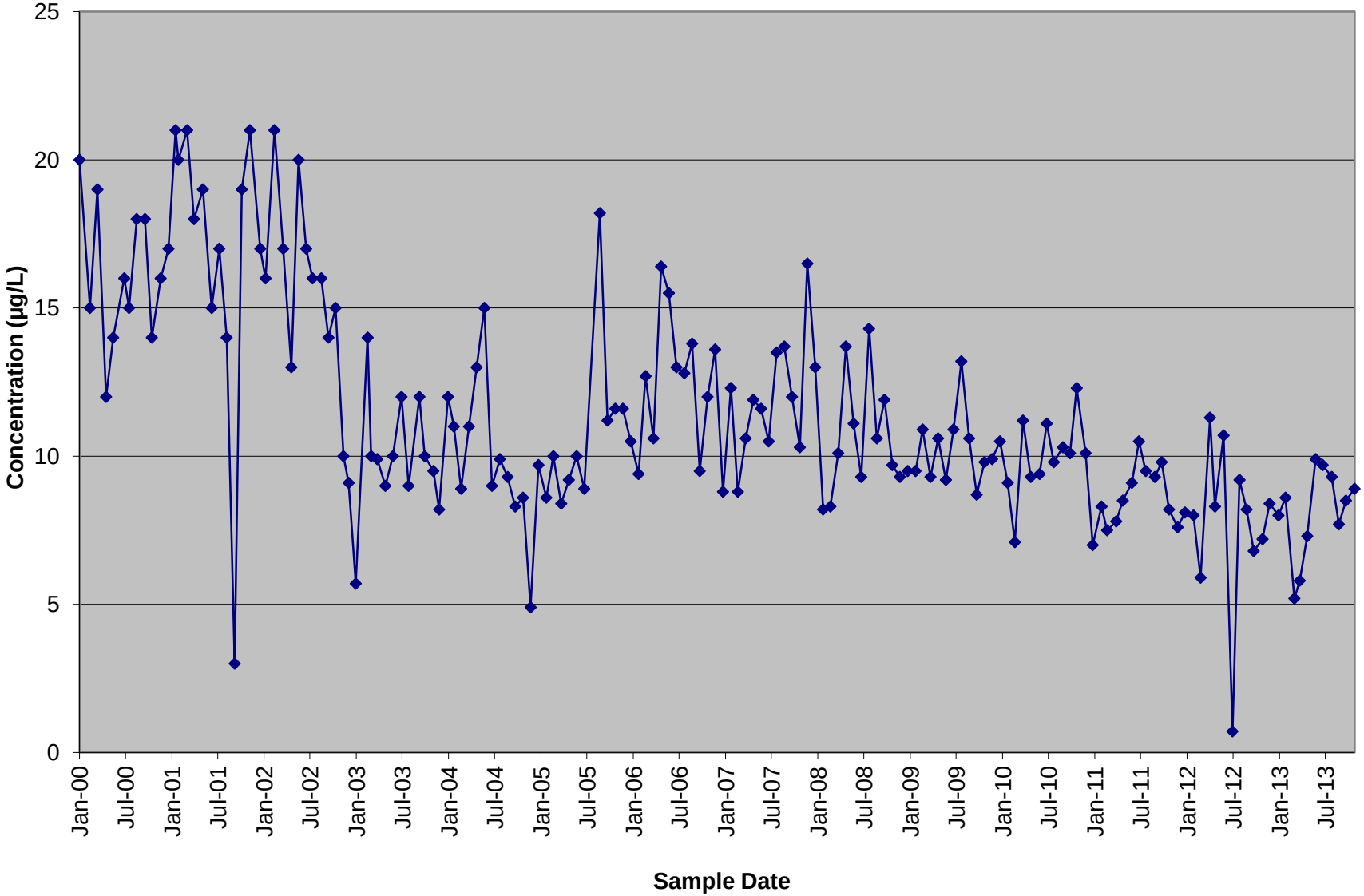
Data prior to January 2011 are taken from prior reports submitted by others.

Influent Concentrations - 1,1-DCE
Naval Weapons Industrial Reserve Plant
Bedford, Massachusetts



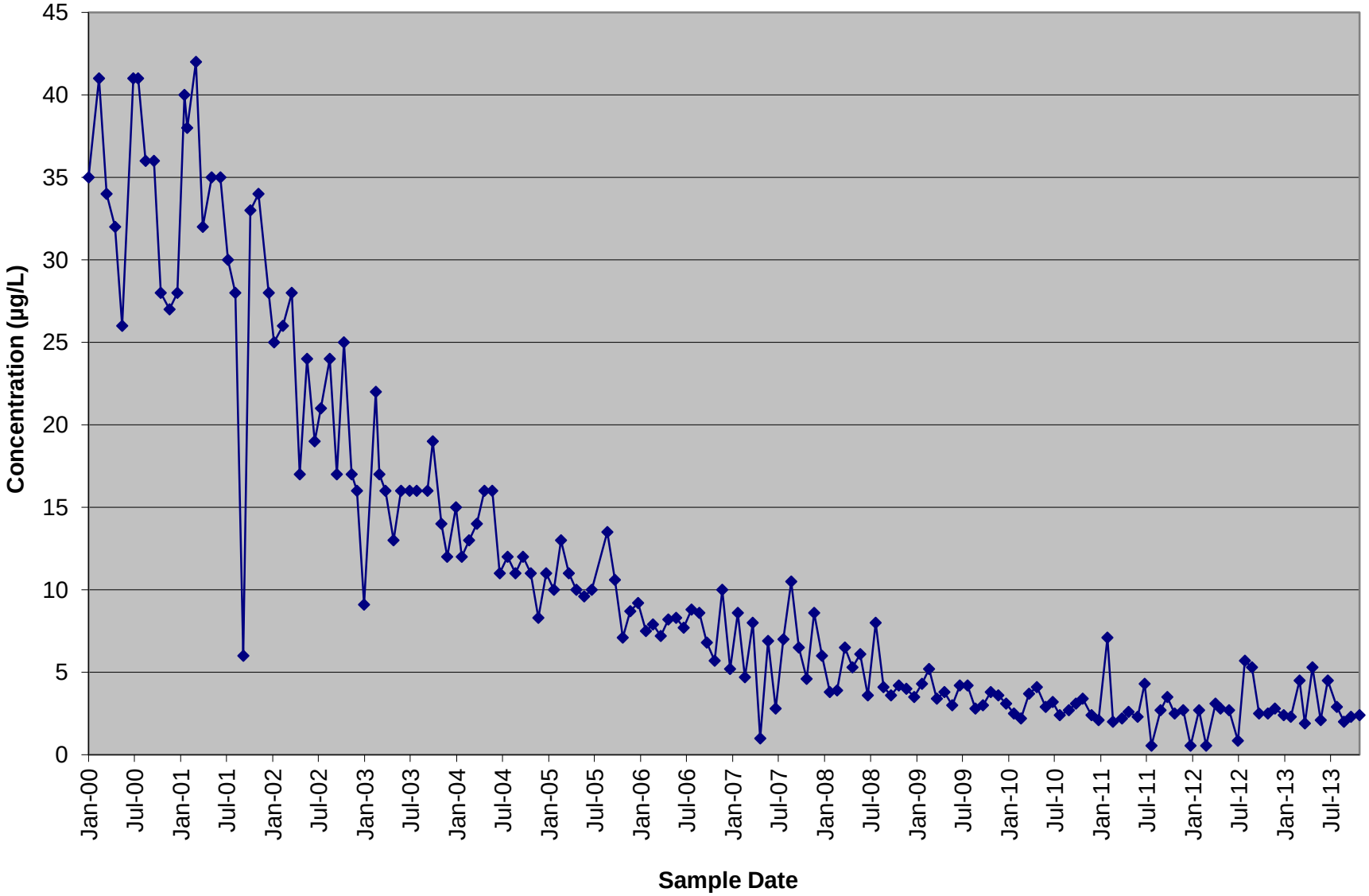
Data prior to January 2011 are taken from prior reports submitted by others.

Influent Concentrations - PCE
Naval Weapons Industrial Reserve Plant
Bedford, Massachusetts



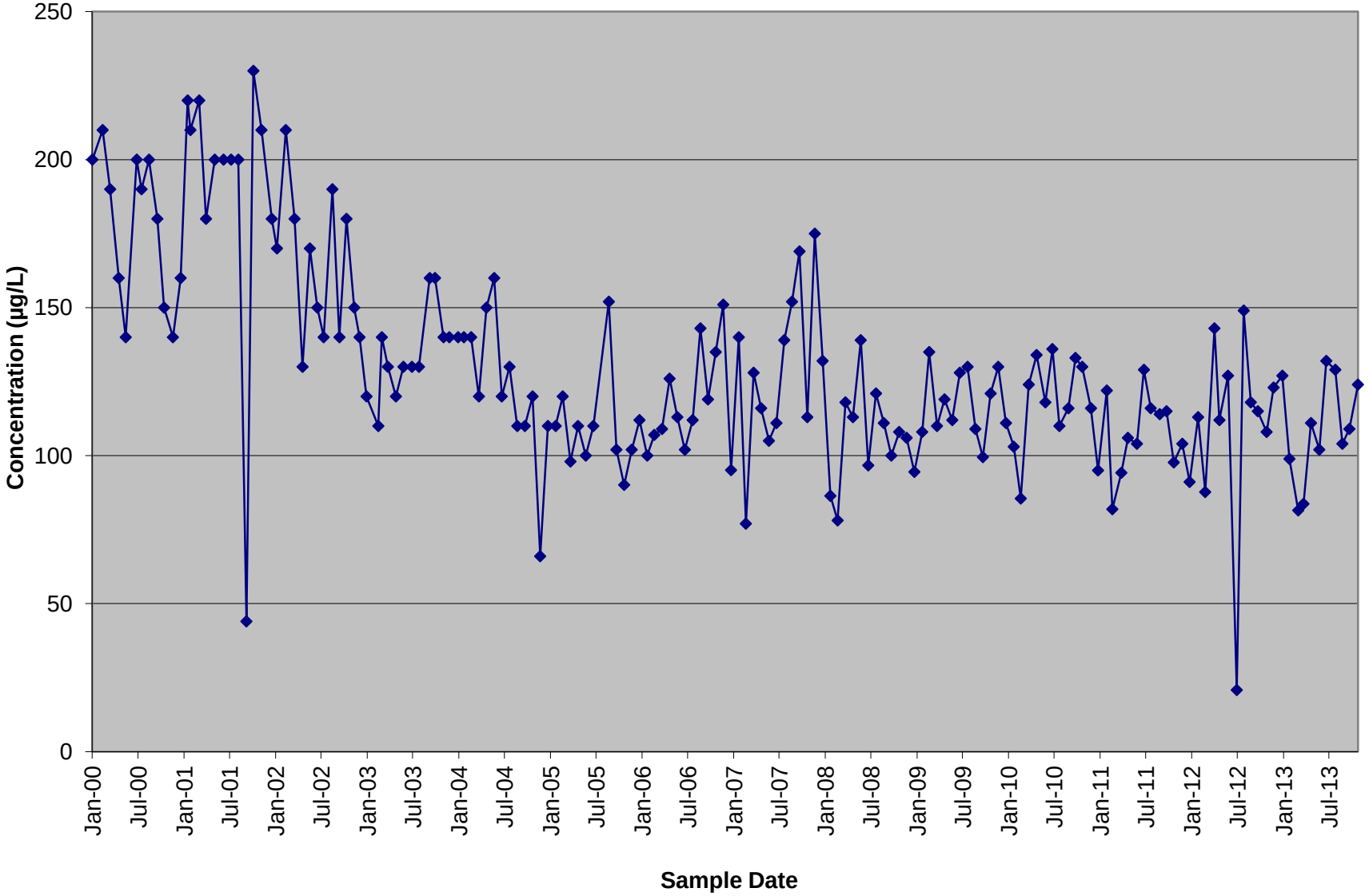
Data prior to January 2011 are taken from prior reports submitted by others.

Influent Concentrations - 1,1,1-TCA
Naval Weapons Industrial Reserve Plant
Bedford, Massachusetts

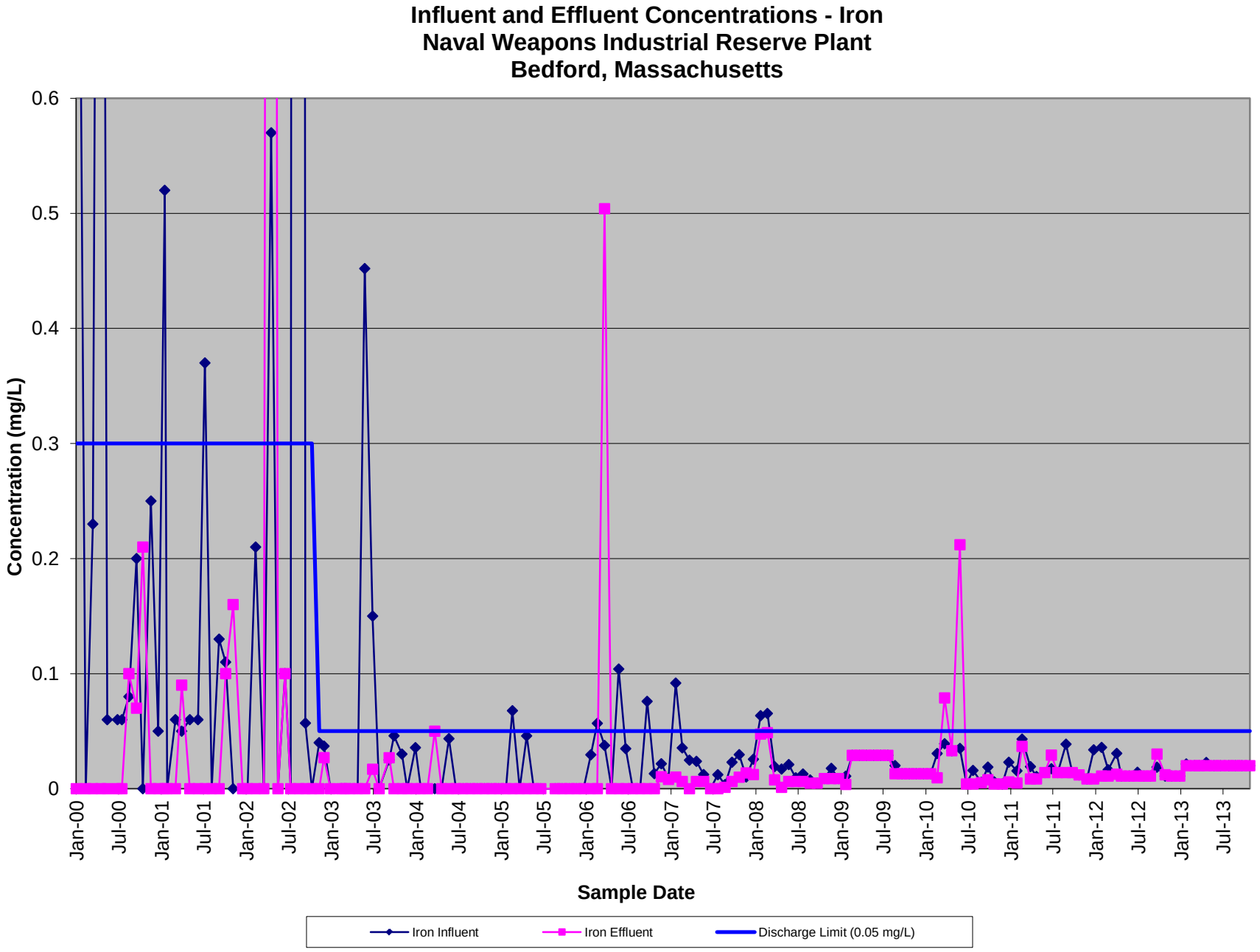


Data prior to January 2011 are taken from prior reports submitted by others.

