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NAS SOUTH WEYMOUTH
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RECORD OF DECISION FOR SITE 11 SOLVENT RELEASE AREA OPERABLE UNIT 14 (OU 14) NAS SOUTH WEYMOUTH MA

9/1/2013

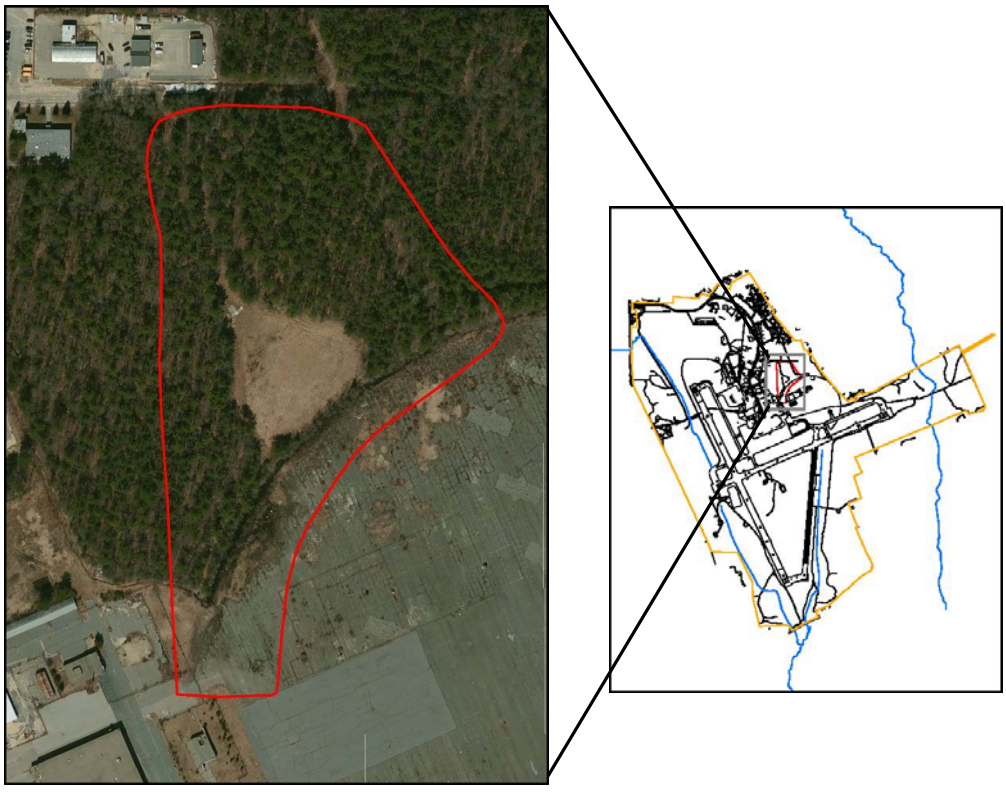
TETRA TECH

RECORD OF DECISION

SOLVENT RELEASE AREA

FORMER NAVAL AIR STATION SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SEPTEMBER 2013



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APPENDICES

ACRONYMS

AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
BEHP	bis(2-ethylhexyl)phthalate
bgs	Below Ground Surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CDI	Chronic Daily Intake
CFR	Code of Federal Regulations
cis-1,2-DCE	cis-1,2-Dichloroethene
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CVOC	Chlorinated volatile organic compound
DCB	Dichlorobenzidine
DNAPL	Dense non-aqueous phase liquid
EBS	Environmental Baseline Survey
ED	Electron Donor
EMD	East Mat Ditch
EOS	Emulsified oil substrate
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
FFA	Federal Facility Agreement
FS	Feasibility Study
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
ILCR	Incremental Lifetime Cancer Risk
IR	Installation Restoration
IUR	Inhalation Unit Risk
LNR	LNR South Shore LLC
LTM	Long-term monitoring
LUC	Land Use Control
MassDEP	Massachusetts Department of Environmental Protection

MCL	Maximum Contaminant Level
MCP	Massachusetts Contingency Plan
NAS	Naval Air Station
NAVD	North American Vertical Datum
NCP	National Contingency Plan
NPW	Net Present Worth
O&M	Operation and Maintenance
OU	Operable Unit
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PCP	Pentachlorophenol
PRB	Permeable reactive barrier
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RD	Remedial Design
RfC	Reference Concentration
RfD	Reference Dose
RG	Remediation Goal
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SF	Slope factor
SMP	Site Management Plan
SRA	Solvent Release Area
SSTTDC	South Shore Tri-Town Development Corporation
SVOC	Semi-Volatile Organic Compound
TBC	To Be Considered
TCE	Trichloroethene
TCRA	Time Critical Removal Action
TTZ	Target treatment zone
UST	Underground Storage Tank
VOC	Volatile Organic Compound

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

The Solvent Release Area (SRA), which is also known as Operable Unit (OU) 14 and Installation Restoration (IR) Site 11, is located within the former Naval Air Station (NAS) South Weymouth, Weymouth, Massachusetts. The former NAS South Weymouth has been assigned United States Environmental Protection Agency (EPA) ID number MA2170022022.

FIGURE 1-1. SRA LOCATION MAP

1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the Selected Remedy for the SRA Site which was chosen by the Navy and EPA in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record for the site. The Massachusetts Department of Environmental Protection (MassDEP) concurs with the Selected Remedy, as shown in Appendix A. Figure 1-1 depicts the location of the SRA Site within former NAS South Weymouth.

1.3 ASSESSMENT OF SITE

The response action selected in this ROD is necessary to protect the public health and welfare or the environment from actual or threatened releases of hazardous substances into the environment. A CERCLA action is required because concentrations of chlorinated volatile organic compounds (CVOCs), pentachlorophenol (PCP), 3,3'-dichlorobenzidine (DCB), arsenic, and barium in site groundwater would pose unacceptable risks to human health under future recreation and open space land use scenarios.

1.4 DESCRIPTION OF SELECTED REMEDY

The Selected Remedy addresses potential unacceptable human health risks associated with extraction of site groundwater for production, supply and irrigation uses, risks associated with exposure to surface water due to migration of chemicals of concern (COCs) in groundwater to surface water, or risks associated with vapor intrusion by reducing site-wide contaminant concentrations in groundwater to risk-based remediation goals (RGs). Land use controls (LUCs) will be implemented to control exposure pathways. Implementation of this remedy is expected to achieve substantial long-term risk reduction and

will allow for future open space and recreational uses of the Site consistent with the established zoning and the Reuse Plan.

No unacceptable risks were estimated from exposures to surface water. However, contaminated groundwater discharging to the East Mat Ditch (EMD) may result in potential future exposures to surface water in the EMD. No unacceptable risks associated with site soil or sediment were identified. There are no unacceptable risks to ecological receptors.

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

- In-situ enhanced bioremediation to reduce contaminant concentrations in the overburden and bedrock source zones.
- Installation of two overburden mulch permeable reactive barriers (PRBs) to intercept and treat the overburden groundwater contaminant plume.
- Implementation of a permanent LUC to prohibit the installation of groundwater extraction wells for production, supply, and irrigation uses at the Site.
- Implementation of a permanent LUC to prohibit residential uses at the Site. [(1)]
- Implementation of interim LUCs to: (1) require that EPA and MassDEP approval of construction dewatering plans is obtained prior to conducting any construction dewatering activities at the Site; and (2) specify building design and construction methods, such as foundation venting, to prevent unacceptable exposure to volatile organic compounds (VOCs) through vapor intrusion for any future structures that might be built in the upland area.
- Implementation of engineering controls to restrict access to surface water in the EMD.
- Maintenance and inspections of the LUCs and engineering controls.
- Monitoring of groundwater to evaluate the progress of remediation.
- Monitoring of surface water to evaluate potential impacts of groundwater discharges to surface water.
- Monitoring of sediment to evaluate trends in concentrations of inorganic compounds.
- Completion of five-year reviews as long as COCs are present at concentrations that prevent unrestricted use.

The remediation at the SRA Site will not adversely impact the current use and reasonably anticipated future uses of the Site. This ROD documents the final remedial action for the SRA Site and does not include or adversely impact any other sites at former NAS South Weymouth.

[1] While the remedial goals for the Site are based on non-residential future use which is consistent with the Re-Use Plan, as noted in comments received during the public comment period, there is a potential for zoning to be changed in the future to allow residential use even though conditions at the Site may not be fully protective of that change in use. The addition of this new component to the selected remedy will assure protectiveness intended by the decision, and is considered a minor change consistent with EPA "A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents", Chapter 4, July 1999, OSWER 9200.1-23P. This change does not substantially alter the scope, performance, or cost of the Preferred Alternative. This new LUC is discussed further in Section 2.12.

1.5 STATUTORY DETERMINATIONS

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

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

1.6 ROD DATA CERTIFICATION CHECKLIST

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

TABLE 1-1. ROD DATA CERTIFICATION CHECKLIST

DATA	LOCATION IN ROD
COCs and their respective concentrations	Sections 2.5 and 2.7
Baseline risk represented by the COCs	Section 2.7
Cleanup levels established for COCs and the basis for these levels	Section 2.7 and 2.8
How source materials constituting principal threats are addressed	Section 2.11
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the risk assessment	Section 2.6
Potential land and groundwater uses that will be available at the site as a result of the Selected Remedy	Section 2.12.3
Estimated capital, operation and maintenance (O&M), and total net present worth (NPW) costs; discount rate; and number of years over which the remedy costs are projected	Appendix B
Key factors that led to the selection of the remedy	Section 2.12.1

1.7 AUTHORIZING SIGNATURES

9/26/13

David A. Barney
BRAC Environmental Coordinator
BRAC PMO East
U. S. Navy

Date

09/30/13

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

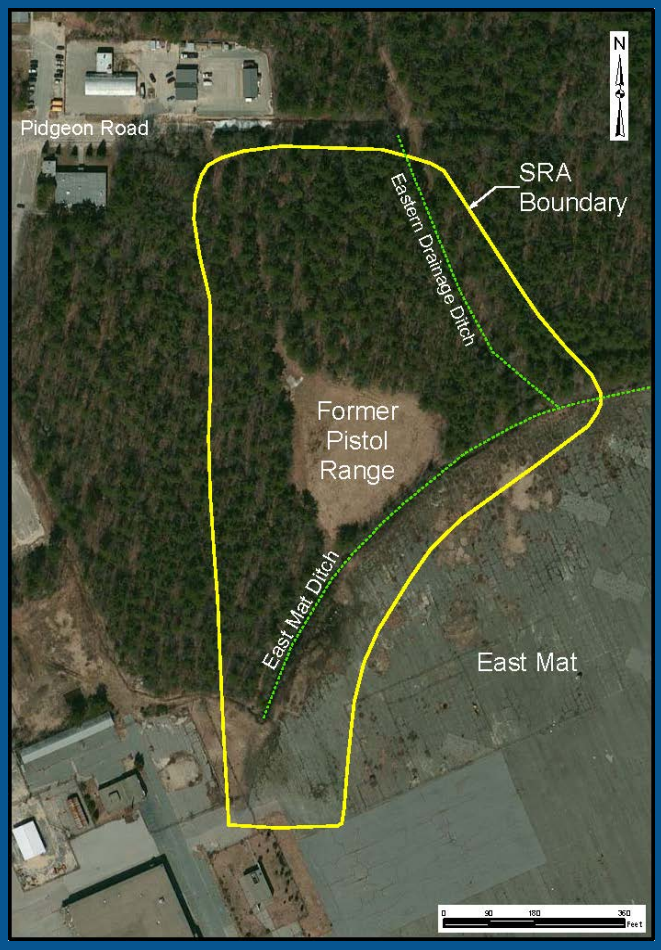
Date

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The former NAS South Weymouth (the Base), EPA ID number MA2170022022, is located primarily in the Town of Weymouth, Massachusetts. Portions of former NAS South Weymouth extend into the adjacent Towns of Abington and Rockland, Massachusetts. The SRA (the Site) is located within the Town of Weymouth. The Base was developed during the 1940s for dirigible aircraft used to patrol the North Atlantic during World War II. The facility was closed at the end of the war and was reopened in 1953 as a Naval Air Station for aviation training. The Base was in continuous use from that time until it was operationally closed on September 30, 1996, and was administratively closed on September 30, 1997. The majority of the base property has been transferred to the South Shore Tri-Town Development Corporation (SSTTDC) for re-development in accordance with the SSTTDC Reuse Plan and Zoning and Land Use By-Laws.

FIGURE 2-1. SRA SITE PLAN



Contamination at the Site was initially identified during the Phase II Environmental Baseline Survey (EBS). The results of an assumed EBS background soil boring led to other investigations that identified CVOCs in both soil and groundwater around this area. As a result, the Site was moved to the CERCLA program and named the SRA.

The SRA Site is located in the eastern portion of the Base on an approximately 14 acre undeveloped parcel of land: 11 acres are located north of the EMD and 3 acres are located south of the EMD on the East Mat. The portion of the Site located north of the EMD is vegetated by white pine and red maple trees, has densely vegetated undergrowth, and was previously delineated as a predominantly forested wetland system with a saturated water regime. The SRA Site is bounded to the north by Pidgeon Road. The Eastern Drainage Ditch to the east and EMD to the south lie within the Site boundaries shown on Figure 2-1. The Site boundary is based on the established limits of contamination. The boundaries are approximately 300 feet west of the access road to the former Pistol Range to the west, and about 200 feet south of the East Mat Ditch to the south (Figure 2-1).

A portion of the Site (approximately 2 acres) immediately north of the EMD was formerly used as a Pistol Range and was designated as Area of Concern (AOC) 35. AOC 35 was closed with a determination of No Further Action for soils and a decision to address groundwater as part of IR Site 11, subsequently named the SRA Site. The balance of the Site is undeveloped and was used for recreation. The EMD provided drainage from the East Mat and the surrounding areas. The primary use of the East Mat was as a mooring area for lighter-than-air aircraft, aircraft fuel discharge area, aircraft de-arming area, and as a

taxiway and parking area for aircraft. The former Hobby Shop (Building 95) is located on the north side of Pidgeon Road and upgradient of the Site. The Hobby Shop is a one-story, corrugated steel building that was constructed in the 1960s and used for vehicle maintenance and repairs. There are no records of activities at the SRA Site beyond those at the former Pistol Range. The Site is currently vacant.

The former NAS South Weymouth is a closed facility, and environmental investigations and remediation at the base are funded under the Department of Defense Base Realignment and Closure (BRAC) program. The Navy is the lead agency and EPA the lead regulatory agency for CERCLA activities at the former NAS South Weymouth.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Table 2-1 provides brief summaries of previous investigations at and associated with the SRA Site and surrounding areas (i.e. Hobby Shop and AOC 35). The results of these investigations indicated that VOCs, PCP, 3,3'-DCB, arsenic, and barium are present in groundwater at concentrations potentially harmful to human health. The nature and extent of groundwater contamination is presented in Section 2.5.2.

TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION

INVESTIGATION	DATE	ACTIVITIES
Preliminary Assessment (PA)	1988	The PA included a records search, interviews, and a site walkover. The purposes of the PA were to identity and evaluate past waste practices at former NAS South Weymouth and make an assessment of the associated potential for environmental contamination. As a result of the study, five sites (not including the SRA) were identified for further study.
Phase I EBS	1996	The Navy conducted a Phase I EBS in 1995. The November 1996 Phase I EBS Report identified the Pistol Range as one of the sites for further study.
Phase II EBS	1998 - 2003	Phase II EBS activities were conducted to further investigate a background soil location (BG-05) in the area now known as the Site. The BG-05 soil sample was collected in 1998 during background sampling for the basewide background statistics study. A separate EBS Review Item Area (RIA) 108 was established based on detections of VOCs, specifically tetrachloroethene (PCE).
Soil Characterization	2002	Additional soil samples were collected in the vicinity of BG-05. PCE and cis-1,2-dichloroethene (cis-1,2-DCE) were detected. RIA 108 was moved from the EBS program and designated as CERCLA AOC 108.
Groundwater Sampling	2003	A groundwater sample was collected downgradient of the soil boring locations to determine if CVOCs were present in groundwater. PCE, trichloroethene (TCE), and cis-1,2-DCE were detected in the groundwater sample. Temporary wells were installed to determine if CVOCs were present throughout the Site. CVOCs were detected at several locations at AOC 108.
Groundwater and Soil Sampling, Geophysical Survey	2004	Overburden and shallow bedrock monitoring wells were installed to evaluate the extent of VOCs in groundwater. CVOCs were detected in the overburden and bedrock groundwater. Shallow soil samples were also collected to try to identify the potential PCE source. A geophysical survey was conducted to determine if there was a subsurface source of VOC contamination. Surface metal/debris was identified and removed. AOC 108 was designated as IR Site 11, also referred to as the SRA. A Remedial Investigation (RI) was required under the IR Program.
Former Hobby Shop (Building 95)	2004	Maintenance and repairs on vehicles were performed within Building 95. Four removal actions were conducted including: cleaning and removal of an above ground storage tank that stored No. 2 fuel oil for heating Building 95; removal of two floor drain systems; and removal of two hydraulic lift systems. Soil and groundwater samples were collected following the removal actions. No further action was recommended in the decision document. The Building 95 site was closed in 2004.

TABLE 2-1. PREVIOUS INVESTIGATIONS AND SITE DOCUMENTATION (CONT.)

INVESTIGATION	DATE	ACTIVITIES
AOC 35 (Pistol Range)	2004	The Pistol Range comprised about 2 acres of land in the southeastern corner of the Site (within the current Site boundary). In 2000, the Navy conducted a CERCLA Time-Critical Removal Action (TCRA) to address soil with elevated concentrations of lead (from past Pistol Range operations) through excavation and off-site disposal. Post-excavation soil sampling results confirmed that the lead clean-up goal of 300 mg/kg was achieved. A No Further Action (NFA) ROD was issued for the Pistol Range in December 2004. The ROD documented that the soil had been remediated and the groundwater would be addressed as part of the SRA Site.
Remedial Investigation	2006	The Navy completed an RI Work Plan in accordance with CERCLA. The comprehensive RI included soil, groundwater, discrete interval groundwater, surface water, and sediment sampling; in-situ hydraulic conductivity testing; surface water investigation; groundwater and surface water level measurements; ecological assessment; borehole geophysics; and surface geophysical surveys. Additional investigation was required to close data gaps.
AOC 60 (EMD)	2009	AOC 60 encompassed most of the EMD. The Phase I EBS identified discolored water and solid waste in the EMD. The solid waste was removed from the EMD during the Phase I EBS. A Technical Memorandum documented the sediment and surface water investigations performed in the EMD, a Streamlined Ecological Risk Assessment (ERA), and removal actions completed in 2004 and 2007 to address polycyclic aromatic hydrocarbon (PAH) concentrations in sediments. A NFA ROD was issued for AOC 60 in 2009.
AOC 61 (Tactical Air Navigation [TACAN] Outfall)	2009	The AOC 61 Technical Memorandum documented characterization of about 200 linear feet of the western portion of the EMD. Sediment in the area was excavated and confirmation samples were collected as part of the TACAN Outfall remediation activities. A NFA ROD was issued for AOC 61 in 2009.
Supplemental RI	2009	A supplemental groundwater investigation and soil-vapor survey were conducted. All data deemed acceptable for use from the RI and historical investigations was compiled and presented in the RI Report. All samples collected as part of the RI field program, plus samples collected from previous investigations, were **evaluated** to determine the nature and extent of contamination. A human health risk assessment (HHRA) and ERA were performed using available data deemed suitable for risk assessment purposes.
Feasibility Study (FS)	2012	Based on the results of the RI and subsequent sampling, **potential alternatives** to address contaminants were developed and evaluated.

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

2.3 COMMUNITY PARTICIPATION

The Navy has performed public participation activities in accordance with CERCLA and the NCP throughout the CERCLA site cleanup process at the former NAS South Weymouth. The Navy released a Community Relations Plan in July 1998 to address community concerns and keep citizens informed about and involved in remediation activities. In September 1995, the Navy initiated a series of public meetings, at which the restoration advisory board (RAB) process was explained, and community members were asked to join the RAB. A sufficient number of interested community members were assembled and RAB meetings began in March 1996. Since that time, RAB meetings have been held on a regular basis to keep the RAB and local community informed of IR Program activities. RAB meetings held during May 2009, October 2010, and April 2012 included presentations specifically highlighting the SRA Site. Other RAB meetings have included brief updates of SRA Site activities as they progressed.

The Navy has generated an index of the Administrative Record to identify the documents used in the decision-making process for this SRA Site ROD. The index is attached to this ROD. The Administrative Record files are available for public review at several locations, including the Tufts Library in Weymouth, Massachusetts; the Abington Public Library in Abington, Massachusetts; the Hingham Public Library in Hingham, Massachusetts; the Rockland Memorial Library in Rockland, Massachusetts; and the U.S. Department of the Navy, Caretaker Site Office, South Weymouth, Massachusetts. Site documents and RAB meeting information are also available on the Department of the Navy BRAC Program Management Office website, www.bracpmo.navy.mil.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from February 21, 2013 to March 23, 2013, for the proposed alternative described in the Proposed Plan for the SRA Site. A public meeting to present the Proposed Plan was held on February 27, 2013, at the New England Wildlife Center, Weymouth. **Public notice** of the meeting and availability of documents was published in the *Patriot Ledger* and the *Weymouth News* on February 20, 2013 and in the *Rockland Mariner/Standard* on February 22, 2013.

2.4 SCOPE AND ROLE OF OPERABLE UNIT

The SRA Site is part of the Navy IR Program, a comprehensive environmental investigation and cleanup program being performed at former NAS South Weymouth under CERCLA authority pursuant to the Federal Facility Agreement (FFA) signed by the Navy and the EPA in April 2000. Eleven IR sites have been identified at former NAS South Weymouth. The SRA Site is IR Site 11.

The RODs for IR Sites 1 through 5, 7, 8, and 10 have been finalized and signed by the Navy and EPA. IR Site 6 was transferred out of the IR program and addressed as a petroleum site under the underground storage tank (UST) program portion of the regulatory structure presented in the Massachusetts Contingency Plan (MCP). IR Site 9 is in the FS stage of development in the IR program. The Site Management Plan (SMP) for former NAS South Weymouth provides further details on the IR sites, ROD issuance dates (as applicable), and schedule for post-ROD activities. The SMP is updated by the Navy on an annual basis.