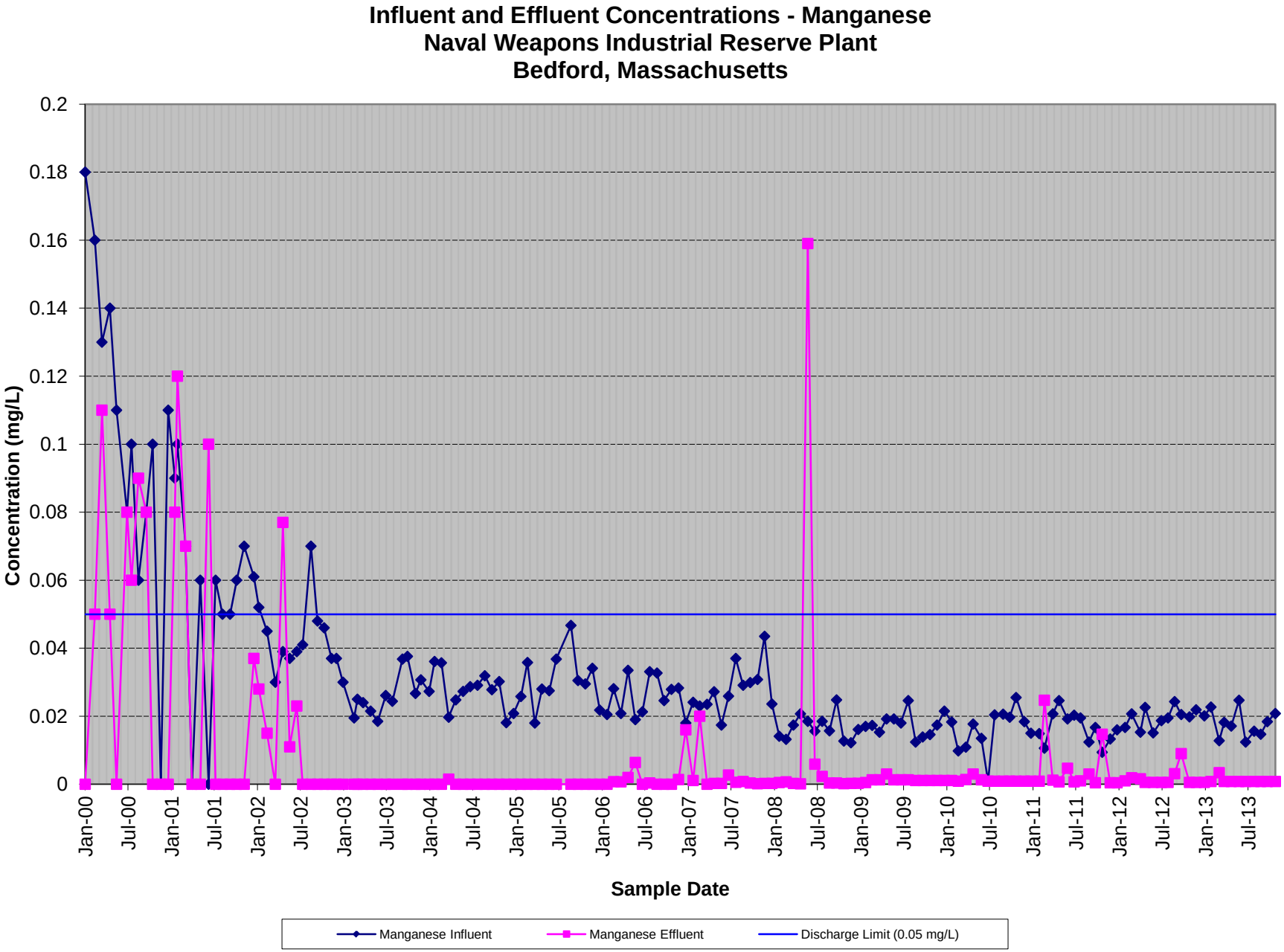
Influent Concentrations - TCE
Naval Weapons Industrial Reserve Plant
Bedford, Massachusetts



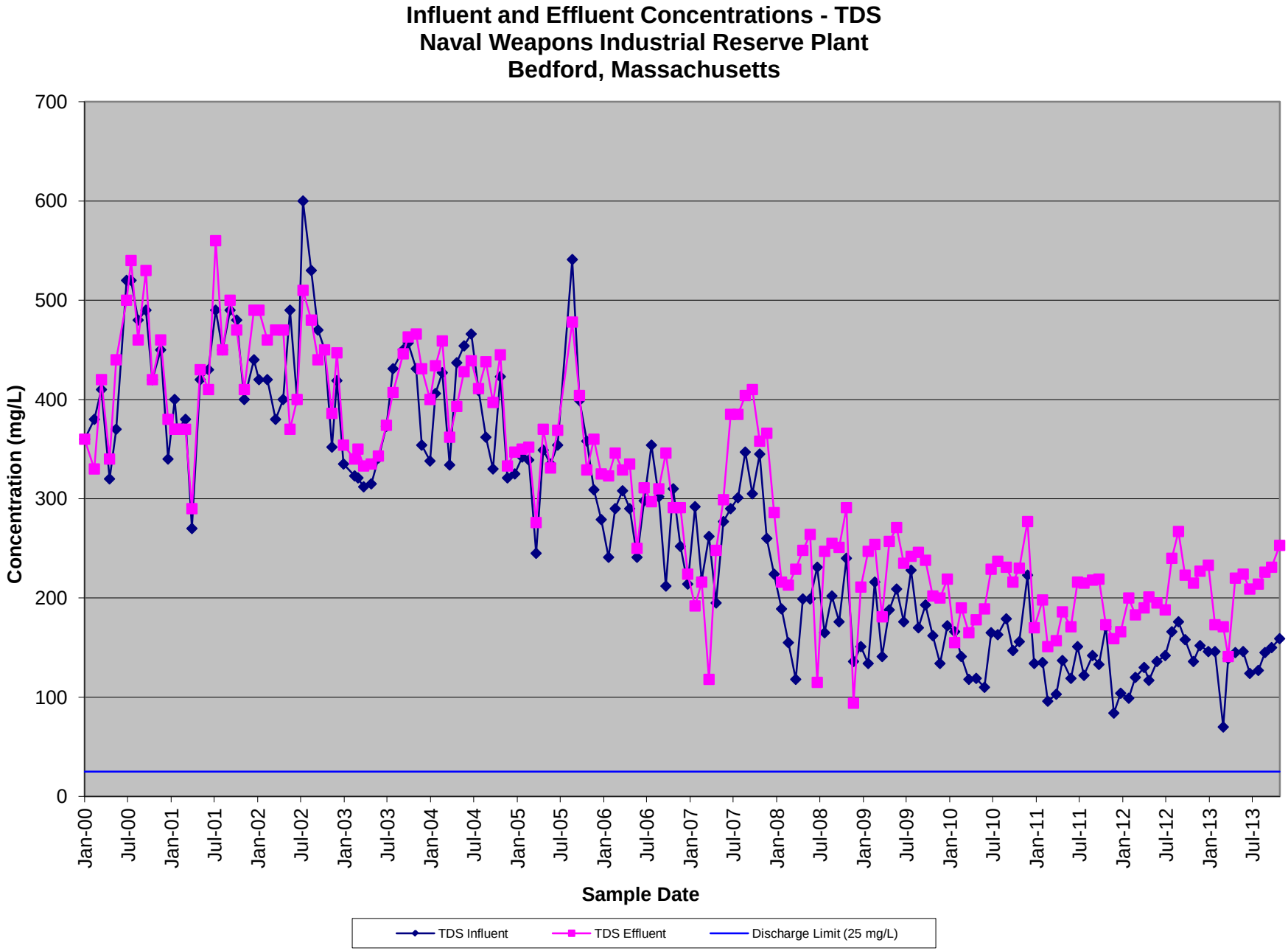
Data prior to January 2011 are taken from prior reports submitted by others.



Data prior to January 2011 are taken from prior reports submitted by others.

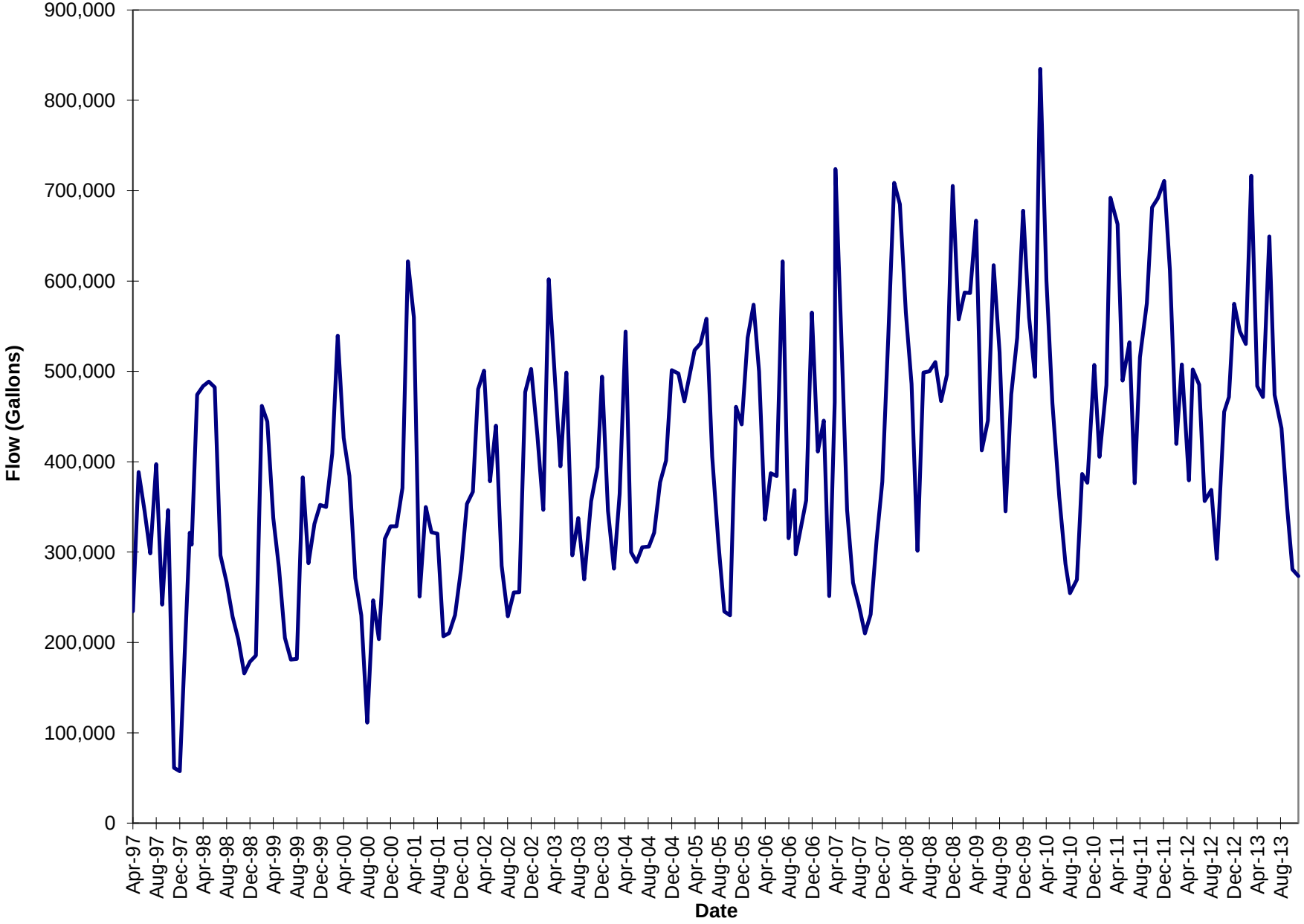


Data prior to January 2011 are taken from prior reports submitted by others.

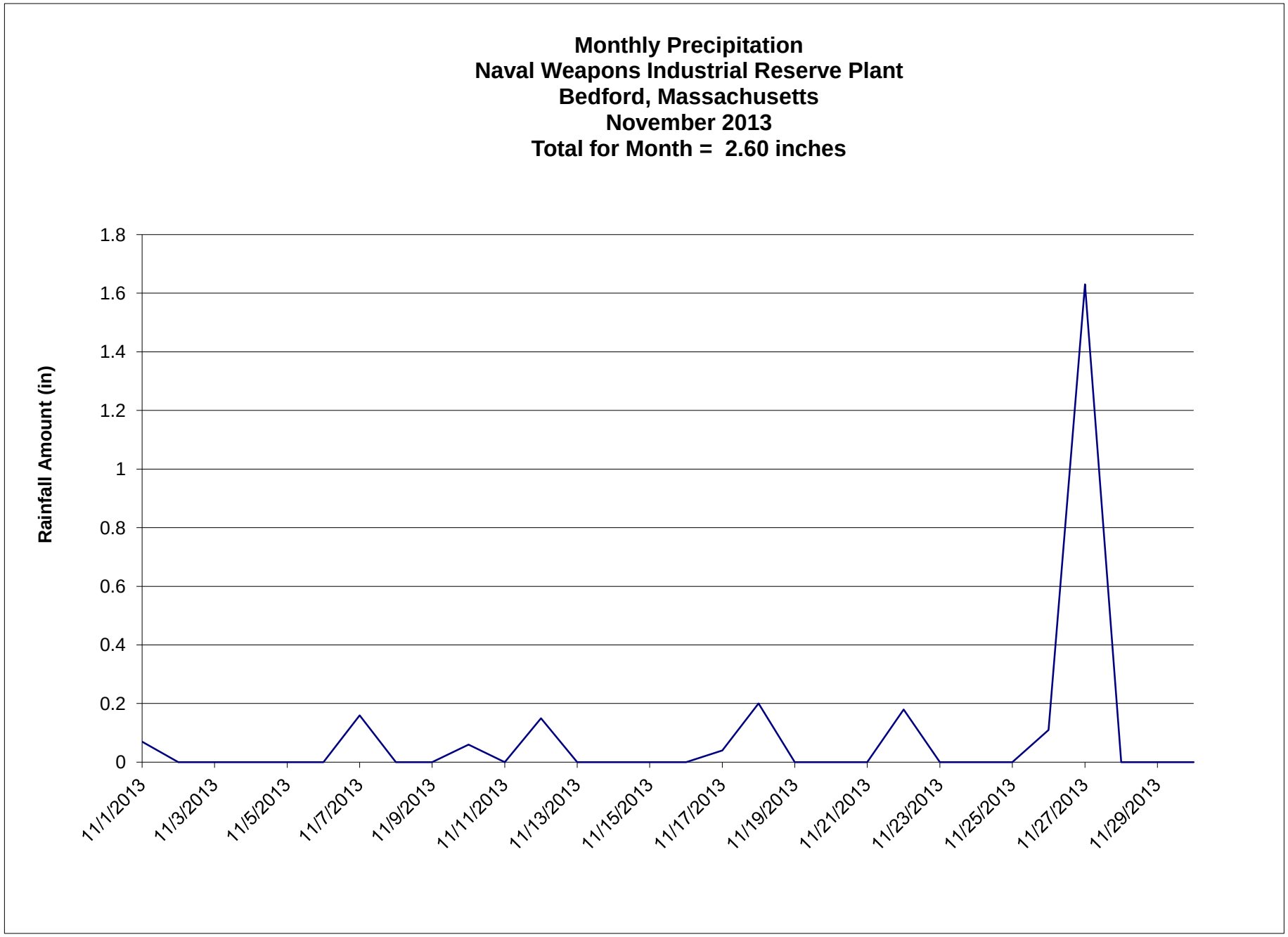


Data prior to January 2011 are taken from prior reports submitted by others.