Investigations at the SRA Site indicated the presence of groundwater contamination that poses unacceptable human health risk to potential future recreational users of the Site. The remedy documented in this ROD will achieve the Remedial Action Objectives (RAOs) for the SRA Site, as listed in Section 2.8. Implementation of this remedy will allow future public and outdoor commercial recreation and indoor commercial recreation uses consistent with the established zoning for the Site. These uses are consistent with the reasonably anticipated future uses for open space and recreation zoning districts as well as the overall cleanup strategy for former NAS South Weymouth.

2.5 SITE CHARACTERISTICS

Figure 2-2 presents the SRA Site conceptual site model (CSM) developed using the results of the RI. The CSM identifies potential contaminant sources, contaminant release mechanisms, transport routes, and potential receptors under current and future land use scenarios. The primary contaminant release and transport mechanisms include releases to the subsurface from the suspected source area and migration and potential discharge of groundwater to the EMD. Human health and ecological receptors evaluated in the RI and the actual risks to those receptors are discussed in Sections 2.7.1 and 2.7.2, respectively.

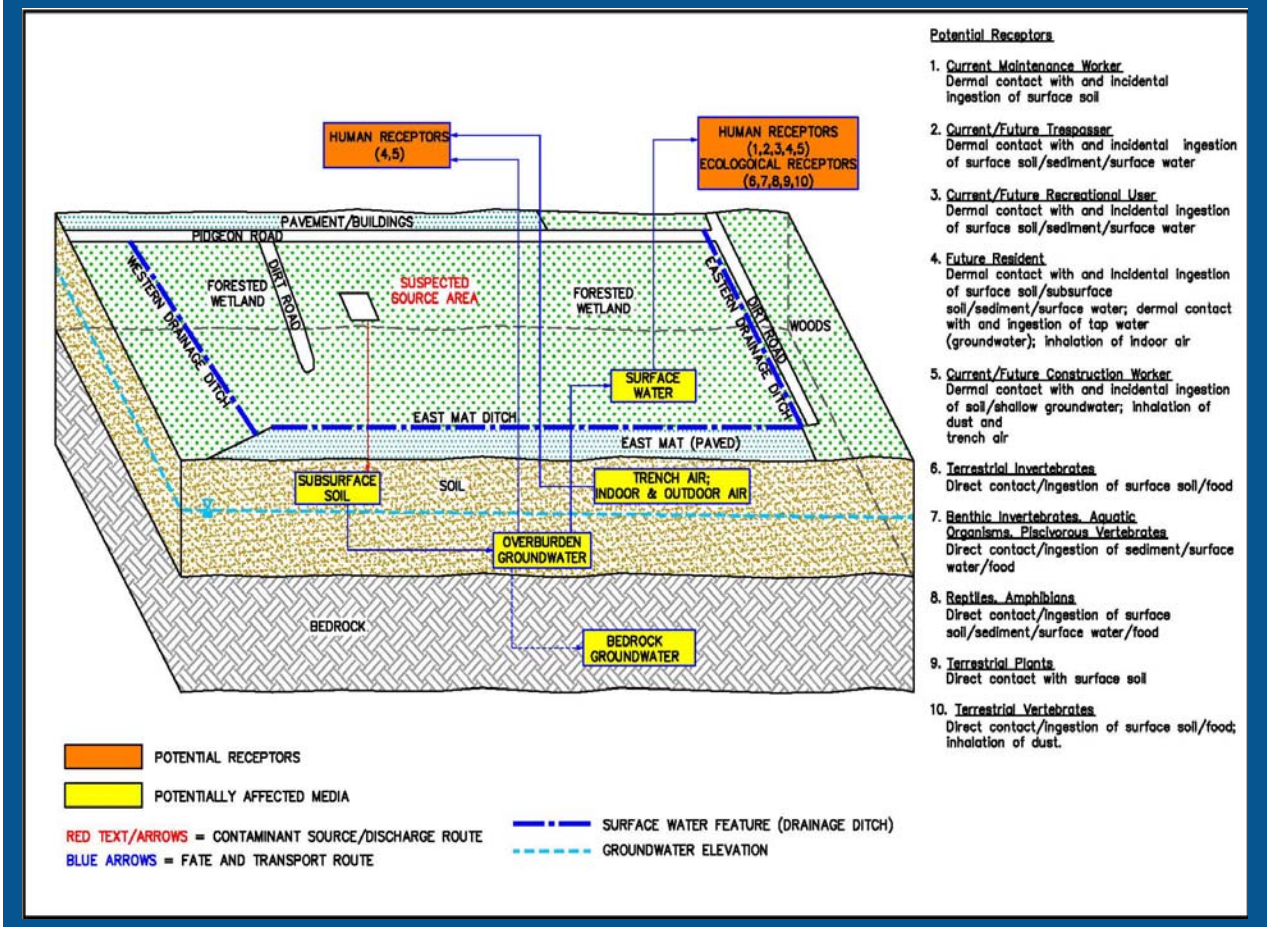
2.5.1 Physical Characteristics

The topography of the SRA Site is relatively flat. The ground-surface elevations over most of the Site range from approximately 167 to 157 feet (North American Vertical Datum [NAVD] 1988); elevations decrease to approximately 153 feet (NAVD 1988) at the drainage ditches to the east (Eastern Drainage Ditch) and south (EMD) of the Site. The dirt road along the eastern perimeter of the Site provides access

to the East Mat. The East Mat is an open, flat paved area which was used for mooring lighter-than-air aircraft.

The Site overburden consists of approximately 10 to 30 feet of native unconsolidated materials, underlain by bedrock. Four overburden geologic units have been observed at the Site, including: a fine-to-coarse sand unit ranging from 0 to approximately 16 feet in thickness throughout the Site; a discontinuous fine-to-coarse sand, silty sand, and silt unit ranging from 0 to approximately 6 feet in thickness in a few locations; a sand and gravel unit predominant throughout the Site ranging in thickness from 0 to 9 feet; and a glacial till unit, ranging from 0 to 18 feet in thickness, comprised of sand, silt, and gravel with varying amounts of clay and rock fragments on top of bedrock throughout most of the Site, with the exception of the area to the west of the former Pistol Range.

FIGURE 2-2. SRA CONCEPTUAL SITE MODEL



The Site is underlain by Dedham Granite, which is weathered, fractured, medium to coarse-grained, and light grayish-pink to greenish-gray in color. Overall, the bedrock surface elevation at the Site ranges from approximately 133 feet to 153 feet (NAVD 1988) and slopes from north to south.

The overburden, shallow bedrock, and deep bedrock groundwater contour maps all show a southerly groundwater **flow direction** beneath the Site. Four synoptic groundwater level measurement rounds indicated a consistent depth to groundwater, ranging from 0 to 6 feet below ground surface (bgs) across the Site. The EMD is the dominant surface or near-surface feature in the area that affects groundwater flow, particularly in the overburden.

Along with the EMD and the eastern drainage ditch, a drainage ditch is also present to the west of the western boundary of the Site. Surface drainage over a majority of the Site flows in a southerly direction toward the EMD. The surface water flow in the EMD divides where the Eastern Drainage Ditch flows into the EMD. The western component of surface water in the EMD flows to a catch basin which is part of the base-wide storm water drainage system that ultimately drains into French Stream. The eastern component of surface water in the EMD becomes part of the base-wide storm water drainage system that ultimately drains into Old Swamp River. Surface water in the ditches is intermittent, and at times portions of the ditches are dry.

2.5.2 Nature and Extent and Fate and Transport of Contamination

An evaluation of the RI data and the results presented in the RI are summarized below.

VOCs are the predominant contaminants at the Site. The most frequently detected VOC compounds are CVOCs, predominantly PCE and its degradation products: TCE, cis-1,2-DCE, and vinyl chloride (to a more limited extent). There is a distinct plume of CVOCs in Site groundwater (overburden and bedrock). These four compounds are also the only VOCs that exceeded their respective Maximum Contaminant Levels (MCLs). CVOCs, including PCE and its breakdown products, were detected infrequently in soil, sediment, and surface water. Direct evidence of dense non-aqueous-phase liquid (DNAPL) was not found at the Site. However, indirect evidence for the potential presence of DNAPL exists. PCE and its breakdown products dissolved in groundwater are migrating from the source area and discharging into the EMD and Eastern Drainage Ditch. PCE and its breakdown products were detected at concentrations above screening criteria in surface water.

Semi-volatile organic compounds (SVOCs) were also detected at the Site. Caprolactam and naphthalene were the most frequently detected SVOCs in groundwater. The SVOC, 3,3'-DCB, was detected in one sample; the concentration exceeded the EPA screening criteria. Concentrations of pentachlorophenol (PCP) exceeded the screening criteria in two groundwater samples and the MCL was also exceeded in one of these samples. A few additional SVOCs were detected at concentrations that did not exceed the applicable screening criteria. PAHs were detected in the surface water location in the western portion of the EMD. Four PAHs and bis(2)ethylhexylphthalate (BEHP) were the only SVOCs that were detected at concentrations greater than their screening criteria in site soils. Sediment sample concentrations exceeded the screening criteria for five SVOCs, all PAHs.

Pesticides were detected in Site soil, groundwater, and sediment, generally infrequently and at low concentrations. Endosulfan I was the only pesticide detected in groundwater; no pesticides were detected in the surface water samples. Polychlorinated biphenyls (PCBs) (Aroclor-1242 and Aroclor-1260) were detected in surface and subsurface soil samples. PCBs were not detected in Site groundwater. Aroclor-1242, Aroclor-1248, Aroclor-1252, and Aroclor-1260 were detected in sediment samples.

Five metals (aluminum, arsenic, iron, manganese, and vanadium) were present at concentrations exceeding their respective screening criteria in soil, groundwater, surface water and sediment. Barium concentrations in groundwater exceeded the screening criteria in one location; its MCL was also exceeded at this location.

Figures 2-3 and 2-4 show the 5 µg/L contour (pink dashed line) delineating the extent of the PCE plume in overburden and bedrock groundwater, respectively. The 5 µg/L contour, which is the MCL for PCE, is used for reference only. The PCE plumes are based on the 2006 and 2009 RI data and additional time series data collected in April 2011 (high groundwater condition) and August 2011 (low groundwater condition). The additional time series data were collected as part of the FS to supplement the RI information. A comparison of the overburden groundwater RI data and 2011 data indicated that the PCE concentrations and plume (Figure 2-3) were consistent or decreasing. The TCE, cis-1,2-DCE, and vinyl chloride plumes in the overburden groundwater continued to be much more limited in extent than the PCE plume, with the detected concentrations similar to prior events. The 2011 data indicated slight changes in the extent of the plume but overall the changes were not considered significant.