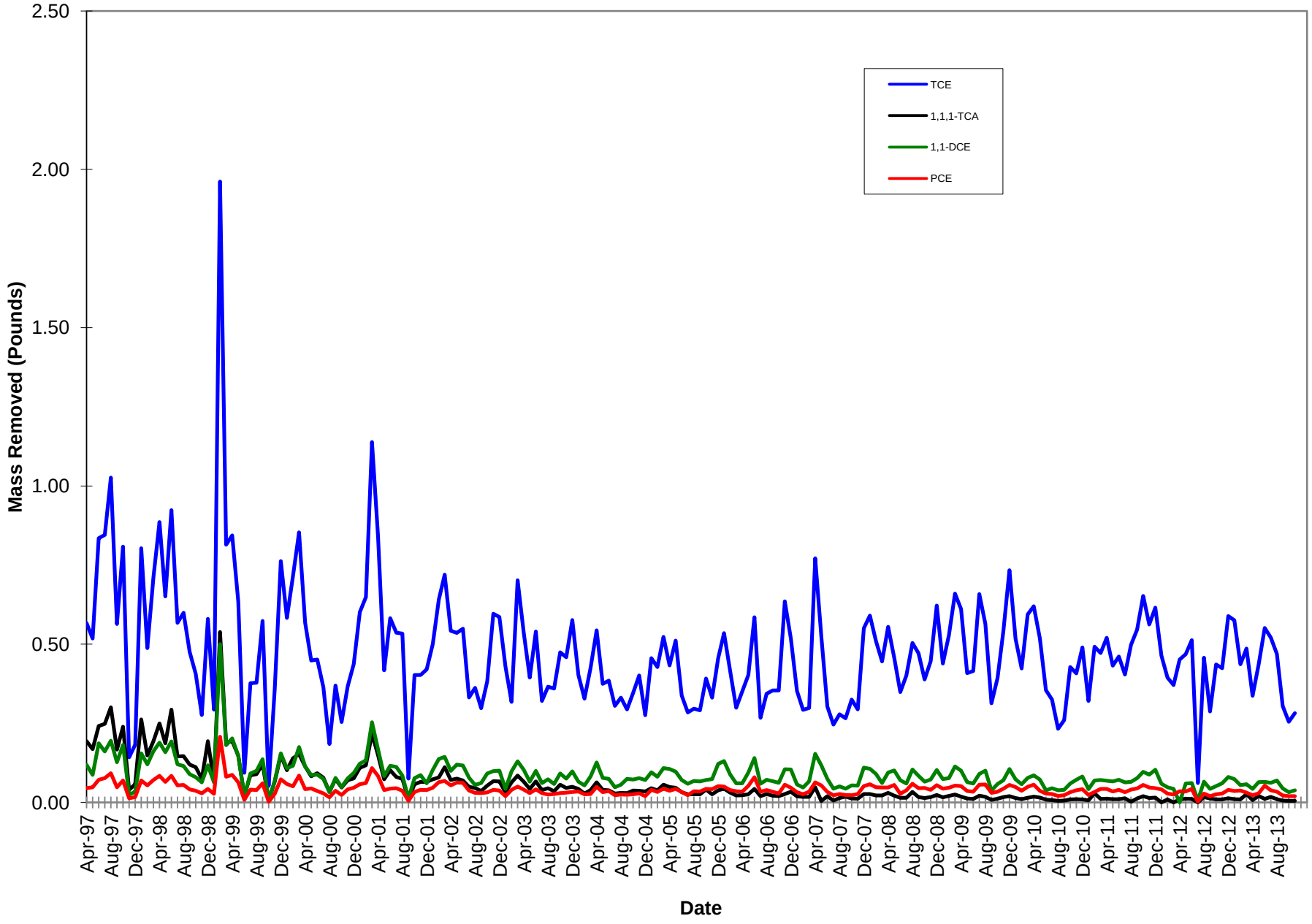
Monthly Influent Flow
Naval Weapons Industrial Reserve Plant
Bedford, Massachusetts



Data prior to January 2011 are taken from prior reports submitted by others.

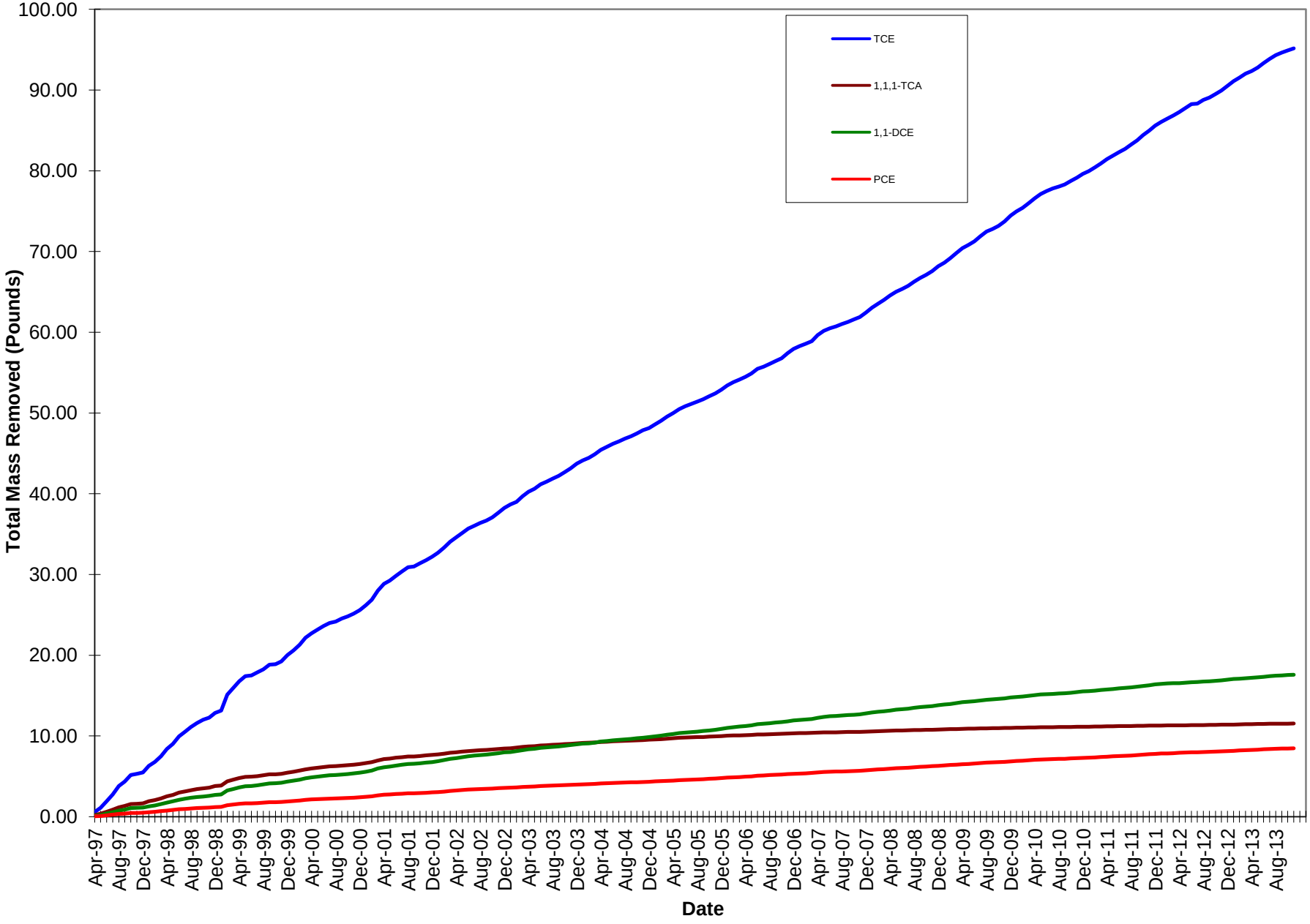

Monthly Precipitation
Naval Weapons Industrial Reserve Plant
Bedford, Massachusetts
November 2013
Total for Month = 2.60 inches
Rainfall Amount (in)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
11/1/2013
11/3/2013
11/5/2013
11/7/2013
11/9/2013
11/11/2013
11/13/2013
11/15/2013
11/17/2013
11/19/2013
11/21/2013
11/23/2013
11/25/2013
11/27/2013
11/29/2013

Mass Removal - Monthly



Data prior to January 2011 are taken from prior reports submitted by others.

Mass Removal - Cumulative



Data prior to January 2011 are taken from prior reports submitted by others.

Appendix D

Sites 3, 4, and SFTA Five Year Review Inspection Checklists 2013

Site 3 Five Year Review Inspection Checklist
August 12, 2013

NWIRP Bedford - Five Year Review Inspection Checklist			**Remarks**
Site Name: Site 3, NWIRP Bedford			
Date/Time: 12 August 2013			
Inspector: Mike Zobel (EnSafe), Jimm Ropp (Tetra Tech) and Bob Santuosso (Tetra Tech)			Matt Audet (EPA), Dave Gallgher (MassDEP), Pat Schauble (H&S), Jim Nicotri (AGVIQ/CH2M HILL) were not present for this inspection.
Signature:			
Remedial Elements in place: Groundwater Treatment and Extraction System (GWETS) for downgradient plume, Bioinjection System in the source area, LTM for MNA, and LUCs for groundwater use, building occupancy, and new construction.			GWETS was installed as an IRA in 1997 and O&M and semiannual GW monitoring data go back to 1997. GWETS is currently operated by H&S. Bioinjection system was installed in 2012 and O&M and performance monitoring data go back to 2012. Bioinjection system resides in the same building as the GWETS and is operated by Tetra Tech. O&M manuals for both systems and monthly effluent sampling records for the GWETS were present on site. Groundwater monitoring and reporting is currently performed by AGVIQ/CH2M HILL. LUC inspections currently performed by Tetra Tech.
	YES	**NO**	
Are institutional controls and LUCs properly implemented and fully enforced?	X		LUC inspections were performed in 2012 and 2013 in accordance with the LUC Remedial Designs for the site. Groundwater associated with the site is not used for drinkingwater, the buildings on-site are presently unoccupied, residential development is not taking place within the site. Both the 2012 and 2013 LUC Inspection reports indicate signs of vandalism and identified needed fencing repairs. The repairs are reported to be addressed as part of routine O&M for the perimeter fence.
(If no, note on map and explain in Remarks)			
For active remediation systems, are the following components in good condition and operating properly?			The enhanced bioremediation system was operational and in good condition. The GWETS was operational and in good condition. The GWETS pumps from 23 extraction wells located in Site 3 at approximately 13 gpm on average. Individual wells are brought on/off line from the pump house located by the extraction wells on Site 3, which was also in good condition and operational. A photolog of these components is available as part of this inpsection.
(If no, explain in Remarks)			
Pumps and Electrical:	X		
Extraction system pipelines, valve boxes, and appurtenances:	X		
Treatment technologies:	X		
Discharge structures and appurtenances:	X		
Recovery wells:	X		
Do any observations indicate that RAO's are not being met?		X	
(If yes, note on map and explain in Remarks)			
Has land use on- or off-site changed?		X	A privately owned athletic field borders Site 3 immediately to the west of the GWETS. The field is artificial turf and is not capped, however, it is believed that the field is outside of the contamination zone and the land use is consistent with the anticipated zoning for the area. There is talk of diverting runoff from the field to the Navy property, but this has not yet been officially requested. The owner is Edge Sports Centers.
(If yes, explain in Remarks)			
Are monitoring wells functioning, locked and in good condition?	X		The Site 3 wells appear to be generally in good condition and are accessible. Most wells are in flush-mount manholes, however those located in the woods and along the edges of the parking lot are in standpipes. The standpipes in the parking lot are surrounded with steel bollards. Examples are provided in the photolog for this inspection.
(If no, explain in Remarks)			
Is the site free of identifiable concerns, such as dumping of chemicals or debris, or unanticipated activity?		X	Both the 2012 and 2013 LUC Inspection reports indicate signs of vandalism or tresspasser use.
(If no, explain in Remarks)			
Are there any previously undocumented features/conditions at the site (i.e. new wetlands, grading, paving, grade changes, roads, etc.)?		X	
(If yes, note on map and explain in Remarks)			

SFTA Five Year Review Inspection Checklist
August 12, 2013

NWIRP Bedford - Five Year Review Inspection Checklist			**Remarks**
Site Name: SFTA, NWIRP Bedford			
Date/Time: 12 August 2013			
Inspector: Mike Zobel (EnSafe), Jimm Ropp (Tetra Tech) and Bob Santuosso (Tetra Tech)			Matt Audet (EPA), Dave Gallgher (MassDEP), Pat Schauble (H&S), Jim Nicotri (AGVIQ/CH2M HILL) were not present for this inspection.
Signature:			
Remedial Elements in place: LTM for MNA.			This site is in the process of being transferred from the US Air Force to the Navy and will be added to the Site 3 ROD. The site is currently under investigation for vapor intrusion. The Explanation of Significant Differences to the Site 3 ROD has not (or has only recently) been signed, therefore , LUCs for groundwater use, building occupancy, and new construction have not yet been finalized. GW monitoring data go back to 1989 in some wells with routine semiannual monitoring starting in 2003.
	YES	**NO**	
Are institutional controls and LUCs properly implemented and fully enforced?		X	The LUCs for this site are still under development. The air field site is currently not occupied and there is no residential development. The Navy uses the hanger occasionally for Navy SEAL aircraft storage. The temporary chain link fence has been taken down and is laying on the edge of the property. However, the site is within the perimeter fence and security zone of the airport so it protected from the public. The site is not operational.
(If no, note on map and explain in Remarks)			
For active remediation systems, are the following components in good condition and operating properly?			Not applicable; no active remediation system.
(If no, explain in Remarks)			
Pumps and Electrical:			
Extraction system pipelines, valve boxes, and appurtenances:			
Treatment technologies:			
Discharge structures and appurtenances:			
Recovery wells:			
Do any observations indicate that RAO's are not being met?		X	
(If yes, note on map and explain in Remarks)			
Has land use on- or off-site changed?		X	
(If yes, explain in Remarks)			
Are monitoring wells functioning, locked and in good condition?	X		All wells were located and in good condition. Landscaping around the wells is being maintained and the wells are accessible. Wells are marked with orange 5-gallon buckets filled with water and with flags. Wells have flush mount manholes.
(If no, explain in Remarks)			
Is the site free of identifiable concerns, such as dumping of chemicals or debris, or unanticipated activity?		X	
(If no, explain in Remarks)			
Are there any previously undocumented features/conditions at the site (i.e. new wetlands, grading, paving, grade changes, roads, etc.)?		X	
(If yes, note on map and explain in Remarks)			

Site 4 Five Year Review Inspection Checklist
August 12, 2013

NWIRP Bedford - Five Year Review Inspection Checklist			**Remarks**
Site Name: Site 4, NWIRP Bedford			
Date/Time: 12 August 2013			
Inspector: Mike Zobel (EnSafe), Jimm Ropp (Tetra Tech) and Bob Santuosso (Tetra Tech)			Matt Audet (EPA), Dave Gallgher (MassDEP), Pat Schauble (H&S), Jim Nicotri (AGVIQ/CH2M HILL) were not present for this inspection.
Signature:			
Remedial Elements in place: LTM for MNA, and LUCs for groundwater use, building occupancy, and new construction.			The planned source area treatment at Site 4 was cancelled based on the results of a pre-design investigation conducted in March 2010. The results of the invetigation indicated the extent of the remaining BTEX in the source area did not warrant additional treatment to meet site RAO's, so there were no signs of any additional remedy implementation since the ROD and no recovery wells in the vicinity of the site beyond those already implemented for Site 3. GW monitoring data go back to 1993 in some wells with routine quarterly monitoring starting in 1997. LUC inspections currently performed by Tetra Tech since 2012.
	YES	**NO**	
Are institutional controls and LUCs properly implemented and fully enforced?	X		LUC inspections were performed in 2012 and 2013 in accordance with the LUC Remedial Designs for the site. Groundwater associated with the site is not used for drinkingwater, the buildings on-site are presently unoccupied, residential development is not taking place within the site. Both the 2012 and 2013 LUC Inspection reports indicate signs of vandalism and identified needed fencing repairs. The repairs are reported to be addressed as part of routine O&M for the perimeter fence.
(If no, note on map and explain in Remarks)			
For active remediation systems, are the following components in good condition and operating properly?			Not applicable; no active remediation system.
(If no, explain in Remarks)			
Pumps and Electrical:			
Extraction system pipelines, valve boxes, and appurtenances:			
Treatment technologies:			
Discharge structures and appurtenances:			
Recovery wells:			
Do any observations indicate that RAO's are not being met?		X	
(If no, note on map and explain in Remarks)			
Has land use on- or off-site changed?		X	
(If yes, explain in Remarks)			
Are monitoring wells functioning, locked and in good condition?		X	The site 4 wells are generally in poor condition with missing bolts, cracked well covers, etc. The site 4 wells are difficult to locate due to landscaping no being maintained and several have been overgrown with bushes, vines, and grasses. Most wells are in flush-mount manholes, however those located in the woods and along the edges of the parking lot are in standpipes. The standpipes in the parking lot are surrounded with steel bollards. Examples are provided in the photolog for this inspection.
(If no, explain in Remarks)			
Is the site free of identifiable concerns, such as dumping of chemicals or debris, or unanticipated activity?		X	Both the 2012 and 2013 LUC Inspection reports indicate signs of vandalism or tresspasser use.
(If no, explain in Remarks)			
Are there any previously undocumented features/conditions at the site (i.e. new wetlands, grading, paving, grade changes, roads, etc.)?		X	
(If yes, note on map and explain in Remarks)			