FIGURE 2-3. OVERBURDEN GROUNDWATER PCE PLUME

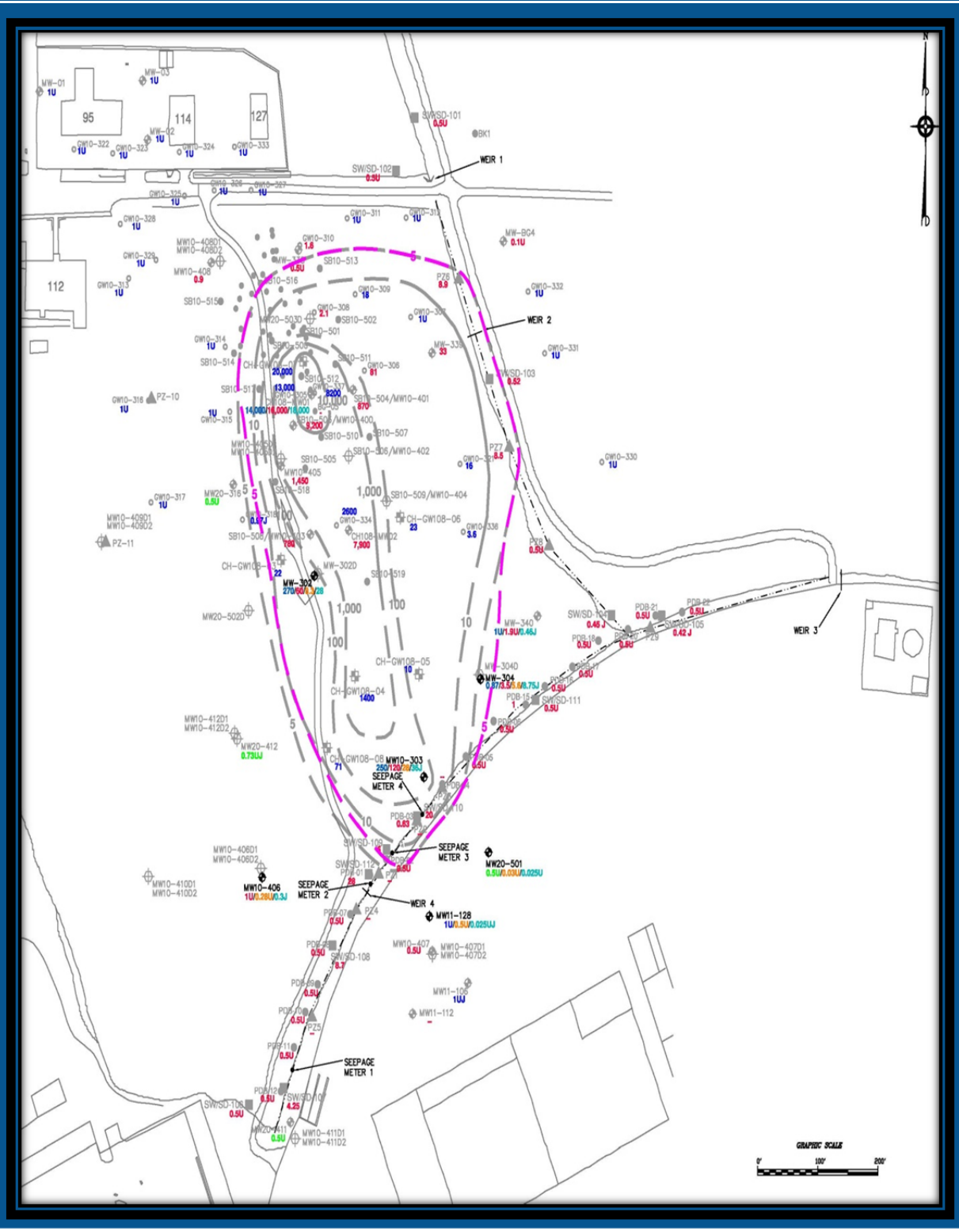
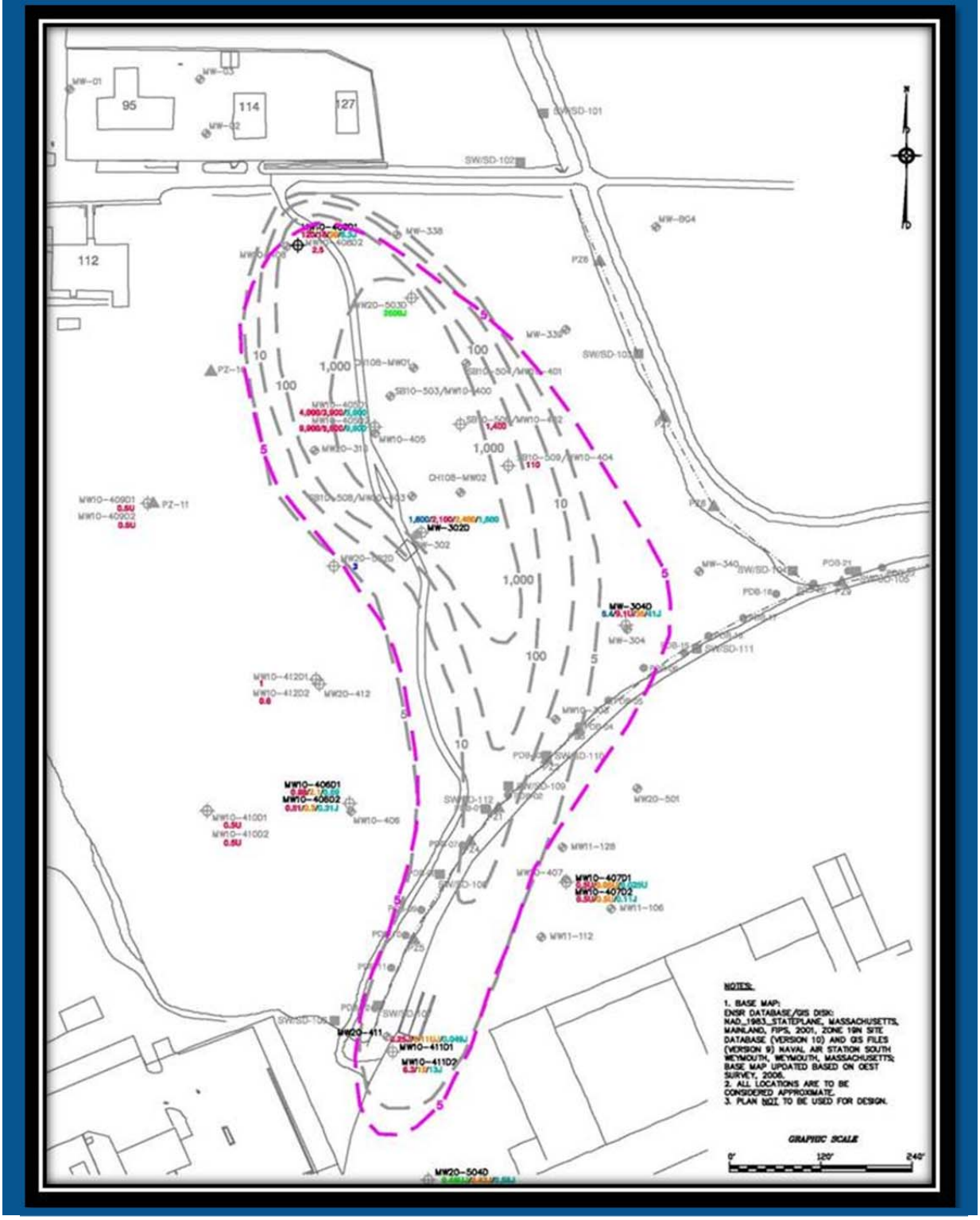


FIGURE 2-4. BEDROCK GROUNDWATER PCE PLUME



A comparison of the bedrock groundwater RI data and the 2011 time series data indicated that the PCE concentrations and plume (Figure 2-4) were slightly decreasing in the north, variable within the source area, consistent to the southeast and southwest, and increasing or consistent in the south. The TCE, cis-1,2-DCE, and vinyl chloride plumes in the bedrock groundwater continued to be much more limited in extent than the PCE plume and the measured concentrations were similar to those measured in the RI sampling events. The bedrock groundwater results to date indicate that the extent of the plume is generally consistent to the southeast and southwest, slightly expanding to the south and east, and contracting to the north. The contaminant concentrations in bedrock within the source area are variable. Overall, the 2011 data do not suggest a significant shift in the bedrock plume configuration in this time period.

Two primary sources of contaminants detected in Site soil, groundwater, surface water, and sediment have been identified based on an evaluation of the concentrations and distribution of contaminants, contaminant properties, and the physical characteristics of the Site. These two sources include: releases of contaminated liquids adjacent the dirt access road to the former Pistol Range; and historical disposal of debris and fuel in the EMD.

While several hypotheses regarding the origin of the contamination have been advanced, none have been corroborated. The most plausible explanation for the source of contamination is that a waste containing PCE was discharged onto the ground surface. The source of contamination in the EMD sediment has been attributed to a report that aircraft fuel tanks were previously drained into the EMD and the historical presence of solid waste which was removed from the EMD during the Phase I EBS.

2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Former NAS South Weymouth was designated for closure under the BRAC of 1990, as part of the BRAC Commission's 1995 Base Closure List (BRAC IV). Operational closure of former NAS South Weymouth began in September 1996 with the transfer of aircraft to other Navy facilities, and through personnel reductions. Former NAS South Weymouth was closed administratively under BRAC on September 30, 1997.

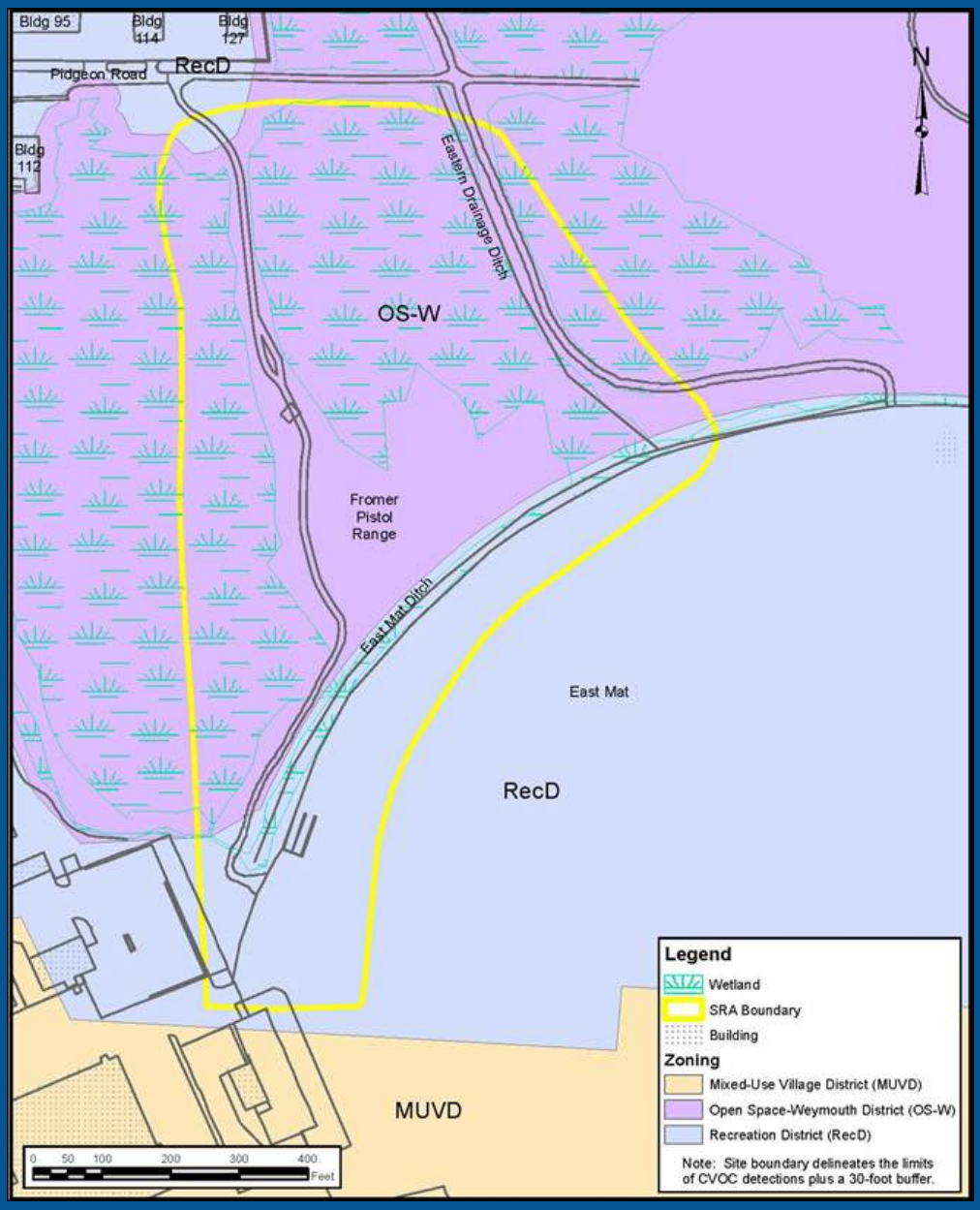
Currently, the SRA Site is vacant and remains part of the former NAS South Weymouth property owned by the Navy. The Navy plans to transfer the property as part of the redevelopment of the Base once the environmental cleanup is implemented and the property is determined to be suitable for transfer. The SSTTDC Zoning and Land Use By-Laws established open space and recreation zoning districts for the Site as shown on Figure 2-5. The range of allowed future uses could include indoor and outdoor commercial recreation, athletic fields, health and fitness clubs, some institutional uses under a special permit only, and passive recreation such as walking trails.