Appendix E

Sites 3, 4, and SFTA Five Year Review Inspection Photolog 2013

Site 3 Former main Raytheon building

Site 3 parking lot facing north, facility storage building in background

Site 3 parking lot facing south

Site 3 parking lot facing west, GWETS treatment building in background

Site 3 extraction wells for GWETS

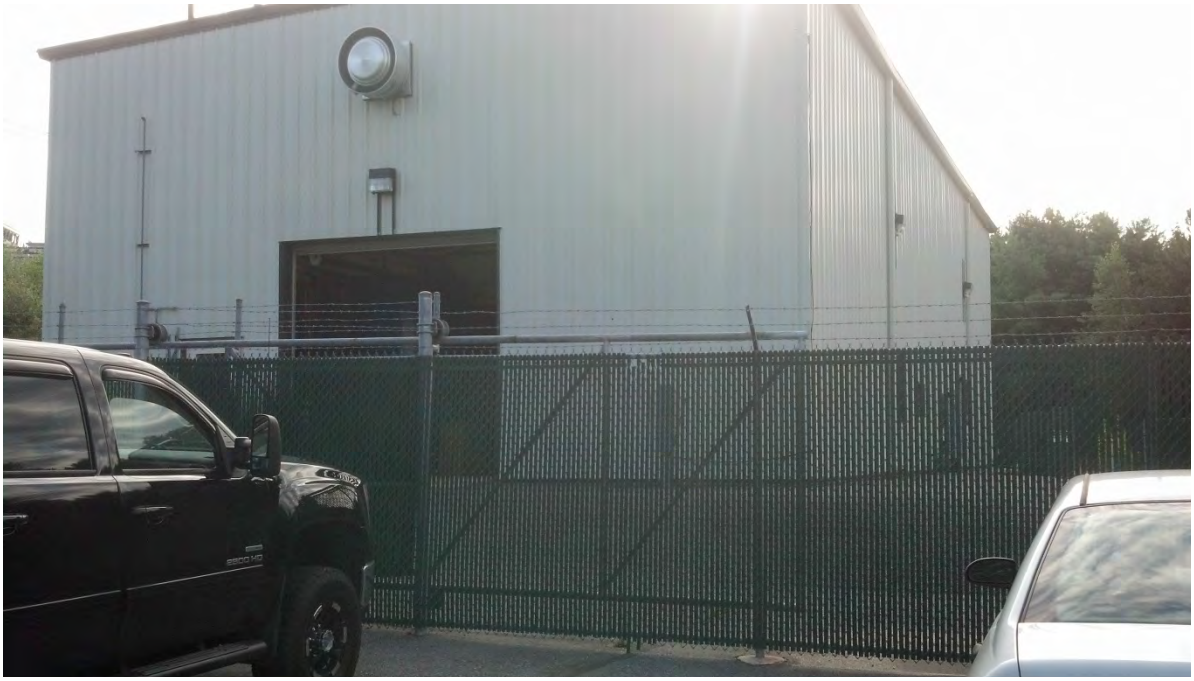
Site 3 extraction wells for GWETS

Site 3 pump house located near extraction wells

Site 3 Transfer pump inside pumphouse

Site 3 Extraction well controls

Site 3 Extraction well flow meters located inside pumphouse



Site 3 GWETS system exterior

Site 3 GWETS system interior

Site 3 hydrogen peroxide and sodium peroxide pH adjustment

Site 3 equalization tank and feed tank

Site 3 enhanced bioremediation injection system, and drum of Lactoil

Site 3 row of bio injection wells

Site 3 bio injection well A4 artesian seepage

Site 3 area of injection wells on top of hill north of former main Raytheon building

Site 3 bio injection well head

Off-site athletic fields bordering west side of site 3, adjacent to GWETS treatment building

Off-site Athletic fields bordering west side of site 3

Front (south) and east side of SFTA hanger

East side of SFTA hanger

North side of SFTA hanger

SFTA well area, five gallon buckets indicate well locations, Hanscom Field in background

SFTA area looking east, sections of temporary chain link fence

SFTA MW25S

Site 4 Antenna Building, well area in left foreground

Site 4 well area

Site 4 - MW-46, flush mount monitoring well head

Site 4 Example of overgrown well

Appendix F

SFTA Groundwater Trend Data and Analysis 1989-2013

The February 2013 SFTA Groundwater Report (Tetra Tech, May 2013) includes the cumulative groundwater and surface water data collected at SFTA sample locations since 1989. Groundwater is sampled semi-annually and data through the February 2013 event are included in this report. The attachments in this Appendix (F) include extracted tables and figures that demonstrate the groundwater trends for the COCs at the SFTA. Trend analysis includes curve fit information where applicable. Statistical analysis includes Seasonal Kendal and Mann-Kendall evaluations presented in tabular format.

SFTA Groundwater Data Tables

SFTA Groundwater Monitoring Report — February 2013

(Tetra Tech, May 2013)

TABLE 3-2

GROUNDWATER QUALITY DATA
SEMI-ANNUAL MONITORING REPORT – FEBRUARY 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
SOUTHERN FLIGHT TEST AREA
BEDFORD, MASSACHUSETTS

Well Location	Date	Time (24 hrs)	Cumulative Volume Purged (gal)	Temp (°C)	Spec. Cond. (µS/cm)	pH (S.U.)	ORP (mV)	DO (mg/L)	Turbidity (NTU)	Purge Rate (mL/min)
MW-7B	2/20/2013	1035	1.25	9.65	531	7.41	-102.1	0.48	3.36	100
MW-8B	2/21/2013	1000	1.5	10.18	555	6.77	183.8	0.29	0.27	125
MW-23R	2/20/2013	1200	4.0	11.35	659	6.20	130.7	1.71	1.26	260
MW-24R	2/20/2013	1535	3.0	11.19	1028	6.45	60.8	0.22	3.81	150
MW-25R	2/21/2013	1255	1.5	11.17	518	6.29	94.5	2.78	1.38	130
MW-84R	2/20/2013	1305	2.5	11.71	667	6.64	-105.2	0.40	4.80	115
MW-85R	2/20/2013	1200	5	10.49	353	7.18	79.2	0.26	4.63	200
MW-86R	2/20/2013	1600	3	8.47	551	6.88	-129.4	0.57	0.36	100

°C = degrees Celcius
DO = dissolved oxygen
hrs = hours
gal = gallons
L = liters
mg/L = milligrams per liter
mL/min = milliliters per minute
mV = millivolts
NTU = nephelometric turbidity units
ORP = oxidation-reduction potential
Spec. Cond. = specific conductivity
S.U. = standard units
Temp = temperature
µS/cm = microsiemens per centimeter

TABLE 3-3

ANALYTICAL RESULTS FOR CONTAMINANTS OF CONCERN IN GROUNDWATER
SEMI-ANNUAL GROUNDWATER SAMPLING EVENT – FEBRUARY 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
SOUTHERN FLIGHT TEST AREA
BEDFORD, MASSACHUSETTS

Location ID	Sample Date	TCE (µg/L)	cis-1,2-DCE (µg/L)	trans-1,2-DCE (µg/L)
		PAL = 5 µg/L	PAL = 70 µg/L	PAL = 90 or 100 µg/L[1]
MW-7B	2/20/2013	0.5 U	0.5 U	0.5 U
MW-8B	2/21/2013	**11.9**	**2.8**	0.5 U
MW-23R	2/20/2013	0.5 U	0.5 U	0.5 U
MW-24R[2]	2/20/2013	**38.4 J**	**1.64 J**	0.5 U
MW-25R	2/20/2013	0.5 U	0.5 U	0.5 U
MW-84R[2]	2/21/2013	**7.4**	**4.4**	0.5 U
MW-85R	2/20/2013	**1.8**	**0.83 J**	0.5 U
MW-86R	2/20/2013	**0.76 J**	0.5 U	0.5 U

Notes:
Bold values indicate a detected concentration.
Highlighted values indicate concentrations which exceed the PAL.
DCE = dichloroethene
TCE = trichloroethene
J = estimated value
U = non-detect value
µg/L = microgram(s) per liter
PAL = project action limit - PALs were selected to be the lower of the federal Maximum Contaminant Levels (MCLs) for drinking water or the applicable MCP Method 1 GW-1 and/or GW-2 groundwater standards.

(1) For trans-1,2-DCE, the Massachusetts Contingency Plan (MCP) GW-2 criterion (90 µg/L) is lower than GW-1 criterion (100 µg/L); thus, the GW-2 criterion is used to develop the PAL for groundwater samples collected from wells where the depth to water is less than or equal to 15 feet. The GW-1 criterion is used for the other wells. The depth to water was less than 15 feet in all wells except MW-7B.

(2) Concentration represents the average of the original and the duplicate sample.

TABLE 3-4

COMPARISON OF THE AVERAGE CONCENTRATIONS FOR THE CONTAMINANTS OF CONCERN IN BEDROCK GROUNDWATER TO PROJECT ACTION LIMITS
SEMI-ANNUAL GROUNDWATER MONITORING REPORT - FEBRUARY 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
SOUTHERN FLIGHT TEST AREA
BEDFORD, MASSACHUSETTS

Location ID	Sample Date	Analyte	Result	Units	Reporting Detection Limit	PAL (µg/L)	Type	PAL Exceeded?
Bedrock SFTA Monitoring Wells								
MW-7B	2/20/2013	TCE	0.5 U	µg/L	0.5	5	MCL, MMCL, GW-1	No
MW-8B	2/21/2013	TCE	11.9	µg/L	0.5	5	MCL, MMCL, GW-1	**Yes**
MW-23R	2/20/2013	TCE	0.5 U	µg/L	0.5	5	MCL, MMCL, GW-1	No
MW-24R	2/20/2013	TCE	38.5	µg/L	0.5	5	MCL, MMCL, GW-1	**Yes**
MW-25R	2/20/2013	TCE	0.5 U	µg/L	0.5	5	MCL, MMCL, GW-1	No
MW-84R	2/21/2013	TCE	7.5	µg/L	0.5	5	MCL, MMCL, GW-1	**Yes**
MW-85R	2/20/2013	TCE	1.8	µg/L	0.5	5	MCL, MMCL, GW-1	No
MW-86R	2/20/2013	TCE	0.76 J	µg/L	0.5	5	MCL, MMCL, GW-1	**No**
Average of Trichloroethene Concentrations			7.6	µg/L	0.5	5	MCL, MMCL, GW-1	**Yes**
MW-7B	2/20/2013	cis-1,2-DCE	0.5 U	µg/L	0.5	70	MCL, MMCL, GW-1	No
MW-8B	2/21/2013	cis-1,2-DCE	2.8	µg/L	0.5	70	MCL, MMCL, GW-1	No
MW-23R	2/20/2013	cis-1,2-DCE	0.5 U	µg/L	0.5	70	MCL, MMCL, GW-1	No
MW-24R	2/20/2013	cis-1,2-DCE	1.65	µg/L	0.5	70	MCL, MMCL, GW-1	No
MW-25R	2/20/2013	cis-1,2-DCE	0.5 U	µg/L	0.5	70	MCL, MMCL, GW-1	No
MW-84R	2/21/2013	cis-1,2-DCE	4.5	µg/L	0.5	70	MCL, MMCL, GW-1	No
MW-85R	2/20/2013	cis-1,2-DCE	0.83 J	µg/L	0.5	70	MCL, MMCL, GW-1	No
MW-86R	2/20/2013	cis-1,2-DCE	0.5 U	µg/L	0.5	70	MCL, MMCL, GW-1	No
Average of cis-1,2-Dichloroethene Concentrations			1.2	µg/L	0.5	70	MCL, MMCL, GW-1	No
MW-7B	2/20/2013	trans-1,2-DCE	0.5 U	µg/L	0.5	100	MCL, MMCL, GW-1	No
MW-8B	2/21/2013	trans-1,2-DCE	0.5 U	µg/L	0.5	90	MCL, MMCL, GW-2	No
MW-23R	2/20/2013	trans-1,2-DCE	0.5 U	µg/L	0.5	90	MCL, MMCL, GW-2	No
MW-24R	2/20/2013	trans-1,2-DCE	0.5 U	µg/L	0.5	90	MCL, MMCL, GW-2	No
MW-25R	2/20/2013	trans-1,2-DCE	0.5 U	µg/L	0.5	90	MCL, MMCL, GW-2	No
MW-84R	2/21/2013	trans-1,2-DCE	0.5 U	µg/L	0.5	90	MCL, MMCL, GW-2	No
MW-85R	2/20/2013	trans-1,2-DCE	0.5 U	µg/L	0.5	90	MCL, MMCL, GW-2	No
MW-86R	2/20/2013	trans-1,2-DCE	0.5 U	µg/L	0.5	90	MCL, MMCL, GW-2	No
Average of trans-1,2-Dichloroethene Concentrations			0	µg/L	0.5	90	MCL, MMCL, GW-2	No

J = estimated value
U = non-detect value
MCL = maximum contaminant level
MMCL = Massachusetts maximum contaminant level
PAL = project action limit
µg/L = micrograms per liter
Non-detects are assigned a value of zero for purposes of determining average concentrations.

TABLE 3-5

HISTORICAL ANALYTICAL RESULTS FOR CONTAMINANTS OF CONCERN
SEMI-ANNUAL MONITORING REPORT - FEBRUARY 2013
NWIRP BEDFORD SOUTHERN FLIGHT TEST AREA
BEDFORD, MASSACHUSETTS

Location ID	Sample Date			TCE (µg/L) PAL = 5 µg/L	cis-1,2-DCE (µg/L) PAL = 70 µg/L	trans-1,2-DCE (µg/L) PAL = 90 or 100 µg/L[1]	Total TCE/DCE (µg/L)
MW-7B	Oct	1989		10 U	NS	NS	ND
	Jan	1990		0.2 U	NS	NS	ND
	Apr	1990		0.2 U	NS	NS	ND
	Apr	1993		10 U	NS	NS	ND
	Oct	1998		1 U	5 U	5 U	ND
	Nov	2011		0.5 U	0.5 U	0.5 U	ND
	Jun	2012		0.5 U	0.5 U	0.5 U	ND
	Feb	2013		0.5 U	0.5 U	0.5 U	ND
MW-8B	Jun	1989		**230**	NS	NS	230
	Nov	1989		**200**	NS	NS	200
	Jan	1990		**190**	NS	NS	190
	Apr	1990		**150**	NS	NS	150
	Apr	1993		**110**	NS	NS	110
	Sep	1998		**58.5**	**5.1**	5 U	63.6
	Nov	2002		**33**	**4**	1 U	37
	Apr	2003		**28.2**	**3.83**	1 U	32.03
	Jul	2003		**26.6**	**3.74**	1 U	30.34
	Feb	2004		**26.8**	**4.05**	1 U	30.85
	Jul	2004		**25.5**	**3.3**	1 U	28.8
	Feb	2005		**26.6 J**	**3.4 J**	1 UJ	30
	Aug	2005		**24.1 J**	**3.4 J**	1 UJ	27.5
	Apr	2006		**25.5**	**4.4**	0.51 U	29.9
	Aug	2006		**19.4**	**2.6**	1 U	22
	Apr	2007		**23**	**4.4**	1 U	27.4
	Aug	2007		**20.5**	**3.2 J**	1 U	23.7
	Mar	2008		**23**	**4.8**	1 U	27.8
	Aug	2008		**18**	**3.9**	1 UJ	21.9
	Mar	2009		**21**	**5**	1 U	26
	Sep	2009		**16**	**3**	1 U	19
	Mar	2010		**18**	**4**	1 U	22
	Sep	2010		**15**	**3**	1 U	18
	Mar	2011		**16**	**4**	1 U	20
	Nov	2011	AVG	**12**	**2.6**	0.5 U	14.6
	Jun	2012		**12**	**2.3**	0.5 U	14.3
	Nov	2012		**13**	**2.1**	1 U	15.1
	Feb	2013		**11.9**	**2.8**	0.5 U	14.7
MW-9B	Oct	1989		**9**	10 U	10 U	9
	Jan	1990		**6.2**	0.2 U	0.2 U	6.2
	Apr	1990		**4.7**	0.2 U	0.2 U	4.7
	Apr	1993		**4 J**	10 U	10 U	4 J

TABLE 3-5

HISTORICAL ANALYTICAL RESULTS FOR CONTAMINANTS OF CONCERN
SEMI-ANNUAL MONITORING REPORT - FEBRUARY 2013
NWIRP BEDFORD SOUTHERN FLIGHT TEST AREA
BEDFORD, MASSACHUSETTS