There are no medium or high-yield aquifers mapped at the Site, so site groundwater is not considered a drinking water source. The Local Redevelopment Authority, SSTTDC, as well as the Master Developer, LNR South Shore LLC (LNR), have indicated that groundwater production, supply, and irrigation needs for the redevelopment can be provided by sources other than the groundwater associated with the SRA Site.

2.7 SUMMARY OF SITE RISKS

The baseline risk assessments in the RI estimate what risks the Site poses if no action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. A **human health risk assessment** (HHRA) and an **ecological risk assessment** (ERA) were performed as part of the RI using only validated analytical results. The risk assessments used data from multiple groundwater sampling rounds and the soil, sediment and surface water sampling conducted in 2006 and 2009 as part of the RI. In addition, the risk assessments used soil and sediment analytical data that represent current conditions from all investigations performed between 2000 and 2004.

FIGURE 2-5. EXTENT OF GROUNDWATER CONTAMINATION AND FUTURE ZONING



2.7.1 Summary of Human Health Risk

The quantitative HHRA was conducted using validated analytical results for surface and subsurface soil, groundwater, sediment, and surface water samples. Key steps in the risk assessment process included **selection of chemicals of concern (COCs),** exposure assessment, toxicity assessment, and risk characterization as discussed below. Tables summarizing the data used in the HHRA and the associated results are presented in Appendix C. The exposure pathways evaluated in the HHRA are presented in Appendix C, Figure C-1.

Identification of COCs

Tables C-1 through C-5 in Appendix C present exposure point concentrations (EPCs) for the COCs identified in surface soil, subsurface soil, groundwater, surface water, and sediment. EPCs are the concentrations used in the risk assessment to estimate exposure and risk from each COC. The tables include the maximum detected concentration, EPC, and how the EPC was derived.

Exposure Assessment

During the **exposure assessment**, current and potential future exposure pathways through which humans might come into contact with the COCs identified in the previous step were evaluated. The results of the exposure assessment were used to refine the CSM shown in Figure 2-2. Potential exposure routes for soil include ingestion (swallowing small amounts of soil), dermal contact (skin exposure), and/or inhalation (breathing) of airborne soil particulates. Potential exposure routes for sediment and surface water include inadvertent dermal contact and ingestion. Potential exposure routes for groundwater include ingestion of drinking (tap) water, dermal contact, and inhalation of volatile compounds in indoor air and while showering, as well as in trench air (exposure to construction workers). The HHRA considered receptor exposure under industrial land use (maintenance, construction, and industrial workers), trespassing, and future hypothetical recreational and residential land use, as presented below in Table 2-2. Exposure parameters are summarized in Appendix C, Tables C-6 through C-29.

TABLE 2-2. RECEPTORS AND EXPOSURE ROUTES EVALUATED IN THE HHRA

RECEPTORS	EXPOSURE ROUTES
Adolescent Trespassers (current/future)	• Surface Soil – Incidental Ingestion • Surface Soil – Dermal Contact • Surface Water/Sediment – Incidental ingestion • Surface Water/Sediment – Dermal Contact • Inhalation of Outdoor Air (calculated from groundwater)
Adult/Youth Recreational Users (future)	• Surface Soil – Incidental Ingestion • Surface Soil – Dermal Contact • Surface Water/Sediment – Incidental ingestion • Surface Water/Sediment – Dermal Contact
Construction Workers (future)	• Surface Soil – Incidental Ingestion • Surface Soil – Dermal Contact • Surface Soil – Inhalation of Air/Dust/Emissions • Subsurface Soil – Incidental Ingestion • Subsurface Soil – Dermal Contact • Subsurface Soil – Inhalation of Air/Dust/Emissions • Groundwater – Incidental Ingestion • Groundwater – Dermal Contact • Groundwater Inhalation of Volatile Organics (during excavation)
Industrial/Commercial (Maintenance) Workers (future)	• Surface Soil – Incidental Ingestion • Surface Soil – Dermal Contact • Surface Water/Sediment – Incidental ingestion • Surface Water/Sediment – Dermal Contact • Inhalation of Vapors intruding into a building from the groundwater

TABLE 2-2. RECEPTORS AND EXPOSURE ROUTES EVALUATED IN THE HHRA (CONT.)	
RECEPTORS	**EXPOSURE ROUTES**
Adult/Child Residents (future)	• Surface Soil – Incidental Ingestion • Surface Soil – Dermal Contact • Subsurface Soil – Incidental Ingestion • Subsurface Soil – Dermal Contact • Groundwater – Incidental Ingestion • Groundwater – Dermal Contact • Groundwater – Inhalation of volatiles while showering • Inhalation of Vapors intruding into a building from the groundwater • Surface Water/Sediment – Incidental ingestion • Surface Water/Sediment – Dermal Contact • Groundwater Used for Irrigation – Dermal Contact (adult only) • Groundwater Used for Irrigation – Ingestion of Vegetables

Toxicity Assessment

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

Tables C-30 and C-31 in Appendix C provide carcinogenic risk information relevant to the COCs for oral and dermal exposure and for inhalation exposure, respectively. Tables C-32 and C-33 provide noncarcinogenic hazard information relevant to the COCs for oral and dermal exposure and inhalation exposure, respectively.

Risk Characterization

During the risk characterization process, the outputs of the exposure and toxicity assessments are combined to characterize the baseline risk (cancer risks and non-cancer hazards) at the site if no action was taken to address the contamination. Potential **cancer risks** and **non-cancer hazards** were calculated based on reasonable maximum exposure (RME). The RME scenario assumes the maximum level of human exposure that could reasonably be expected to occur and is used to make all risk decisions.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$Risk = CDI \times SF$$

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

These calculated risks are probabilities that are usually expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} under an RME scenario indicates that an individual experiencing the reasonable maximum exposure estimate has an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is 1×10^{-4} to 1×10^{-6}.

Table C-34 provides RME cancer risk estimates for the significant receptors and routes of exposure developed by taking into account various conservative assumptions about the frequency and duration of exposure for each receptor and also about the toxicity of the COCs. Total cancer risk estimates for all applicable exposure routes range from 5×10^{-6} for future adult recreational users to 4×10^{-1} for hypothetical future lifelong residents. These risk levels indicate that if no cleanup action was taken, the increased probabilities of developing cancer as a result of site-related exposure would range from approximately 5 in 1,000,000 to 4 in 10.

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

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

Where: CDI = chronic daily intake, mg/kg-day
RfD = reference dose, mg/kg-day

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

Table C-34 provides RME non-cancer HQs for each receptor and route of exposure and total HIs for all routes of exposure. Total HIs for all applicable exposure routes based on the RME range from 0.006 for an adolescent trespasser to 424 for hypothetical future child residents.

Under the RME scenario, unacceptable cancer and non-cancer hazards were identified for hypothetical future residents (adult, child, and lifelong) and non-cancer hazards were identified for construction workers. No major sources of **uncertainty**, other than those typically associated with risk assessment estimates, were identified for the SRA HHRA. A risk summary is presented in Table 2-3 below. Those risks exceeding EPA acceptable levels are in bold.

As discussed in Section 2.6, open space and recreational zoning districts have been established for the SRA Site; future residential uses are not allowed. The range of future uses allowed in the open space and recreation zoning districts could include indoor and outdoor commercial recreation, and passive recreation such as walking trails. Thus the FS evaluated remedial alternatives to address risks to construction workers and recreational users from potential vapor intrusion risk to occupants of future indoor recreational buildings.

TABLE 2-3. SUMMARY OF ESTIMATED POTENTIAL HUMAN HEALTH RISKS

RECEPTOR	MEDIUM	RME	
		CANCER RISK	NON-CANCER HI
Construction Worker	Subsurface Soil	1.E-06	0.4
	Surface Soil	1.E-06	0.3
	Groundwater	**4.E-04**	**9**
	Total	**4.E-04**	**10**
Maintenance Worker	Sediment	5.E-08	NA
	Surface Soil	2.E-06	0.01
	Surface Water	3.E-06	0.0004
	Total	5.E-06	0.01

TABLE 2-3. SUMMARY OF ESTIMATED POTENTIAL HUMAN HEALTH RISKS (CONT.)			
RECEPTOR	MEDIUM	RME	
		CANCER RISK	NON-CANCER HI
Child Recreational User	Sediment	6.E-07	NA
	Surface Soil	9.E-06	0.04
	Surface Water	2.E-05	0.02
	Total	3.E-05	0.05
Adolescent Trespasser	Sediment	1.E-07	NA
	Surface Soil	6.E-07	0.002
	Surface Water	8.E-06	0.003
	Total	8.E-06	0.006
Adult Recreational User	Sediment	7.E-08	NA
	Surface Soil	5.E-07	0.001
	Surface Water	4.E-06	0.0007
	Total	5.E-06	0.002
Future Child Resident	Subsurface Soil	3.E-05	0.1
	Sediment	6.E-06	NA
	Surface Soil	4.E-05	0.2
	Surface Water	2.E-05	0.05
	Groundwater	**2.E-01**	**424**
	Total	**2.E-01**	**424**
Future Adult Resident	Subsurface Soil	5.E-06	0.01
	Sediment	3.E-07	NA
	Surface Soil	7.E-06	0.02
	Surface Water	4.E-06	0.0024
	Groundwater	**2.E-01**	**131**
	Total	**2.E-01**	**131**
Lifelong Resident	Subsurface Soil	4.E-05	NA
	Sediment	7.E-07	NA
	Surface Soil	3.E-05	NA
	Surface Water	3.E-05	NA
	Groundwater	**4.E-01**	NA
	Total	**4.E-01**	NA
Lifelong Recreational User	Sediment	7.E-07	NA
	Surface Soil	9.E-06	NA
	Surface Water	3.E-05	NA
	Total	4.E-05	NA

2.7.2 Summary of Ecological Risk

As part of the RI, the ERA evaluated potential risks to ecological receptors that may occur in the presence of chemical stressors (i.e., chemicals of potential concern [COPCs]) in environmental media at the SRA Site. The ERA included three primary steps: (1) Screening-Level Problem Formulation (development of the ecological CSM); (2) Screening-Level Exposure Estimate and Risk Calculation; and (3) Step 3a: COPC Refinement. The habitats evaluated in the ERA included the forested wetland as well as the drainage ditches. The Navy collected and evaluated information about the site conditions (e.g., type of habitat and types of plant and animal species at the Site), the COPCs, and the potential exposure pathways.