Location ID	Sample Date			TCE (µg/L) PAL = 5 µg/L	cis-1,2-DCE (µg/L) PAL = 70 µg/L	trans-1,2-DCE (µg/L) PAL = 90 or 100 µg/L[1]	Total TCE/DCE (µg/L)
MW-23R	Apr	1993		10 U	NS	NS	ND
	Sep	1998		1 U	5 U	5 U	ND
	Nov	2011		0.5 U	0.5 U	0.5 U	ND
	Jun	2012		0.5 U	0.5 U	0.5 U	ND
	Feb	2013		0.5 U	0.5 U	0.5 U	ND
MW-24R	Apr	1993		**250**	NS	NS	250
	Sep	1998	AVG	**134**	**5.4**	**1.56 J**	140.96
	Nov	2002	AVG	**74.5**	**2**	1 U	76.5
	Apr	2003		**52.8**	**1.65**	1 U	54.45
	Jul	2003		**71.1**	**2.47**	1 U	73.57
	Feb	2004		**63**	**2.31**	1 U	65.31
	Jul	2004	AVG	**57.6 J**	**2.25**	**0.2 J**	60.05
	Feb	2005	AVG	**62 J**	**2 J**	**0.2 J**	64.2
	Aug	2005		**60.1 J**	**2.2 J**	1 UJ	62.3
	Apr	2006		**60.6**	**2.3**	0.51 U	62.9
	Aug	2006		**49.9**	**2**	1 U	51.9
	Apr	2007		**51.7**	1 U	1 U	51.7
	Aug	2007		**42.2**	**1.8 J**	1 U	44
	Mar	2008	AVG	**48.5**	**2.35**	1 U	50.85
	Aug	2008		**38**	**1.7**	1 UJ	39.7
	Mar	2009	AVG	**51**	**2**	1 U	53
	Sep	2009		**42**	**2**	1 U	44
	Mar	2010		**44**	**2**	1 U	46
	Sep	2010		**37**	**2**	1 U	39
	Mar	2011		**37**	**2**	1 U	39
	Nov	2011		**32**	**1.5**	0.5 U	33.5
	Jun	2012	AVG	**38**	**1.4**	0.5 U	39.4
	Nov	2012	AVG	**34**	**1.5**	1 U	35.5
	Feb	2013	AVG	**38.5**	**1.6**	0.5 U	24.29

TABLE 3-5

HISTORICAL ANALYTICAL RESULTS FOR CONTAMINANTS OF CONCERN
SEMI-ANNUAL MONITORING REPORT - FEBRUARY 2013
NWIRP BEDFORD SOUTHERN FLIGHT TEST AREA
BEDFORD, MASSACHUSETTS

Location ID	Sample Date			TCE (µg/L) PAL = 5 µg/L	cis-1,2-DCE (µg/L) PAL = 70 µg/L	trans-1,2-DCE (µg/L) PAL = 90 or 100 µg/L(1)	Total TCE/DCE (µg/L)
MW-25R	Apr	1993		**130**	NS	NS	130
	Sep	1998		**1.5**	5 U	5 U	1.5
	Nov	2002		**0.80 J**	1 U	1 U	0.80 J
	Apr	2003	AVG	**0.80 J**	1 U	1 U	0.80 J
	Jul	2003		**1**	1 U	1 U	1
	Feb	2004		**0.49 J**	1 U	1 U	0.49 J
	Jul	2004		**0.50 J**	1 U	1 U	0.50 J
	Feb	2005		**0.60 J**	1 UJ	1 UJ	0.60 J
	Aug	2005		**0.88 J**	1 UJ	1 UJ	0.88 J
	Apr	2006		**0.51 J**	0.7 U	0.51 U	0.51 J
	Aug	2006		0.74 U	1 U	1 U	ND
	Apr	2007		1 U	1 U	1 U	ND
	Aug	2007		1 U	1 UJ	1 U	ND
	Mar	2008		**0.36 J**	1 U	1 U	0.36 J
	Aug	2008		**0.95 J**	1 U	1 UJ	0.95 J
	Mar	2009		**0.6 J**	1 U	1 U	0.6 J
	Sep	2009		**0.5 J**	1 U	1 U	0.5 J
	Mar	2010		1 U	1 U	1 U	ND
	Sep	2010		0.4 J	1 U	1 U	0.4 J
	Mar	2011		1 U	1 U	1 U	ND
	Nov	2011		**0.46 J**	0.5 U	0.5 U	0.46 J
	Jun	2012		0.5 U	0.5 U	0.5 U	ND
	Nov	2012		**0.63 J**	0.5 U	1 U	0.63 J
	Feb	2013		0.5 U	0.5 U	0.5 U	ND
MW-84R	Feb	2013		**7.4**	**4.4**	0.5 U	11.8
MW-85R	Feb	2013		**1.8**	**0.83 J**	0.5 U	2.63 J
MW-86R	Feb	2013		**0.76**	0.5 U	0.5 U	0.76 J

(1) The MCP GW-2 criterion (90 ug/L) is lower than GW-1 criterion (100 ug/L); thus the GW-2 criterion is used to develop the PAL for groundwater samples collected from wells where the depth to water is less than or equal to 15 feet. The GW-1 criterion is used for the other wells.

Bold values indicate a detected concentration.
Highlighted values indicate concentrations that exceed the PAL.
AVG = average
PAL = project action limit
DUP = duplicate sample
DCE = dichloroethene
TCE = trichloroethene
NS = Not sampled
J = estimated value
U = non-detect value
µg/L = micrograms per liter

TABLE 3-6

SUMMARY OF REGRESSION DATA FOR TRICHLOROETHENE
SEMI-ANNUAL GROUNDWATER REPORT - FEBRUARY 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
SOUTHERN FLIGHT TEST AREA
BEDFORD, MASSACHUSETTS

Event Date		TCE Concentrations[1] (µg/L)							
		MW-7B	MW-8B	MW-23R	MW-24R	MW-25R	MW-84R	MW-85R	MW-86R
Jun	1989	--	230	--	--	--	--	--	--
Nov	1989	0	200	--	--	--	--	--	--
Jan	1990	0	190	--	--	--	--	--	--
Apr	1990	0	150	--	--	--	--	--	--
Apr	1993	0	110	0	250	130	--	--	--
Sep	1998	0	58.5	0	134	1.5	--	--	--
Nov	2002	--	33	--	74.5	0.8	--	--	--
Apr	2003	--	28.2	--	52.8	0.8	--	--	--
Jul	2003	--	26.6	--	71.1	1	--	--	--
Feb	2004	--	26.8	--	63	0.49	--	--	--
Jul	2004	--	25.5	--	57.6	0.5	--	--	--
Feb	2005	--	26.6	--	62	0.6	--	--	--
Aug	2005	--	24.1	--	60.1	0.88	--	--	--
Apr	2006	--	25.5	--	60.6	0.51	--	--	--
Aug	2006	--	19.4	--	49.9	0	--	--	--
Apr	2007	--	23	--	51.7	0	--	--	--
Aug	2007	--	20.5	--	42.2	0	--	--	--
Mar	2008	--	23	--	48.5	0.36	--	--	--
Aug	2008	--	18	--	38	0.95	--	--	--
Mar	2009	--	21	--	51	0.6	--	--	--
Sept	2009	--	16	--	42	0.5	--	--	--
Mar	2010	--	18	--	44	0	--	--	--
Sept	2010	--	15	--	37	0.4	--	--	--
Mar	2011	--	16	--	37	0	--	--	--
Nov	2011	0	12	0	32	0.46	--	--	--
Jun	2012	0	12	0	38	0	--	--	--
Nov	2012	0	13	0	34	0.63	--	--	--
Feb	2013	0	11.9	0	38.5	0	7.4	1.8	0.76
R^2		--	0.98	--	0.90	--	--	--	--
regression		--	exp.	--	exp.	--	--	--	--

(1) A value of zero was used for "non-detect" results. Data qualifiers are not shown.
µg/L = micrograms per liter (parts per billion)
-- = not sampled
R^2 = regression coefficient of determination
exp. = exponential regression

TABLE 3-7

OVERALL MANN-KENDALL STATISTICS FOR TCE
SEMI-ANNUAL MONITORING REPORT – FEBRUARY 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
SOUTHERN FLIGHT TEST AREA
BEDFORD, MASSACHUSETTS

Sampling Date	MW-8B (µg/L)	MW-24R (µg/L)
Jun-89	230	NS
Oct-89	200	NS
Jan-90	190	NS
Apr-90	150	NS
Apr-93	110	250
Sept-98	58	130
Nov-02	33	74
Apr-03	28	53
Jul-03	27	71
Feb-04	27	63
Jul-04	26	58
Feb-05	27	62
Aug-05	24	60
Apr-06	26	61
Aug-06	19	50
Apr-07	23	52
Aug-07	20	42
Mar-08	23	48
Aug-08	18	38
Mar-09	21	51
Sept-09	16	42
Mar-10	18	44
Sept-10	15	37
Mar-11	16	37
Nov-11	12	32
Jun-12	12	38
Nov-12	13	34
Feb-13	12	38
STATISTICS		
Analysis Count	28	24
S	-120	-81
Mann-Kendall P (1)	0.0000000656	0.00000924
Trend Test Result at: 99% confidence	Downward Trend	Downward Trend
Trend Test Result at: 95% confidence	Downward Trend	Downward Trend

(1) P is the probability (out of 1.0) of no significant trend (greater than 3 analyses are required). This value must be less than or equal to 0.01 for a significant trend to exist at 99% confidence (Gilbert, 1987). This value must be less than to equal to 0.05 for a significant trend to exist at 95% confidence (Gilbert, 1987).

NS – not sampled

TABLE 3-8

SEASONAL MANN-KENDALL STATISTICS FOR TCE
SEMI-ANNUAL MONITORING REPORT – FEBRUARY 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
SOUTHERN FLIGHT TEST AREA
BEDFORD, MASSACHUSETTS

Sampling Date	MW-8B (µg/L)	MW-24R (µg/L)
Season 1 (1)		
Jun-89	230	NS
Jan-90	190	NS
Apr-90	150	NS
Apr-93	110	250
Apr-03	28	53
Feb-04	27	63
Feb-05	27	62
Apr-06	26	61
Apr-07	23	52
Mar-08	23	48
Mar-09	21	51
Mar-10	18	44
Mar-11	16	37
Jun-12	12	38
Feb-13	12	38
STATISTICS		
Analysis Count	15	12
S	-88	-53
Mann-Kendall P (2)	0.00000130	0.000270
Trend Test Result at: 99% confidence	Downward Trend	Downward Trend
Trend Test Result at: 95% confidence	Downward Trend	Downward Trend
Season 2 (1)		
Oct-89	200	NS
Sept-98	58	130
Nov-02	33	74
Jul-03	27	71
Jul-04	26	58
Aug-05	24	60
Aug-06	19	50
Aug-07	20	42
Aug-08	18	38
Sept-09	16	42
Sept-10	15	37
Nov-11	12	32
Nov-12	13	34
STATISTICS		
Analysis Count	13	12
S	-74	-59
Mann-Kendall P (2)	0.00000634	0.0000501
Trend Test Result at: 99% confidence	Downward Trend	Downward Trend
Trend Test Result at: 95% confidence	Downward Trend	Downward Trend

(1) Season 1 is defined as the first 6 months of the year (January – June). Season 2 is the last 6 months (July – December).

(2) P is the probability (out of 1.0) of no significant trend (greater than three analyses are required). This value must be less than or equal to 0.01 for a significant trend to exist at 99% confidence (Gilbert, 1987). This value must be less than or equal to 0.05 for a significant trend to exist at 95% confidence (Gilbert, 1987).

SFTA Groundwater Potentiometric Map

SFTA Groundwater Monitoring Report — February 2013

(Tetra Tech, May 2013)

I:\04457\03-2\SFTA_BED_CONT_022013_SAMR_0213.MXD DWM 05/30/13

N

HARTWELL ROAD

MC11-3 (Former)

MC11-4 (Former)

MW-23R 140.07

MW-23S

Van Duesen

Flight Test Facility

AST

Chemical Storage Shed

Plating Lab

Hawk

Park

MW-7S (Former)

MW-7B 128.94

Old Hangar

MW-24R 123.98

MW-24S

MW-85R 127.11

MC11-1 (Former)

MC11-2 (Former)

Pump House

MW-84R 122.13

Edge of Concrete Apron

MW-9S

MW-9B (Former)

MW-8S

MW-8B 121.03

Grass

MW-25R 121.91

MW-25S

MW-86R 119.13

TAXIWAY R

140 138 136 134 132 130 128 126 124 122 120

Legend

122.13 Bedrock Groundwater Elevation (feet, NAVD, 1988)

Interpreted Bedrock Groundwater Contour Line

Bedrock Groundwater Flow Direction

Existing Groundwater Wells

Former Wells

NWIRP Boundary

Existing Buildings

Former Buildings

0 50 100 200 Feet

TETRA TECH

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

BEDROCK GROUNDWATER CONTOURS - FEBRUARY 20, 2013

SOUTHERN FLIGHT TEST AREA
FEBRUARY 2013 SEMI-ANNUAL MONITORING REPORT

FILE	SCALE
I:\..\SFTA_BED_CONT_022013_SAMR_2013.MXD	PER SCALE BAR

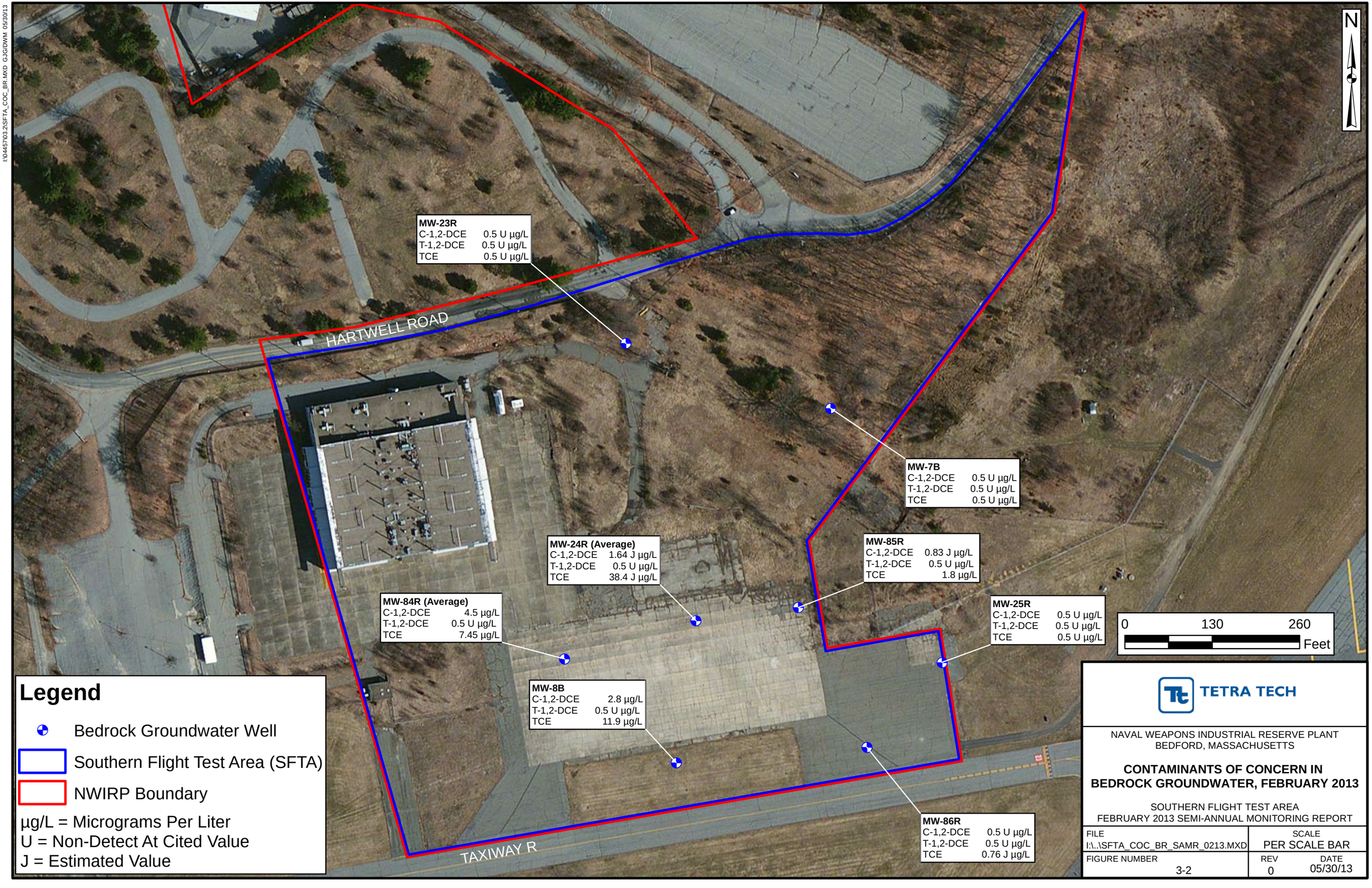
FIGURE NUMBER	REV	DATE
3-1	0	05/30/13

SFTA Groundwater CVOC Result Map

SFTA Groundwater Monitoring Report — February 2013

(Tetra Tech, May 2013)