The ecological receptor groups evaluated in the ERA included terrestrial plants and invertebrates, sediment invertebrates, aquatic organisms, and terrestrial wildlife. The ecological exposure pathways evaluated included direct contact with and/or ingestion of surface soil by plants, soil invertebrates, mammals, birds, and reptiles, direct contact with and/or ingestion of sediment by aquatic receptors (benthic invertebrates, reptiles, and amphibians), consumption of sediment invertebrates, and direct contact and ingestion of surface water by aquatic and terrestrial wildlife. The exposure pathways used in the ERA are presented on Figure D-1 in Appendix D.

Tables D-1, D-2, and D-3 in Appendix D are the ERA COPC screening tables for soil, sediment, and surface water, respectively. Several COPCs were initially selected because their concentrations exceeded screening levels. Tables D-4 and D-5 in Appendix D present the results of the average food chain models for surface soil/wetland sediment and sediment receptors, respectively.

During the detailed risk evaluation it was determined that plants or invertebrates are not likely to be significantly impacted from the chemicals detected in surface soil at the Site and that risks to aquatic organisms were not great enough for any chemicals to warrant further evaluation at this Site and/or the concentrations in the Site samples were similar to the concentrations in background samples. Although some slight impacts to sediment invertebrates could occur from PAHs and pesticides in the sediment, the PAHs and pesticides do not appear to be site-related. Some slight impacts to sediment invertebrates could occur from PCBs in the sediment. None of the metals detected in the sediment samples are expected to significantly impact sediment invertebrates at the Site.

Several chemicals had an ecological HQ greater than 1 based on the conservative food chain models for terrestrial receptors. However, during the detailed risk evaluation, it was determined that risks to wildlife were not great enough for any chemicals to warrant further evaluation at this Site and/or the concentrations in the site samples were similar to the concentrations in background samples. No major sources of uncertainty, other than those typically associated with risk assessment estimates, were identified for the SRA ERA.

2.7.3 Basis for Action

Unacceptable human health cancer and non-cancer risks were estimated in the RI baseline risk assessment for future residents (child, adult and lifetime residents) from exposures to groundwater via ingestion, dermal, or inhalation (vapor intrusion) and for future construction workers from exposures to groundwater via ingestion, dermal contact, or inhalation (vapors in construction trenches). The HHRA did not identify any unacceptable human health risks under current exposure scenarios. The theoretical risk exceedances were based on the presence of the following COCs: PCE, TCE, cis-1,2-DCE, vinyl chloride, 3,3;-DCB, PCP, arsenic and barium in groundwater used as drinking water, and PCE in trench air, with PCE in groundwater as the primary risk driver in both future residents and future construction workers. PCE was also the major risk driver for chemicals migrating from groundwater through vapor intrusion (construction worker and residential scenarios) and groundwater used for irrigation (for residents).

No unacceptable risks were estimated from exposures to surface water. However, contaminated groundwater discharging to the EMD may result in potential future exposures to surface water in the EMD. The ERA concluded that there was no unacceptable risk to ecological receptors.

Since risks were identified for hypothetical future residential receptors and construction workers, a response action is necessary to protect the public health and welfare from actual or threatened releases of hazardous substances into the environment that may present an imminent and substantial endangerment to public health or welfare. However, based on the established zoning, future residential uses are not allowed. The FS evaluated response actions to address risks from recreational and construction worker exposure to COCs consistent with the allowable future uses discussed in Section 2.6. The range of future uses allowed in the open space and recreation zoning districts could include indoor and outdoor commercial recreation, and passive recreation such as walking trails. Thus, while the HHRA did not identify a risk to future recreational users based on ingestion and dermal contact with groundwater, the FS evaluated risks to future recreational users based on potential vapor intrusion risk to occupants of future buildings.

2.8 REMEDIAL ACTION OBJECTIVES

Remedial objectives, or RAOs, are media-specific goals that define the objective of remedial actions to protect human health and the environment. RAOs specify the COCs, potential exposure pathways and receptors, and acceptable concentrations (i.e. cleanup levels) for a site and provide a general description of what the cleanup will accomplish. Additionally, RAOs are developed to ensure compliance with federal

and state applicable or relevant and appropriate requirements (ARARs). RAOs typically serve as the design basis for the remedial alternatives described in Section 2.9. The RAOs for the SRA Site were developed to prevent risks associated with the allowable future uses of the Site as follows:

- Prevent the migration of COCs to surface water at concentrations that pose an unacceptable risk to human health.
- Prevent exposure of building occupants to VOCs resulting from vapor intrusion into future buildings at the Site at concentrations that pose unacceptable risk.
- Prevent exposure of construction workers during excavation activities to VOCs and COCs in groundwater at concentrations that pose unacceptable risk.
- Prevent migration of groundwater containing COCs at concentrations that pose unacceptable risk.

COCs are the chemical contaminants that contribute most significantly to the risks measured for the site, and/or those constituents that exceed an applicable regulatory standard. The COCs for the SRA site are identified below, as those constituents contributed more than 10^{-5} risk or a non-cancer HQ of 1 for a single target organ group.

The cleanup goals for COCs in site groundwater and surface water were selected from the risk-based value (i.e., the lower of the value representing the 10^{-5} incremental lifetime cancer risk [ILCR] level or HI equal to 1) or the MassDEP GW-3 groundwater standard (310 CMR 40.0974), whichever was lower. For this Site the federal drinking water standards (MCLs) are not applicable since Site groundwater is not considered a drinking water source.

The groundwater cleanup goals, or RGs, selected for the open space and recreation zoning districts are the lowest of the vapor intrusion and construction PRGs calculated for the Site. The RGs are shown in Table 2-4 along with the basis for selection.

TABLE 2-4. GROUNDWATER REMEDIATION GOALS

CHEMICAL OF CONCERN	CLEANUP LEVEL (µg/L)	BASIS FOR SELECTION
PCE	370	Human Health Non-Cancer Risk (HI = 1)
TCE	18	Human Health Non-Cancer Risk (HI = 1)
cis-1,2-DCE	4,400	Human Health Non-Cancer Risk (HI = 1)
Vinyl Chloride	39*	Human Health Non-Cancer Risk (HI = 1)
PCP	200	MassDEP GW-3 standard
3,3'-DCB	1,200	Human Health Cancer Risk (ILCR = 10^{-5})
Arsenic	900	MassDEP GW-3 standard
Barium	50.000	MassDEP GW-3 standard

*Recreation zone value; open space zone RG – 52 µg/L.

The selected surface water RGs and the basis for selection are shown in Table 2-5.

TABLE 2-5. SURFACE WATER REMEDIATION GOALS		
CHEMICAL OF CONCERN	CLEANUP LEVEL (µg/L)	BASIS FOR SELECTION
PCE	860	Human Health Non-Cancer Risk (HI = 1)
TCE	220	Human Health Non-Cancer Risk (HI = 1)
cis-1,2-DCE	1,000	Human Health Non-Cancer Risk (HI = 1)
Vinyl Chloride	130	Human Health Cancer Risk (ILCR = 10^{-5})
Aroclor-1248	140	Human Health Cancer Risk (ILCR = 10^{-5})

2.9 DESCRIPTION OF ALTERNATIVES

To address the COCs and the associated human health risks in groundwater, a screening of **General Response Actions**, **remedial technologies**, and **process options** was conducted as part of the FS. The technologies and process options retained from the detailed screening were assembled into six remedial alternatives for the SRA Site. Consistent with the NCP, the No Action alternative was evaluated as a baseline for comparison with other alternatives during the comparative analysis.

The alternatives evaluated and presented in the FS include:

- G-1: No Action
- G-2: Monitoring, Engineering Controls, and LUCs
- G-3: Overburden PRB, Monitoring, Engineering Controls, and LUCs
- G-4: Two Overburden PRBs, Monitoring, Engineering Controls, and LUCs
- G-5: Overburden and Bedrock Source Zones Enhanced Bioremediation, One Overburden PRB, Monitoring, Engineering Controls, and LUCs
- G-5A: Overburden and Bedrock Source Zones Enhanced Bioremediation, Two Overburden PRBs, Monitoring, Engineering Controls, and LUCs

Table 2-6 summarizes the major components and provides estimated costs for each of the remedial alternatives developed for the Site.

TABLE 2-6. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED				
ALTERNATIVE	COMPONENTS	DETAILS	COST	TIME TO CLEANUP
No Further Action (Alternative G-1)	None	No further actions would be taken. The only costs would be for 5-year reviews under CERCLA.	**Capital:** $11,000 **O&M:** $109,000 **30-year NPW:** $120,000	Not Applicable
Monitoring, Engineering Controls, and LUCs (Alternative G-2)	Monitoring	Long term monitoring of groundwater, surface water and sediment to ensure groundwater contaminants do not migrate and impact the EMD.	**Capital:** $180,000 **O&M:** $923,000 **30-year NPW:** $1,103,000	70 years
	Engineering Controls	A temporary fence would be installed around a portion of the EMD to prevent human receptors from contacting surface water in the EMD.		
	LUCs	Interim LUCs would be implemented to prevent unacceptable exposure to groundwater and surface water until cleanup goals are achieved. A permanent LUC would be implemented to prohibit installation of groundwater production, supply, and irrigation wells at the Site. A permanent LUC would be implemented to restrict residential use of the Site.		

TABLE 2-6. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED (CONT.)

ALTERNATIVE	COMPONENTS	DETAILS	COST	TIME TO CLEANUP
One Overburden Mulch PRB, Monitoring, Engineering Controls, and LUCs (Alternative G-3)	One Overburden Mulch PRB	One mulch PRB would be installed in the overburden north of and near the EMD to intercept and treat the overburden PCE plume at its leading edge. The PRB will need to be replenished with a non-petroleum oil-based electron donor (ED) every 5 years. The PRB would be maintained as long as concentrations in the groundwater will cause the surface water RGs to be exceeded.	**Capital:** $920,000 **O&M:** $1,692,000 30-year NPW: $2,612,000	70 years
	Monitoring	Similar to Alternative G-2.		
	Engineering Controls	Same as for Alternative G-2.		
	LUCs	Same as for Alternative G-2.		
Two Overburden Mulch PRBs, Monitoring, Engineering Controls, and LUCs (Alternative G-4)	Two Overburden Mulch PRBs	Similar to Alternative G-3, with a second overburden PRB installed at the upgradient edge of the upland north of the EMD to treat the overburden PCE plume entering the upland area.	**Capital:** $1,107,000 **O&M:** $2,074,000 30-year NPW: $3,181,000	70 years
	Monitoring	Similar to Alternative G-3.		
	Engineering Controls	Same as for Alternative G-2.		
	LUCs	Same as for Alternative G-2.		
Overburden and Bedrock Source Zones Enhanced Bioremediation, One Overburden PRB, Monitoring, Engineering Controls, and LUCs (Alternative G-5)	Overburden and Bedrock Source Zones Enhanced Bioremediation	A soluble **electron donor (ED)**, sodium lactate, would be injected over a targeted depth interval into both overburden and bedrock target treatment zones (TTZ) through grids of injection points. The injection wells would be spaced along lines perpendicular to groundwater flow. To account for any residual sources after the initial treatment with sodium lactate, an oil-based ED would be injected into both TTZs after 6 months and again 2 years later to replenish the organic substrates in the TTZs. Following each re-injection, the results would be evaluated to determine if additional treatment is required. Impacted wetland areas would need to be restored after the injection process is completed.	**Capital:** $1,615,000 **O&M:** $1,987,000 30-year NPW: $3,602,000	55 years
	One Overburden Mulch PRB	Same as for Alternative G-3.		
	Monitoring	Similar to Alternative G-3, but would include monitoring wells in the TTZs.		
	Engineering Controls	Same as for Alternative G-2.		
	LUCs	Same as for Alternative G-2.		

TABLE 2-6. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED (CONT.)

ALTERNATIVE	COMPONENTS	DETAILS	COST	TIME TO CLEANUP
Overburden and Bedrock Source Zones Enhanced Bioremediation, Two Overburden PRBs, Monitoring, Engineering Controls, and LUCs (Alternative G-5A)	Overburden and Bedrock Source Zones Enhanced Bioremediation	Same as for Alternative G-5.	**Capital:** $1,783,000 **O&M:** $2,357,000 30-year NPW: $4,140,000	55 years
	Two Overburden Mulch PRBs	Same as for Alternative G-4.		
	Monitoring	Similar to Alternative G-4, but would include monitoring wells in the TTZs.		
	Engineering Controls	Same as for Alternative G-2.		
	LUCs	Same as for Alternative G-2.		

2.10 COMPARATIVE ANALYSIS OF ALTERNATIVES

Table 2-7 and the text in this section summarize the comparison of the remedial alternatives with respect to the nine **CERCLA evaluation criteria** outlined in the NCP at 40 Code of Federal Regulations (CFR) 300.430(e)(9)(iii) and categorized as threshold, primary balancing, and modifying criteria. Further information on the detailed comparison of remedial alternatives is presented in the SRA FS.

TABLE 2-7. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

	Alternative G-1	Alternative G-2	Alternative G-3	Alternative G-4	Alternative G-5	Alternative G-5A
ALTERNATIVE DESCRIPTION/COMPONENTS						
Evaluation Criteria	No Further Action	Monitoring, Engineering Controls and LUCs	One Overburden PRB, Monitoring, Engineering Controls, and LUCs	Two Overburden PRBs, Monitoring, Engineering Controls, and LUCs	Overburden and Bedrock Source Zone Enhanced Bioremediation, One Overburden PRB, Engineering Controls, and LUCs	Overburden and Bedrock Source Zone Enhanced Bioremediation, Two Overburden PRBs, Engineering Controls, and LUCs
ESTIMATED TIMEFRAMES FOR CLEANUP (YEARS)						
Time to achieve cleanup goals	Not Applicable	70	70	70	55	55
***CRITERIA ANALYSIS:* Threshold Criteria – Selected alternative must meet these criteria**						
Overall Protection of Human Health	⦸	O	O	●	●	★
Compliance with ARARs	⦸	●	●	●	●	●
Primary Balancing Criteria – Used to differentiate between alternatives meeting threshold criteria						
Long-Term Effectiveness and Permanence	⦸	O	●	●	★	★

TABLE 2-7. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES (CONT.)						
Reduction of Mobility, Toxicity, and Volume of Contaminants through Treatment	⦸	⦸	●	●	★	★
Short-Term Effectiveness	⦸	O	O	O	●	●
Implementability	★	●	O	O	O	O
Cost (30-Year NPW, see Table 2-6)	$120,000	$1,103,000	$2,612,000	$3,181,000	$3,602,000	$4,140,000
Modifying Criteria – May be used to modify recommended cleanup						
State Agency Acceptance	-	-	-	-	-	Yes
Community Acceptance	-	-	-	-	-	Yes
Notes: ARARs: Applicable or relevant and appropriate requirements LUCs: Land Use Controls O&M: Operation and Maintenance						★ Best ● Better O Good ⦸ Poor

Threshold Criteria

Overall Protection of Human Health and the Environment. Alternatives G-2 through G-5A would all provide protection to human health and the environment.

Alternative G-5A would provide the greatest protection because it treats the high-PCE concentration source areas in overburden and bedrock with enhanced bioremediation and part of the plume with two PRBs. Alternative G-5 would provide the next greatest protection because it treats the high-PCE concentration source areas in overburden and bedrock with enhanced bioremediation and part of the plume with one PRB. Alternatives G-4 and G-3 would provide the third best protection because they would contain the overburden PCE plume and passively treat it as groundwater flows through the mulch PRBs. In Alternative G-2, COCs would persist for the longest time because no treatment would be performed.

Monitoring would be effective in detecting the potential migration of the plume and presence of COCs in the EMD surface water and in evaluating the progress of the remediation.

The No Action Alternative (G-1) would not achieve the RAOs and therefore does not protect human health and the environment.

Compliance with ARARs. ARARs include any federal or state standards, requirements, criteria, or limitations determined to be legally applicable or relevant and appropriate to the site or remedial action. Alternatives G-2 through G-5A would comply with location- and action-specific ARARs and To Be Considered (TBC) guidance. Alternatives G-2 through G-5A would not immediately comply with chemical-specific ARARs and TBCs, but these alternatives would eventually achieve compliance through a combination of in-situ treatment and LUCs. Alternative G-1 would not comply with ARARs.

Primary Balancing Criteria

Long-Term Effectiveness and Permanence. Alternatives G-2 through G-5A would provide long-term effectiveness and permanence through a combination of monitoring, engineering controls, and LUCs and treatment for Alternatives G-3 through G-5A. Alternatives G-5 and G-5A would provide the greatest long-term effectiveness and permanence since both overburden and bedrock groundwater will be treated. Alternative G-5A would provide slightly greater long-term effectiveness by providing treatment directly to another part of the plume with the second PRB. The second PRB would shorten the duration of Alternative G-5A and reduce the long-term operations and maintenance requirements. For Alternatives G-2 through G-5A, engineering controls and LUCs could be maintained until the RGs are met. Alternative G-1 would provide no protectiveness.

Reduction in Toxicity, Mobility, or Volume Through Treatment. Alternatives G-3 through G-5A would achieve reductions in COC toxicity and volume through treatment. Alternatives G-3, G-4, G-5, and G-5A would permanently remove PCE from groundwater flowing through the PRBs. In addition, Alternatives G-5 and G-5A would permanently remove an estimated 1,900 pounds of PCE from groundwater in the TTZs through source area enhanced bioremediation. There is no active treatment in Alternatives G-1 and G-2.

Short-Term Effectiveness. Short-term effects of Alternatives G-2 through G-5A would result in a possibility of exposing site workers to contaminated groundwater during the maintenance and sampling of existing monitoring wells and during remedial construction and operation. Alternative G-2 would result in the lowest short-term risk, with the potential for exposure only during groundwater sampling events. Alternative G-3 would have a higher potential for short term exposure with excavation of contaminated saturated soil during installation of the mulch PRB north of the EMD. Alternative G-4 would have the next higher potential short term exposure because of the installation of the second mulch PRB at the upland edge. Alternative G-5A would have the greatest potential for short-term exposure during groundwater sampling, enhanced bioremediation injection well installation, and excavation of contaminated saturated soil during construction of the mulch PRBs. Alternative G-5 would have the next greatest potential for short-term exposure during groundwater sampling, enhanced bioremediation injection well installation, and excavation of contaminated saturated soil during construction of the single mulch PRB. However, for these alternatives the risks of exposure would be effectively controlled by wearing appropriate personal protection equipment (PPE) and compliance with proper site-specific health and safety procedures and practices.

Implementation of the groundwater alternatives that have treatment components would have slight adverse impacts on the surrounding community or environment. Alternative G-3 would have the least impact due to the transport of contaminated soil from the mulch PRB for off-site disposal. Alternatives G-4 and G-5A would have the highest impacts due to transport of more contaminated soil from the second mulch PRB for off-site disposal. Implementation of Alternatives G-5 and G-5A would result in the destruction of wetland areas that must be mitigated.

Alternatives G-2 through G-5A would achieve groundwater RAO Nos. 1 through 3 immediately upon implementation of LUCs and monitoring. Construction activities associated with Alternatives G-3, G-4, G-5, and G-5A would be completed in 1 month, 1 month, 3 months, and 4 months, respectively. For Alternatives G-3 through G-5A, replenishment of organic substrate in the PRBs by ED injection would be completed in approximately 2 weeks every 5 years after the installation of the PRBs. Monitoring and five-year reviews would be used to confirm that RAO No. 4 is met. It is estimated that the PRBs would need to be maintained for approximately 70 years under Alternatives G-3 and G-4 and for approximately 55 years under Alternatives G-5 and G-5A. The durations of Alternatives G-5 and G-5A are approximately 15 years less than the other alternatives. Under Alternative G-5A, the time to reach the RGs between the two PRBs is approximately 10 years. Alternative G-1 would not achieve the RAOs.

Alternative G-2 is the most sustainable alternative, followed by Alternative G-3, Alternative G-4, Alternative G-5 and Alternative G-5A, which has the highest relative impact on sustainability.

Implementability. Alternative G-1 would be the easiest to implement because there would be no action taken. Alternative G-2 would be the second easiest of the remaining alternatives to implement because of the minimal amount of field work and monitoring that would be required. Alternatives G-3 and G-4 would be the next easiest to implement. Alternatives G-5 and G-5A would be more difficult to implement than Alternatives G-3 and G-4 because they would require installation of injection wells into the overburden and the bedrock. For Alternatives G-5 and G-5A, the implementability of injecting ED into the bedrock is uncertain. For all four alternatives, contractors and equipment are readily available.

Engineering controls and LUCs would be required until groundwater RGs are attained for Alternatives G-2 through G-5A. For Alternatives G-3 through G-5A, construction of the mulch PRB north of the EMD would allow for removal of the engineering controls when the PCE plume upgradient of the EMD achieves the RGs and no unacceptable risk remains. For Alternatives G-4 and G-5A, construction of the mulch PRB at the upland edge would allow for removal of vapor intrusion LUCs in the upland area when the overburden PCE plume upgradient of the upland area achieves the recreational exposure vapor intrusion RGs and no unacceptable vapor intrusion risk remains. The residential use LUC would prevent exposure to unacceptable risk in the event zoning is changed to allow residential use after remedial goals have been achieved. LUCs can be readily prepared and implemented because the Navy retains ownership of the property.

Use of the property may be affected by the implementation of the alternatives. Alternatives G-3, G-4, G-5, and G-5A would temporarily impact site use during installation of the mulch PRBs and the injection wells for enhanced bioremediation and limit permanent use of the Site over and near the PRBs. The bedrock injection wells would limit the types of uses of the Site for Alternatives G-5 and G-5A. However, current plans call for the area to remain open space, with little or no development.

Cost. Alternative G-1 is the least expensive since there are no treatment or monitoring costs. Alternative G-2 is less expensive than Alternatives G-3 through G-5A because there is no active treatment. Alternative G-4 is more expensive than Alternative G-3 since a second PRB would need to be installed and replenished. Alternatives G-5 and G-5A are more expensive than the other alternatives since they include source area treatment. Alternative G-5A would be the most expensive alternative.