I:\04457\03.2\SFTA_COC_BR.MXD GJG/DWM 05/30/13



TETRA TECH

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

CONTAMINANTS OF CONCERN IN BEDROCK GROUNDWATER, FEBRUARY 2013

SOUTHERN FLIGHT TEST AREA
FEBRUARY 2013 SEMI-ANNUAL MONITORING REPORT

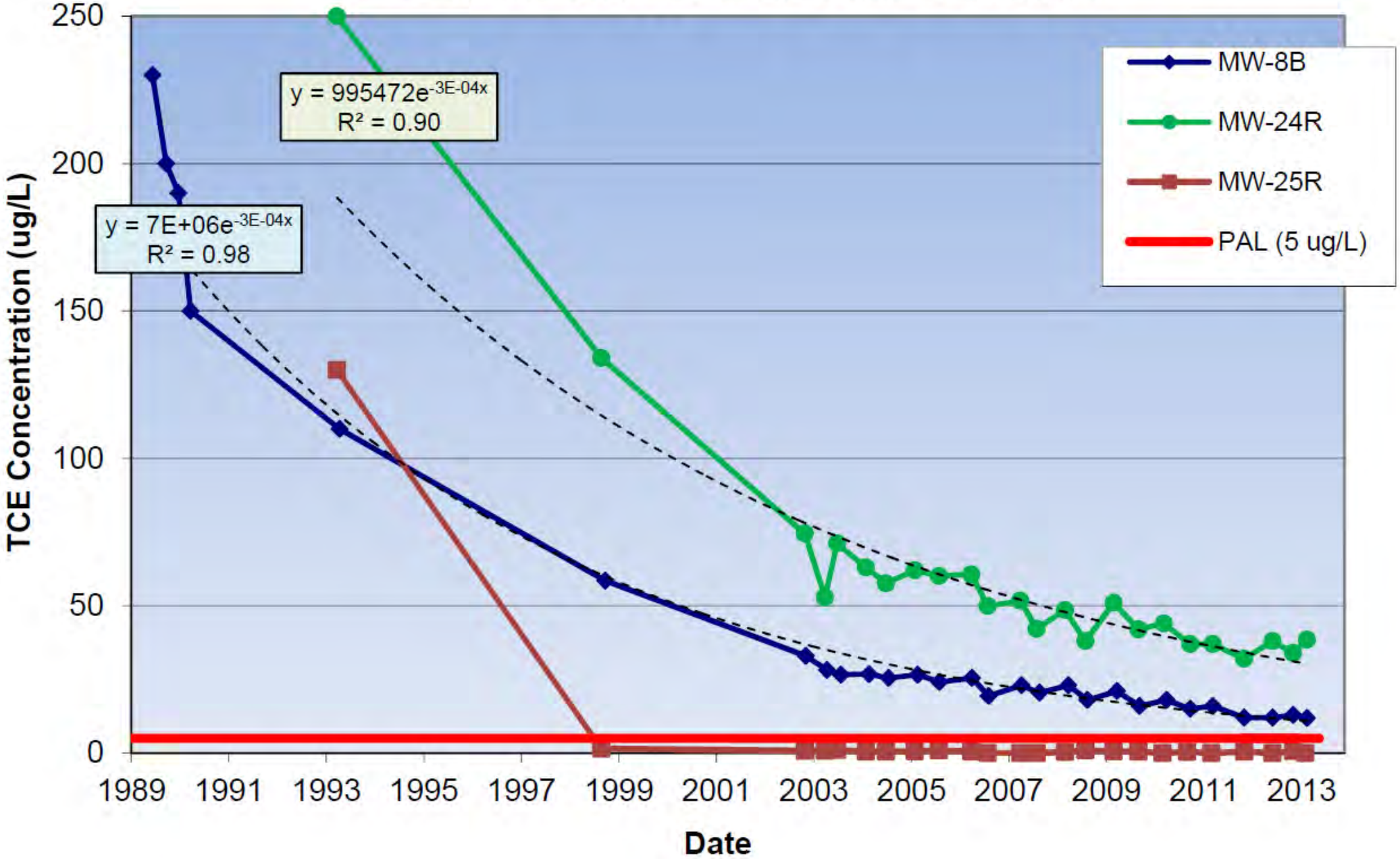
FILE	SCALE
I:\..\SFTA_COC_BR_SAMR_0213.MXD	PER SCALE BAR
FIGURE NUMBER 3-2	REV 0 / DATE 05/30/13

SFTA Groundwater CVOC Trend Plot

SFTA Groundwater Monitoring Report — February 2013

(Tetra Tech, May 2013)

Exhibit 3-1
Trend Graph for Trichloroethene Concentrations in Bedrock Groundwater
Southern Flight Test Area, NWIRP Bedford, MA



Appendix G

Site 3 and Site 4 ROD Concurrence Letters

Site 3 ROD Concurrence Letter
Site 3 ROD
(MassDEP, 29 September 2010)

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

Site 4 ROD Concurrence Letter
Site 4 ROD
(MassDEP, 16 September 2009)

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 16, 2009

Mr. James T. Owens, Director
Office of Site Remediation and Restoration
U.S. Environmental Protection Agency, Region I
One Congress Street, Suite 1100
Boston, MA 02114-2023

Re: State Concurrence with Record of Decision
Naval Weapons Industrial Reserve Plant, Unit 4, Bedford, MA

Dear Mr. Owens:

The Massachusetts Department of Environmental Protection (MassDEP) has reviewed the selected remedy recommended by the U.S. Environmental Protection Agency (EPA) for the cleanup of the Naval Weapons Industrial Reserve Plant (NWIRP) BTEX Plume (Site 4). MassDEP concurs with the selection of the remedy as presented in the Record of Decision.

The selected remedy consists of excavation and biopile treatment or off-site disposal of soil in the source area; the application of oxygen releasing compound (ORC) into the excavated source area to further reduce compounds of concern (COCs); monitored natural attenuation (MNA) of the groundwater plume; and institutional controls restricting the groundwater use, residential development, and occupancy of site structures. This remedy is comprehensive and addresses the principal site risks and the Remedial Action Objectives (RAOs) established for Site 4. The selected remedy also meets applicable or relevant and appropriate state requirements for the selected remedy.

If you have any questions or comments, please contact Anne Malewicz, Federal Facilities Section Chief at 617-292-5659.

Sincerely,

Janine Commerford
Assistant Commissioner
Bureau of Waste Site Cleanup

cc: Matthew Audet, U.S. EPA Region 1
Maritza Montegross, NavFac Midplant
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 H

Site 4 Groundwater Trend Data and Analysis 1993-2013

The September 2013 Site 4 Groundwater Report (AGVIO-CH2MHill, 28 January 2014) includes the cumulative groundwater data collected at Site 4 sample locations since 1997 through the third quarter sampling event for 2013. Groundwater is sampled quarterly. Once per year, the monitoring reports include more detailed evaluations consistent with the Navy's guidance for monitoring reports.

Every other year, the annual report will also include a more detailed assessment of MNA to verify that COC concentrations are attenuating at a rate that is acceptable to the project team and to predict timeframes for site remediation. This detailed assessment will occur later in 2014.

Site 4 Groundwater Data Tables

Site 4 Groundwater Monitoring Report — September 2013

(AGVIQ-CH2MHill, 28 January 2014)

TABLE 3-3
GROUNDWATER QUALITY DATA
SITE 4 MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Well	Total Purge Volume (L)	Total Purge Time (min)	Color	pH	S.C. (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temperature	ORP (mV)
ELM-3	12.5	45	clear	5.98	0.137	1.46	0.36	12.93	4.70
GEI-107U	6	30	clear	6.13	0.513	1.66	2.00	11.07	-20.40
MW-15SR	1.5	18	very turbid	6.10	0.336	>1000	0.85	13.83	24.20
MW-18SR	5.4	30	clear	6.59	0.505	1.02	0.09	14.29	-81.80
MW-46	14	98	clear	6.16	0.881	6.34	0.25	17.07	32.50
MW-60S	6	31	clear	6.25	0.355	7.47	0.31	14.35	-12.40
MW-64S	11	35	clear	6.70	0.570	7.92	0.08	13.86	-154.60
MW-77S	9.5	56	clear	5.96	0.353	1.13	1.27	12.35	45.20
MW-78S	4.75	34	clear	5.94	0.133	3.78	1.63	13.66	47.10
MW-79S	14.5	51	clear	5.96	0.295	0.36	0.61	12.95	-1.80
MW-80S	14.5	50	clear	6.00	0.360	1.48	0.85	12.96	99.60

Notes:

°C = degrees Celsius
DO = dissolved oxygen
L = liters
min = minutes
mg/L = milligrams per liter
mL/min = milliliters per minute
mS/cm = millisiemens per centimeter
mV = millivolts
NTU = nephelometric turbidity units
ORP = oxidation-reduction potential
S.C. = specific conductivity
Temp = temperature

TABLE 3-3
ANALYTICAL RESULTS FOR SITE 4 CONTAMINANTS OF CONCERN
SITE 4 MONITORING REPORT – SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Location				ELM-3		GEI-107U		MW-15SR		MW-18SR		MW-18SR		MW-46	
Sample ID				BED04-GW-ELM3-0913		BED04-GW-GEI107U-0913		BED04-GW-MW15SR-0913		BED04-GW-MW18SR-0913		BED04-GW-DUP02-0913		BED04-GW-MW46-0913	
Sample Date				9/26/2013		9/30/2013		10/1/2013		9/27/2013		9/27/2013		9/27/2013	
Analyte	**Units**	**Cleanup Goals[1]**	**Other Benchmark [1]**												
SW8260C (µg/L)															
Benzene	µg/L	5	--	**0.78**	**J**	**28**		0.5	U	**11**		**11**		0.5	U
Ethylbenzene	µg/L	700	--	0.5	U	**13**		**2.4**		**640**		**650**		0.5	U
Toluene	µg/L	1,000	--	0.5	U	**1.7**		**1.7**		**23**		**23**		0.5	U
Xylene, total	µg/L	--	10,000	1	U	1	U	1	U	**280**		**240**		1	U
Total BTEX	µg/L	--		**0.78**	**J**	**42.7**		**4.1**		**954.0**		**924.0**		0.0	U
SW8270D (µg/L)															
2-Methylnaphthalene	µg/L	150	--	2.0	UJ	NA		NA		**33**		**34**		2.0	U
Naphthalene	µg/L	--	140	2.0	UJ	NA		NA		**110**		**120**		2.0	U

Notes:

µg/l = micrograms per Liter

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

NA = Not analyzed

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
Not detected substantially above the level reported in

UJ = The analyte was not deemed above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

1. No cleanup goals were identified for xylenes and naphthalene in the ROD; however, these two compounds are associated with the Site 4 release and are included in the Site 4 monitoring program for informational purposes (U.S. Navy, 2009). For purposes of comparison, xylenes concentrations are compared to the federal Maximum Contaminant Level (MCL) and naphthalene concentrations are compared to the Massachusetts drinking water guidance value for that compound (no MCL available).

2. Bold indicates the analyte was detected

3. Shaded values indicate concentrations which exceed cleanup goals.

TABLE 3-3
ANALYTICAL RESULTS FOR SITE 4 CONTAMINANTS OF CONCERN
SITE 4 MONITORING REPORT – SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Location				MW-60S		MW-64S		MW-77S		MW-78S		MW-79S		MW-80S		MW-80S	
Sample ID				BED04-GW-MW60S-0913		BED04-GW-MW64S-0913		BED04-GW-MW77S-0913		BED04-GW-MW78S-0913		BED04-GW-MW79S-0913		BED04-GW-MW80S-0913		BED04-GW-DUP01-0913	
Sample Date				9/27/2013		9/26/2013		9/26/2013		9/26/2013		9/26/2013		9/26/2013		9/26/2013	
Analyte	**Units**	**Cleanup Goals[1]**	**Other Benchmark [1]**														
SW8260C (µg/L)																	
Benzene	µg/L	5	--	**4.8**		**0.76**	J	0.5	U	0.5	U	0.5	U	**0.79**	**J**	0.77	J
Ethylbenzene	µg/L	700	--	**81**		**1,400**		0.5	U	0.5	U	0.5	U	**0.54**	**J**	0.5	U
Toluene	µg/L	1,000	--	**1.7**		**3.6**		0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Xylene, total	µg/L	--	10,000	**64**		**2,000**		1	U	1	U	1	U	**1**		1	U
Total BTEX	µg/L	--		**151.5**		**3404.36**	**J**	0.0	U	0.0	U	0.0	U	**2.33**	**J**	**0.77**	**J**
SW8270D (µg/L)																	
2-Methylnaphthalene	µg/L	150	--	NA		NA		NA		NA		NA		2.0	UJ	2.0	UJ
Naphthalene	µg/L	--	140	NA		NA		NA		NA		NA		2.0	UJ	2.0	UJ

Notes:

µg/l = micrograms per Liter

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

NA = Not analyzed

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
Not detected substantially above the level reported in

UJ = The analyte was not deemed above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

1. No cleanup goals were identified for xylenes and naphthalene in the ROD; however, these two compounds are associated with the Site 4 release and are included in the Site 4 monitoring program for informational purposes (U.S. Navy, 2009). For purposes of comparison, xylenes concentrations are compared to the federal Maximum Contaminant Level (MCL) and naphthalene concentrations are compared to the Massachusetts drinking water guidance value for that compound (no MCL available).

2. Bold indicates the analyte was detected

3. Shaded values indicate concentrations which exceed cleanup goals.

TABLE 3-5
ANALYTICAL RESULTS FOR MNA PARAMETERS
SITE 4 MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Location		GEI-107U	MW-15SR	MW-18SR	MW-18SR	MW-43	MW-46	MW-60S
Parameter	**Unit**							
CARBON DIOXIDE	ug/L	**31,700**	**29,300**	**22,800**	**19,100**	NS	**27,100**	**24,300**
IRON (total)	ug/L	**5,620**	**89,600**	**14,400**	**14,600 J**		**2,380**	**148,000**
IRON (dissolved)	ug/L	**5,140**	**49,900**	**13,900**	**14,900 J**		**2,270**	NS
FERROUS IRON (Fe2+) (field test kit)	ug/L	**4,000**	**3,800**	**3,600**	**3,800**		**2,080**	NM
FERRIC IRON (Fe3+) (a)	ug/L	**1,620**	**85,800**	**10,800**	**10,800**		**300**	NC
MANGANESE (total)	ug/L	**3,910**	**944**	**6,630**	**6,680 J**		**705 J**	**4,900**
MANGANESE (dissolved)	ug/L	**3,900**	**665**	**6,000**	**6,760 J**		**844 J**	NS
MANGANESE (Mn2+) (field test kit)	ug/L	**3,600**	**200**	**6,500**	**6,150**		2,100	NM
MANGANESE (Mn4+) (b)	ug/L	**310**	**744**	**130**	**530**		NC [3]	NC
METHANE	ug/L	**190**	**170**	**3,100 J**	**5,900 J**		**430**	**1700**
NITRATE	mg/L	0.1 U	**0.047 J**	**0.051 J**	**0.049 J**		**0.677 J**	**0.051 J**
NITRITE	mg/L	0.1 U	0.1 U	0.1 UJ	0.1 UJ		0.1 UJ	0.1 UJ
DO (field measured)	mg/L	2.00	0.85	0.00	NM		0.25	0.31
ORP (field measured)	mV	-20.4	24.2	0.09	NM		32.5	-12.4
SULFATE	mg/L	**6.32**	**0.921 J**	**0.392 J**	**0.384 J**		**15.5**	**4.03**
SULFIDE	mg/L	0.03 UJ	**4.1 J**	0.03 UJ	0.03 UJ		0.03 UJ	0.03 UJ

Notes:
(a) Ferric iron (Fe3+) was calculated by subtracting the ferrous iron (Fe2+) result from the total iron result.
(b) Mn(4+) was calculated by subtracting the Mn(2+) result from the total manganese result (minimum value of zero).
(c) Lab and field concentrations result in negative calculated Mn(2+) value; result rejected.
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
mg/L = milligram(s) per liter
NC = Not calculated
NM = Not measured
NS = Not sampled

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit. Not detected substantially above the level reported in laboratory or field blanks.
µg/L = microgram(s) per liter

Site 4 Groundwater Analysis Tables

Site 4 Groundwater Monitoring Report — September 2013

(AGVIQ-CH2MHill, 28 January 2014)

TABLE 3-6
COMPARISON OF SEPTEMBER 2013 TOTAL BTEX CONCENTRATIONS TO HISTORICAL DATA
SITE 4 MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

Well	Number of Times Well Was Sampled Between Q1 - Q38	Baseline (Feb 1997) Total BTEX (µg/L)	Q1 - Q38 Average Total BTEX (µg/L)	September 2013 (Q39) Total BTEX (µg/L)	Is Q39 ≤ Q1 - Q38 Average?	Is Q39 ≤ Baseline?
ELM-2	31	0	0.43	NS	NA	NA
ELM-3	4	NS	3.20	0.78	Yes	NA
GEI-107U	16	2,200	1,150	42.7	Yes	Yes
MW-15SR[1]	21	NS	89.71	4.1	Yes	NA
MW-18SR[2]	15	NS	1,434	954	Yes	NA
MW-46	4	NS	0.43	0.0	Yes	NA
MW-60S	6	NS	396.9	151.5	Yes	NA
MW-64S	9	NS	4,279	3,404	Yes	NA
MW-77S	2	NS	0.90	0.0	Yes	NA
MW-78S	2	NS	79.95	0.0	Yes	NA
MW-79S	2	NS	33.40	0.0	Yes	NA
MW-80S	4	NS	0.58	2.33	**No**	NA

Notes:
ug/L = micrograms per liter
BTEX = Benzene, Toluene, Ethylbenzene, Xylenes
Non-detect values are shown as zero.
NA = Not Applicable
NS = Not Sampled

TABLE 3-7
SEASONAL KENDALL AND MANN-KENDALL TREND EVALUATION
SITE 4 MONITORING REPORT - AUG 2007 - SEPT 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

					Mann-Kendall Trend Evaluation		
Well	Parameter	Number of Detects	Number of Results	Percent Detects	Calculated Probability [1]	Decision Using Significance Level of 0.05	Decision Using Significance Level of 0.01
ELM-3	Benzene	4	4	100	0.367	No Significant Change	No Significant Change
GEI-107U	Benzene	5	5	100	0.231	No Significant Change	No Significant Change
MW-15SR	Benzene	13	14	93	0.350	No Significant Change	No Significant Change
MW-18SR	Benzene	12	12	100	0.339	No Significant Change	No Significant Change
MW-60S	Benzene	7	7	100	0.500	No Significant Change	No Significant Change
MW-64S	Benzene	7	7	100	0.438	No Significant Change	No Significant Change
MW-80S	Benzene	1	1	100	*Insufficient Events Available*		
ELM-3	Ethylbenzene	3	4	75	0.625	No Significant Change	No Significant Change
GEI-107U	Ethylbenzene	5	5	100	0.500	No Significant Change	No Significant Change
MW-15SR	Ethylbenzene	14	14	100	0.043	Significantly Decreasing	No Significant Change
MW-18SR	Ethylbenzene	12	12	100	0.795	No Significant Change	No Significant Change
MW-60S	Ethylbenzene	7	7	100	0.382	No Significant Change	No Significant Change
MW-64S	Ethylbenzene	6	6	100	0.354	No Significant Change	No Significant Change
MW-80S	Ethylbenzene	1	1	100	*Insufficient Events Available*		
ELM-3	Total BTEX	4	4	100	0.367	No Significant Change	No Significant Change
GEI-107U	Total BTEX	5	5	100	0.403	No Significant Change	No Significant Change
MW-15SR	Total BTEX	14	14	100	0.035	Significantly Decreasing	No Significant Change
MW-18SR	Total BTEX	12	12	100	0.608	No Significant Change	No Significant Change
MW-46	Total BTEX	4	5	80	0.290	No Significant Change	No Significant Change
MW-60S	Total BTEX	7	7	100	0.382	No Significant Change	No Significant Change
MW-64S	Total BTEX	7	7	100	0.274	No Significant Change	No Significant Change
MW-77S	Total BTEX	2	3	67	*Insufficient Events Available*		
MW-78S	Total BTEX	2	3	67	*Insufficient Events Available*		
MW-79S	Total BTEX	2	3	67	*Insufficient Events Available*		
MW-80S	Total BTEX	4	4	100	0.500	No Significant Change	No Significant Change

Notes:
1. The probability that observed patterns in data appear are consistent with an assumption that there are no trends in the data over time
2. Mann-Kendall trend evaluation was calculated for wells that were sampled at least four times from January 2007 to September 2013 using most recent 12 data points from each location.

TABLE 3-8
SUMMARY OF COC REGRESSION DATA
SITE 4 MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

LOCATION		ELM-2	ELM-3		
CONCENTRATIONS		(µg/L)	(µg/L)		
COMPOUND		Total BTEX	Total BTEX	Benzene	Ethylbenzene
	Aug-93				
Q00 Baseline	Feb-97	0			
Q24	Aug-07	1.9			
Q25	Mar-08	0			
Q26	Aug-08	0			
Q27	Mar-09	0			
Q28	Sep-09	0			
Q29	Mar-10	0			
Q30	Sep-10	0			
Q31	Mar-11	0			
Q32	Nov-11	0			
Q33	March/ April 2012				
Q34	Jun-12				
Q35	Sep-12		0.85	0.85	0.0
Q36	Dec-12		7.5	7.5	0.0
Q37	Mar-13		2.16	1.6	0.0
Q38	Jun-13		2.8	2.8	0.0
Q39	Sep-13		0.78 J	0.78 J	0.0
R^2		--	--	--	--
		--	--	--	--

Notes:
Regression data were not calculated for ELM-2, ELM-3, MW-46, MW-77S, MW-78S, MW-79S, and MW-80S due to mostly trace/non-detect values or lack of data points.
Non-detect results are assigned a value of zero.
R^2 = regression coefficient of determination
log. = logarithmic regression

TABLE 3-8
SUMMARY OF COC REGRESSION DATA
SITE 4 MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

LOCATION		GEI-107U			MW-15SR		
CONCENTRATIONS		(µg/L)			(µg/L)		
COMPOUND		Total BTEX	Benzene	Ethylbenzene	Total BTEX	Benzene	Ethylbenzene
	Aug-93	3,350	940	1,400			
Q00 Baseline	Feb-97	2,150	690	990			
Q24	Aug-07				0.0	0.0	0.0
Q25	Mar-08				75.4	0.82	48
Q26	Aug-08				45	0.0	32
Q27	Mar-09				24	0.0	16
Q28	Sep-09				46.8	0.8	32
Q29	Mar-10				13	0	8
Q30	Sep-10				DRY		
Q31	Mar-11				10	0.0	6
Q32	Nov-11	46	33	13	4.45	0.0	2.05
Q33	March/ April 2012	53.2 J	35	16	20.6	0.0	10
Q34	Jun-12				18.4	0.0	10
Q35	Sep-12	0.0	0.0	0.0	0.0	0.0	0.0
Q36	Dec-12				19.6	1.2	10
Q37	Mar-13	40.8	30	9.4	8.2	0.0	4.1
Q38	Jun-13	35.0	24	9.6	5.9	0.0	2.7
Q39	Sep-13	42.7	28	13	4.1	0.0	2.4
R^2		0.871	0.854	0.833	0.598	0.3875	0.656
		log.	log.	log.	log.	log.	log.

Notes:
Regression data were not calculated for ELM-2, ELM-3, MW-46, MW-77S, MW-78S, MW-79S, and MW-80S due to mostly trace/non-detect values or lack of data points.
Non-detect results are assigned a value of zero.
R^2 = regression coefficient of determination
log. = logarithmic regression

TABLE 3-8
SUMMARY OF COC REGRESSION DATA
SITE 4 MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

LOCATION		MW-18SR			MW-46	MW-60S		
CONCENTRATIONS		(µg/L)			(µg/L)	(µg/L)		
COMPOUND		Total BTEX	Benzene	Ethylbenzene	Total BTEX	Total BTEX	Benzene	Ethylbenzene
	Aug-93							
Q00 Baseline	Feb-97							
Q24	Aug-07							
Q25	Mar-08	1,110	16.5	575				
Q26	Aug-08							
Q27	Mar-09	1,249	12	510				
Q28	Sep-09							
Q29	Mar-10	13	0.0	9				
Q30	Sep-10	1,130	9	510				
Q31	Mar-11	1,270	11	565				
Q32	Nov-11	1,110	6.2	540	0.33	19.1	1.1	18
Q33	March/ April 2012	1, 279	9.1	500	0.0	788.4	6.1	330
Q34	Jun-12	1,306	10	520		873	8.6	440
Q35	Sep-12	5,000	0.0	1,900	1.37	45.1	4.3	7.2
Q36	Dec-12	784	12	300		673.2	9.1	390
Q37	Mar-13	943.4	8.4	570	0.0	1.47	0.0	0.84
Q38	Jun-13	639.8	4.8	330		0.0	0.0	0.0
Q39	Sep-13	954	11	640	0.0	151.5	4.8	81
R^2		0.011	0.616	0.004	--	0.513	0.294	0.403
		exp.	log.	log.	--	log.	log.	log.

Notes:
Regression data were not calculated for ELM-2, ELM-3, MW-46, MW-77S, MW-78S, MW-79S, and MW-80S due to mostly trace/non-detect values or lack of data points.
Non-detect results are assigned a value of zero.
R^2 = regression coefficient of determination
log. = logarithmic regression

TABLE 3-8
SUMMARY OF COC REGRESSION DATA
SITE 4 MONITORING REPORT - SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

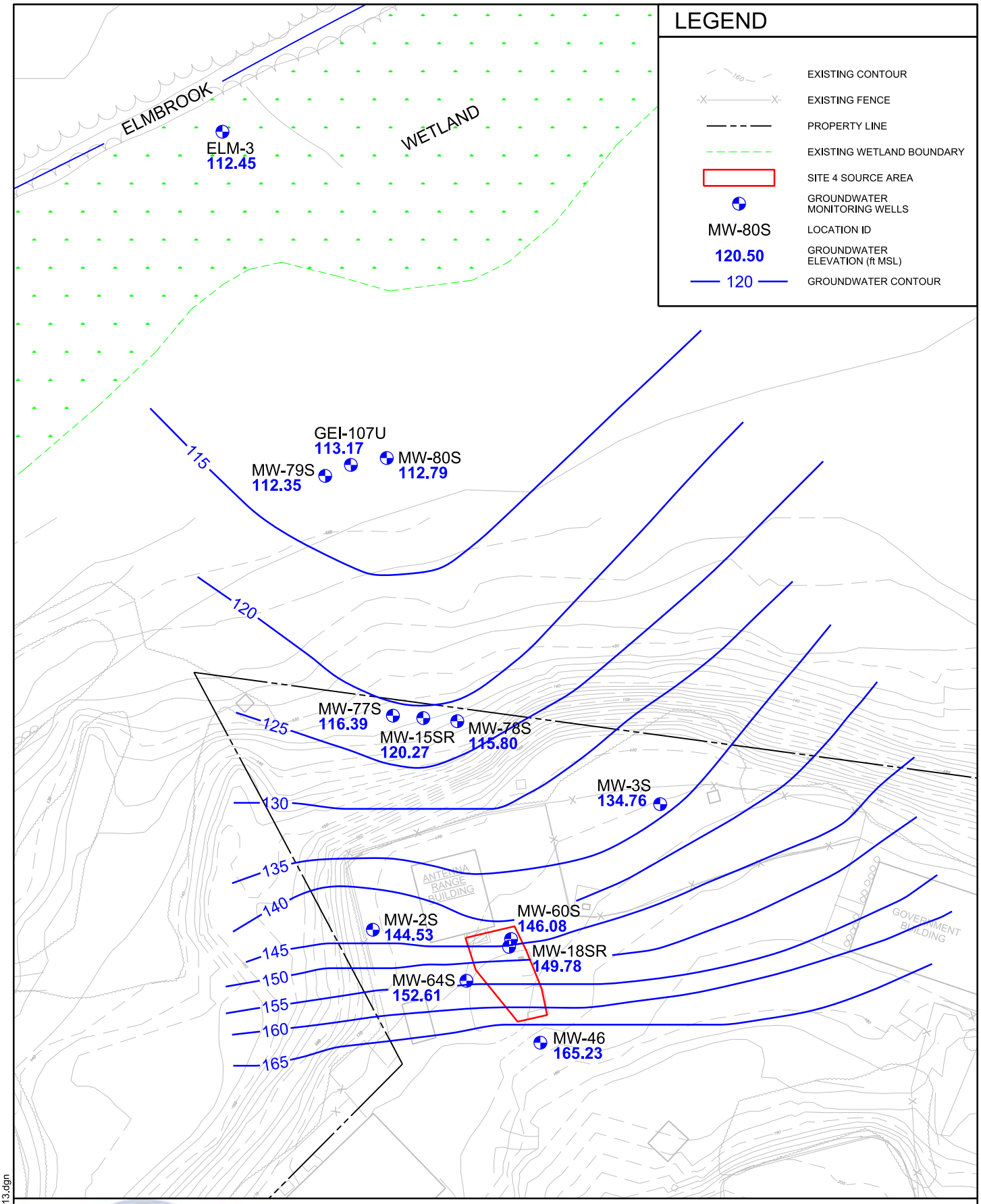
LOCATION		MW-64S			MW-77S	MW-78S	MW-79S	MW-80S
CONCENTRATIONS		(µg/L)			(µg/L)	(µg/L)	(µg/L)	(µg/L)
COMPOUND		Total BTEX	Benzene	Ethylbenzene	Total BTEX	Total BTEX	Total BTEX	Total BTEX
	Aug-93							
Q00 Baseline	Feb-97							
Q24	Aug-07							
Q25	Mar-08							
Q26	Aug-08							
Q27	Mar-09							
Q28	Sep-09							
Q29	Mar-10							
Q30	Sep-10	3,616	2	700				
Q31	Mar-11	2,206	0.0	1,600				
Q32	Nov-11	3,619	1					
Q33	March/ April 2012	5,315	0.0	1,700				
Q34	Jun-12							
Q35	Sep-12	568.9	6.9	330	1.8	159.9	0.0	2.3
Q36	Dec-12							0.0
Q37	Mar-13	0.0	0.0	0.0	0.0	0.0	66.8	0.0
Q38	Jun-13							0.0
Q39	Sep-13	3404.4	0.76 J	1,400	0.0	0.0	0.0	2.33
R^2		0.452	0.633	0.122	--	--	--	--
		log.	log.	log.	--	--	--	--

Notes:
Regression data were not calculated for ELM-2, ELM-3, MW-46, MW-77S, MW-78S, MW-79S, and MW-80S due to mostly trace/non-detect values or lack of data points.
Non-detect results are assigned a value of zero.
R^2 = regression coefficient of determination
log. = logarithmic regression

Site 4 Groundwater Potentiometric Maps

Site 4 Groundwater Monitoring Report — September 2013

(AGVIQ-CH2MHill, 28 January 2014)



AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL JOINT VENTURE

N

0 50 100 150
Scale In Feet

FIGURE 3-1
SITE 4
INTERPRETED WATER TABLE CONTOURS
SHALLOW OVERBURDEN, SEPTEMBER 27, 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

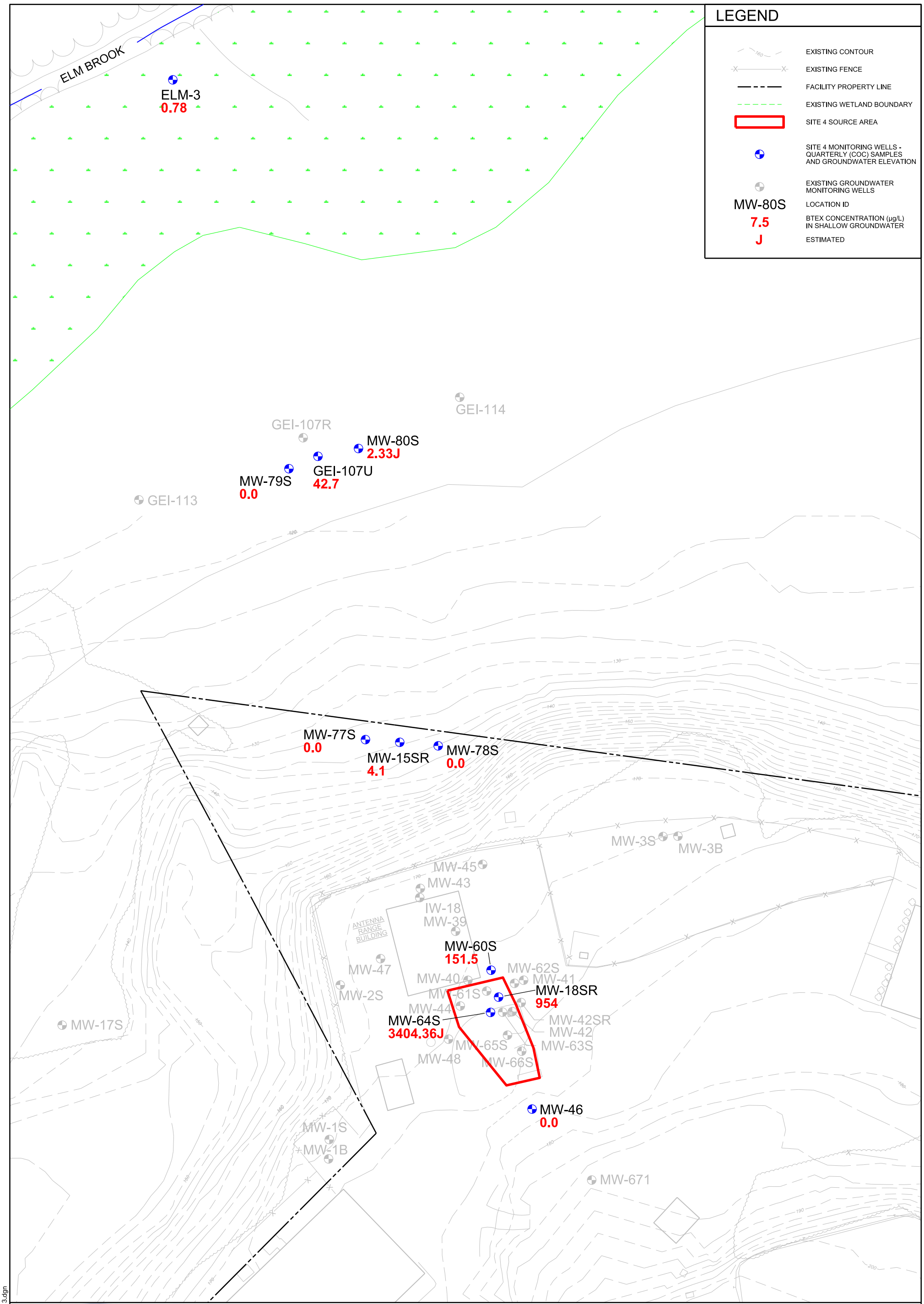
FILENAME: Figure 3-1 Sept 2013.dgn

409428.04

Site 4 Groundwater BTEX Result Map

Site 4 Groundwater Monitoring Report — September 2013

(AGVIQ-CH2MHill, 28 January 2014)



AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL JOINT VENTURE

FIGURE 3-2
SITE 4
TOTAL BTEX CONCENTRATIONS IN GROUNDWATER
SEPTEMBER 2013
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BEDFORD, MASSACHUSETTS

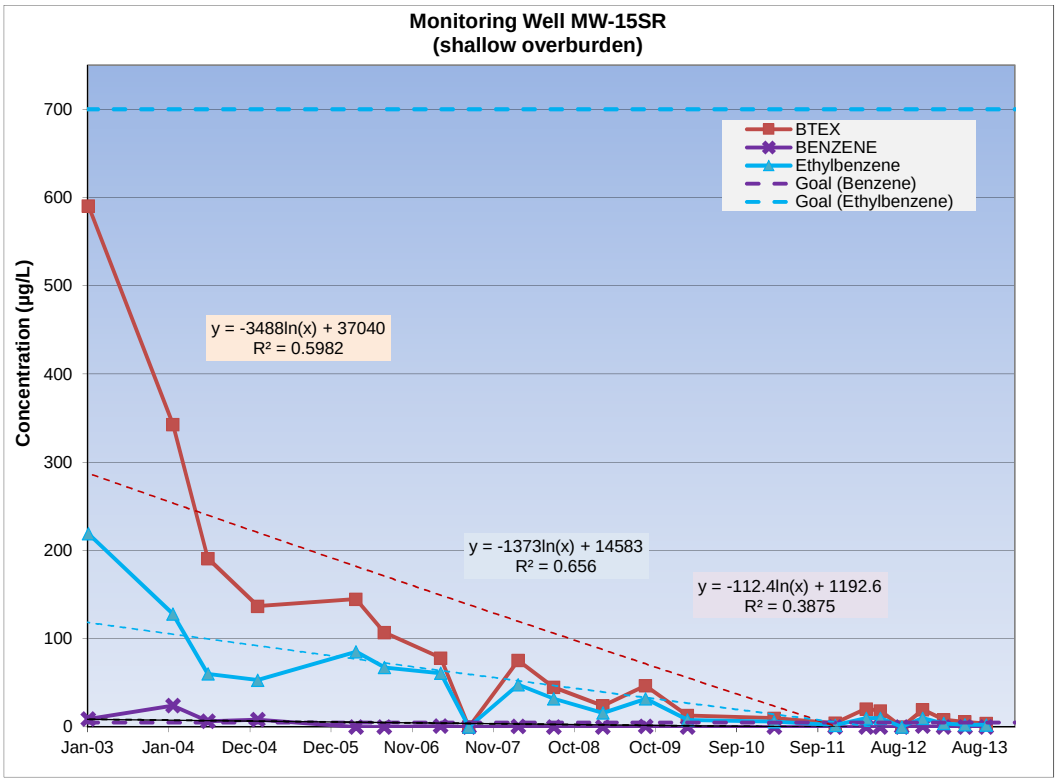
FILENAME: Figure 3-2 Sept 2013.dgn

Site 4 Groundwater BTEX Trend Plots

Site 4 Groundwater Monitoring Report — September 2013

(AGVIQ-CH2MHill, 28 January 2014)

FIGURE 3-4
COC CONCENTRATION TREND GRAPHS – SITE 4
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT, BEDFORD, MASSACHUSETTS



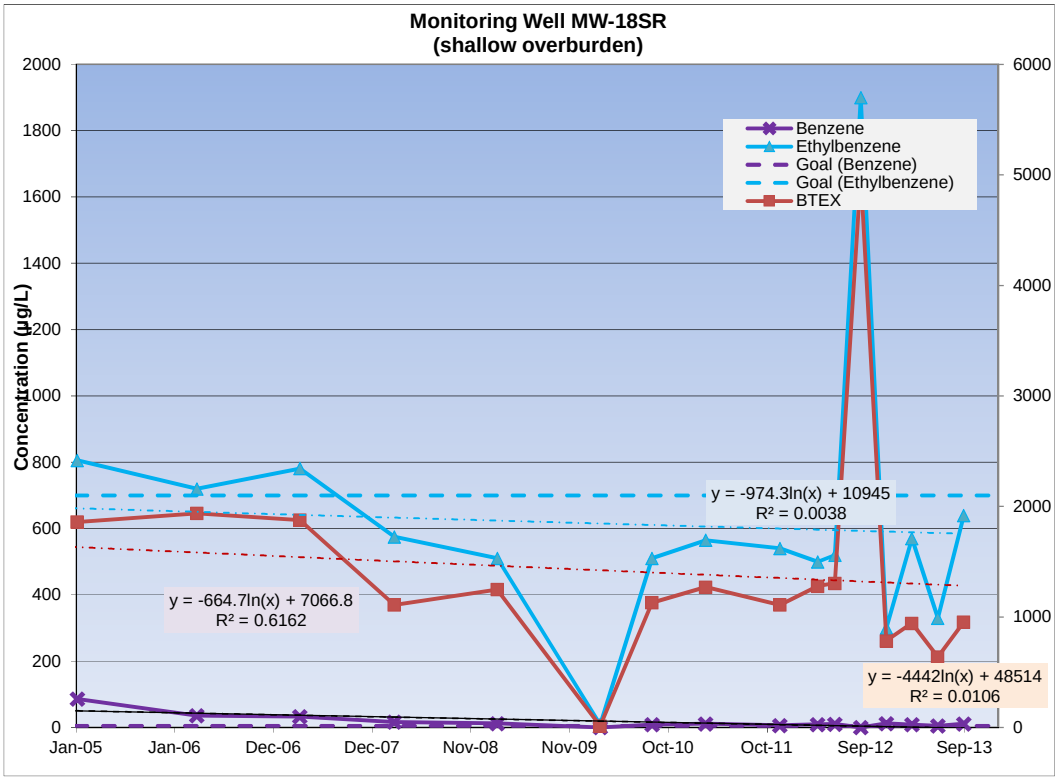
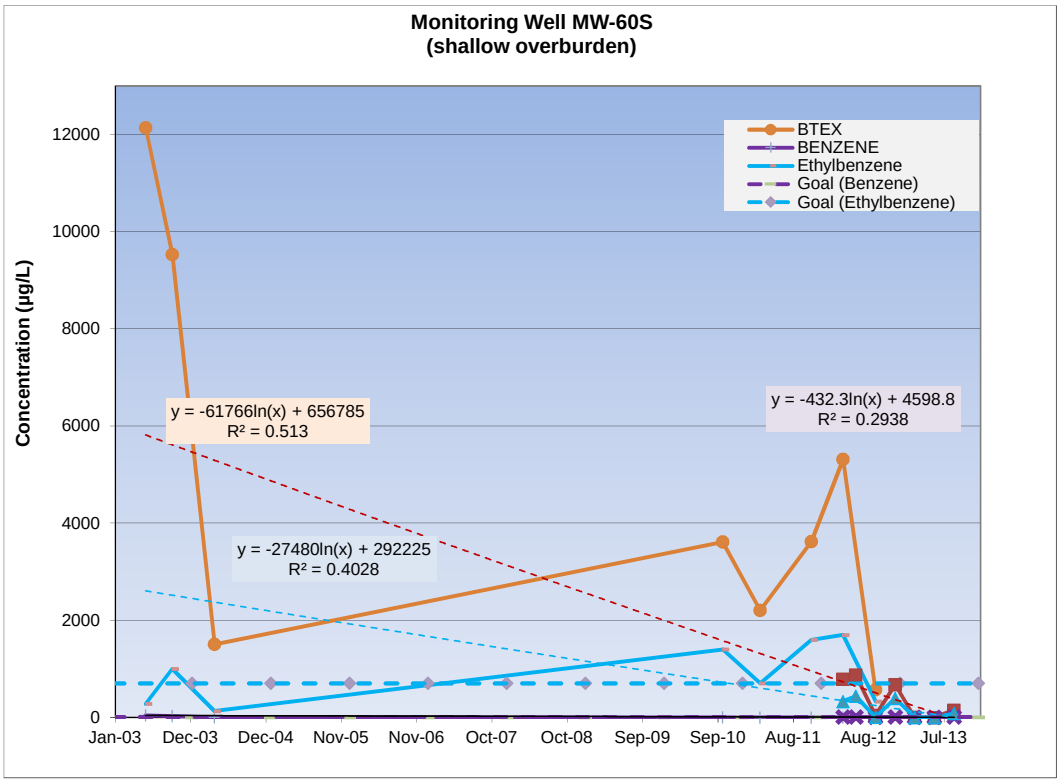


FIGURE 3-4
COC CONCENTRATION TREND GRAPHS – SITE 4
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT, BEDFORD, MASSACHUSETTS



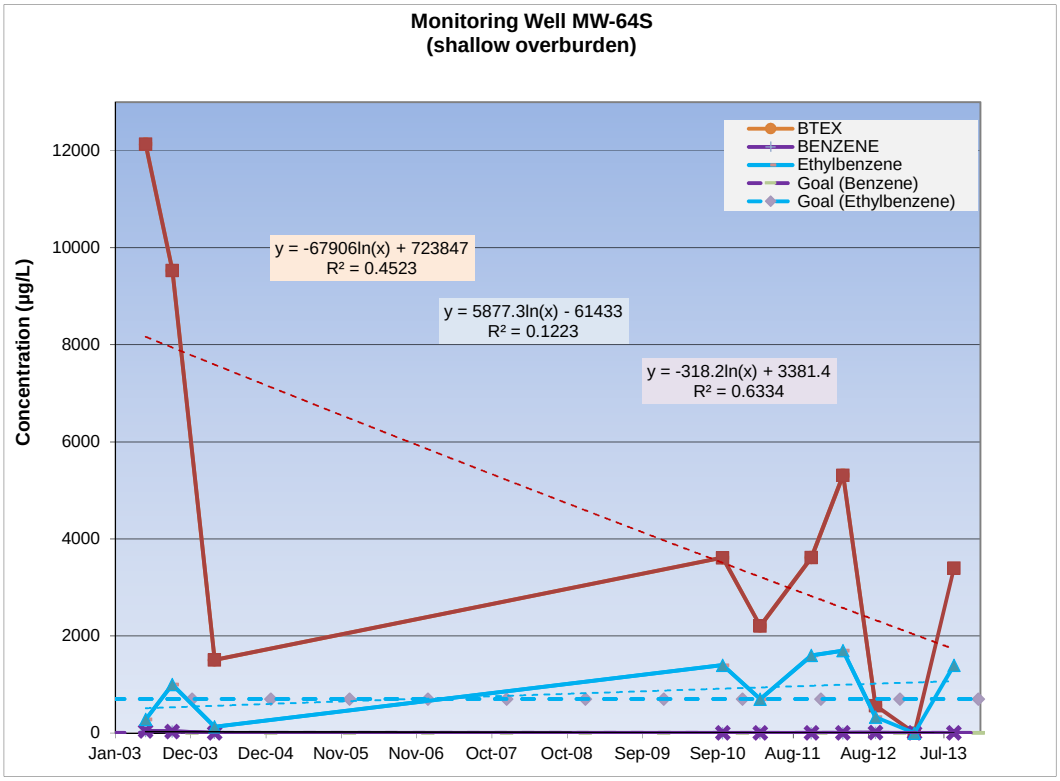
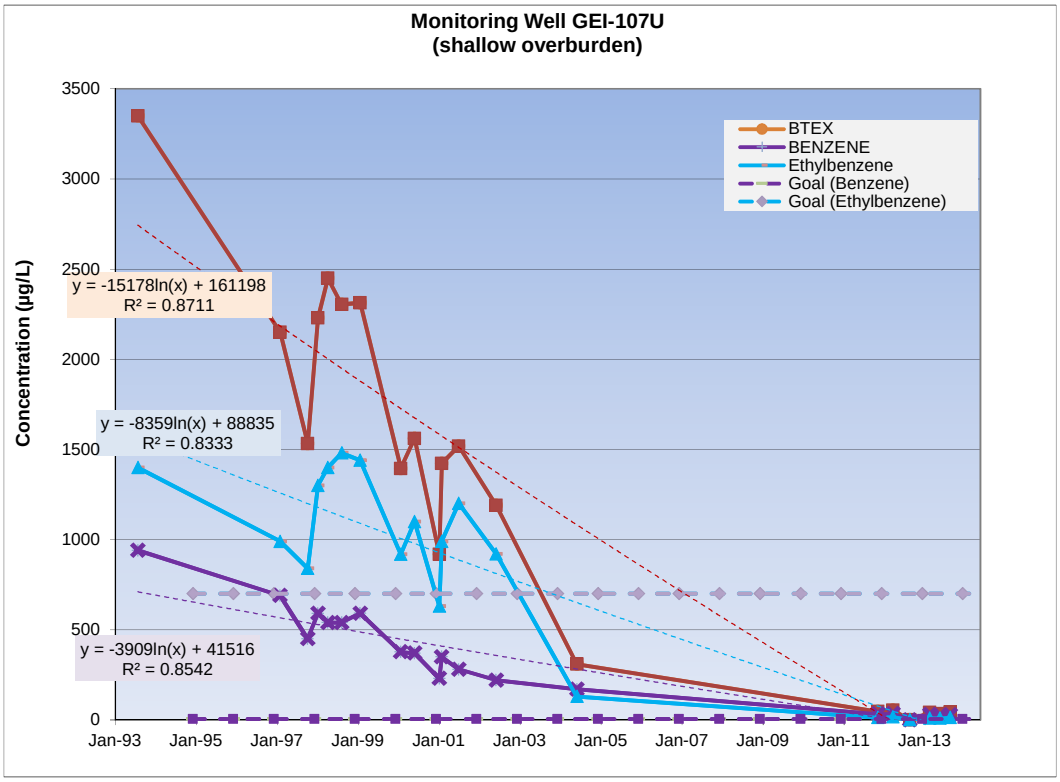



FIGURE 3-4
COC CONCENTRATION TREND GRAPHS – SITE 4
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT, BEDFORD, MASSACHUSETTS