Modifying Criteria

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

Community Acceptance. The community expressed its support for Alternative G-5A. Many of the comments and questions raised at the public hearing on February 27, 2013 and the written comments received during the public comment period were for clarification and informational purposes. However concerns were raised regarding a potential for zoning to be changed in the future to allow residential use of the property. In response to this concern, the Navy modified the LUC component of the preferred remedy presented in the Proposed Plan to include establishment of a LUC to prohibit residential uses at the Site. Implementation of this additional LUC will assure protectiveness should zoning be changed in the future. These comments and Navy responses are discussed in Section 3.0.

2.11 PRINCIPAL THREAT WASTE

The NCP at 40 CFR 300.430(a)(1)(iii)(A) establishes an expectation that treatment will be used to address the principal threats posed at a site wherever practicable. Principal threat wastes are defined as those source materials considered to be highly toxic or highly mobile, and which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. A source material is a material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or acts as a source for direct exposure. There are no principal threat wastes present at the Site: there is only indirect evidence that DNAPL is present in the source area. High concentrations of COCs in the source area will be reduced by enhanced bioremediation. Exposure will also be prevented

by LUCs which will prohibit groundwater use as a potable water source and prohibit residential use of the Site.

2.12 SELECTED REMEDY

2.12.1 Rationale for the Selected Remedy

The selected remedy for the SRA site is Alternative G-5A, overburden and bedrock source area enhanced bioremediation, two overburden mulch PRBs, engineering controls, long-term monitoring (LTM), and LUCs. The Navy and EPA have concluded that this remedy is protective of human health and the environment, and achieves the overall goals established for the Site. This remedy is expected to clean the groundwater concentrations to the RAOs described in this ROD in the shortest amount of time. The remedy will meet the RAOs by reducing COC concentrations through enhanced bioremediation and passive treatment through PRBs and controlling exposure to contaminants in groundwater, vapors, and surface water through interim LUCs until the remediation goals of the selected remedy have been achieved. Permanent LUCs will prohibit the use of groundwater for production, supply, and irrigation purposes and prohibit future residential uses at the Site. The Navy proposes that this remedy be the final remedy for the SRA.

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

- The remedy will achieve substantial risk reduction by treating the source materials constituting principal threats.
- The remedy will provide safe management of both the overburden and the bedrock source zones.
- The remedy is consistent with the future zoning uses of the Site.

2.12.2 Description of the Selected Remedy

The selected remedy includes the following components, described below and shown on Figure 2-6:

- Overburden and Bedrock Source Area Enhanced Bioremediation
- Mulch PRBs
- Engineering Controls
- LUCs
- Monitoring
- Five-Year Reviews (as needed)

Overburden and Bedrock Source Area Enhanced Bioremediation

This component consists of active treatment by in-situ enhanced bioremediation to reduce the source mass of the PCE plumes in areas with the highest groundwater concentrations in overburden and bedrock. Prior to the design of the enhanced bioremediation system, a pilot treatability study will be performed to determine chemical injection rates, buffering requirements, injection well spacing, and details of construction of the PRBs. Existing site information and assumptions based on typical enhanced bioremediation systems and PRBs were used for the conceptual design in the FS. As part of the study, the need for bioaugmentation by the addition of microorganisms will also be evaluated.

A soluble ED, sodium lactate, is proposed for the initial injection in both the overburden and bedrock TTZs through grids of injection points. At each injection location, a sodium lactate solution will be introduced via an injection well over the entire saturated thickness. A buffering agent, such as sodium bicarbonate, may be needed to maintain the pH in the optimum range.

The pilot treatability study will be performed to determine chemical injection rates, buffering requirements, and the number and spacing of the injection wells. The estimated number of injection points, depths and amount of ED are summarized in the table below.

TTZ	No. of Injection Points	Targeted Depth Interval	Sodium Lactate (lb)
Overburden	42	2 – 17 feet bgs	1,500
Bedrock	9	17 – 37 feet bgs	60

To account for any residual sources after the initial treatment with sodium lactate, an oil-based ED, such as an emulsified oil substrate (EOS), will be injected into both TTZs to replenish the organic substrates in the TTZs. Volumes and injection rates will be determined during the remedial design phase. Following each re-injection, the results will be evaluated to determine if additional treatment is required.

Because the source area treatment will impact wetlands, the impacted areas will need to be restored after injection process is completed.

Mulch PRBs

Two mulch PRBs will be installed in the overburden: one north of and near the EMD to intercept and treat the overburden PCE plume at its leading edge and one at the upgradient edge of the upland north of the EMD to treat the PCE plume entering the upland area. This upland PRB will be located south of the wetlands to avoid wetland impacts. A pilot treatability study will be performed to determine the details of the construction of the PRBs.

The estimated width of the mulch barrier is 2 feet and vertical thickness of the PRBs is approximately 15 feet. Wells will be installed in each PRB to allow for replenishment with an oil-based ED after the organic material in the mulch is exhausted. Monitoring wells on both sides of the PRBs will be used to monitor the progress and effectiveness of treatment.

Engineering Controls

A temporary fence will be installed around a portion of the EMD to prevent contact of the surface water in the EMD by human receptors.

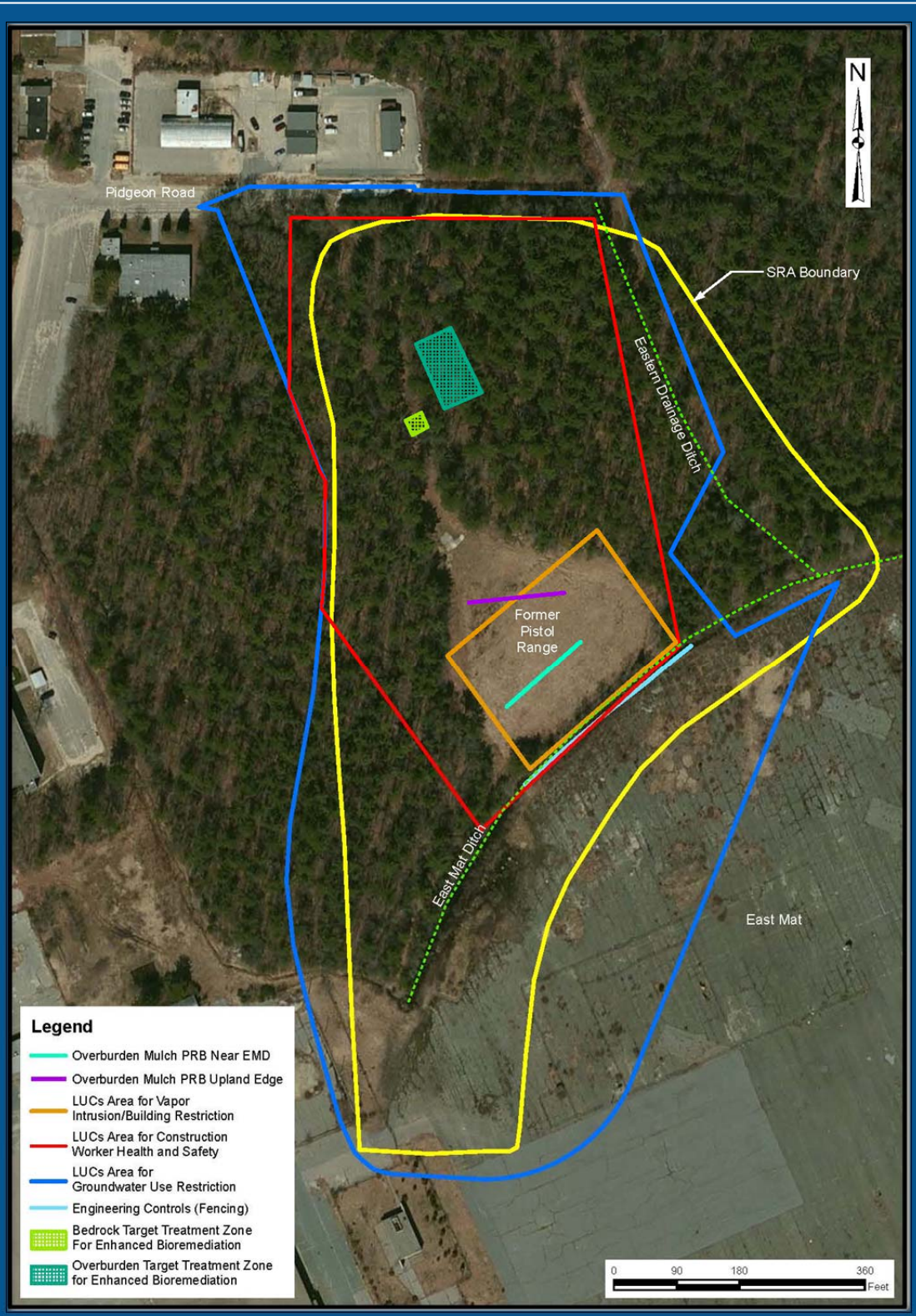
Land Use Controls

LUCs will be implemented to control exposure to COCs in groundwater until the RGs are achieved. A permanent LUC will be implemented to prohibit installation of groundwater production, supply, and irrigation wells at the SRA Site. A second permanent LUC will be implemented to prohibit residential use at the SRA Site. The interim LUCs listed below will be established north of the EMD:

- A LUC requiring prior EPA and MassDEP approval of construction dewatering plans before excavation activities could be conducted, until the RGs are met.
- A LUC specifying health and safety procedures to be used by construction workers to prevent unacceptable exposure risks until the RGs are met.
- A LUC requiring approval of plans for recreational buildings to prevent exposure of building occupants to site vapor in indoor air, until the RGs are met.

Figure 2-6 shows the approximate extent of a permanent LUC restricting use of groundwater and of interim LUCs to prevent unacceptable risk from exposure to contaminants in groundwater, vapors, and surface water. This combination of permanent and interim LUCs in addition to a permanent LUC to prohibit residential use within the SRA Site Boundary will prevent any unacceptable risk to human health should the current zoning be changed in the future to allow residential uses.

FIGURE 2-6. SELECTED REMEDY



The LUCs will be implemented through a LUC Remedial Design (RD) as part of the remedial design phase for the selected remedy. Within one hundred and twenty (120) days of ROD signature, the Navy will prepare and submit the LUC RD to the EPA and the State. The LUC RD will describe the specific controls for the Site, as well as implementation and maintenance actions, including periodic inspections.

The LUCs will be maintained and enforceable for as long as they are required to prevent unacceptable exposure to contamination and to preserve the integrity of the selected remedy. The Navy is responsible for implementing, maintaining, reporting on, and enforcing land use controls. Although the Navy may later transfer one or more of these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity.

If the remedial design provides that MassDEP has the right to enforce the LUCs, the form of LUCs shall be satisfactory to MassDEP, and, to the extent applicable, shall comply with M.G.L. c. 21E and 310 CMR 40.0000.

Annual inspections of the Site will be conducted to confirm compliance with the LUC objectives, and an annual compliance certificate will be prepared and provided to EPA and MassDEP. Prior to any property conveyance, EPA and MassDEP will be notified.

Monitoring

Monitoring will consist of groundwater, surface water, and sediment monitoring. Monitoring wells will be located to monitor groundwater both north and south of the EMD. Long-term groundwater monitoring wells will be selected to monitor: (1) groundwater immediately north of the EMD (to verify that the overburden source and impacted groundwater remain contained at levels protective of the EMD); (2) groundwater south of the EMD (to verify that the nature and boundaries of any LUCs are still appropriate); and (3) groundwater at the eastern edge of the plume (to verify that the impacted groundwater is not migrating to the east).

Surface water monitoring will be conducted in the EMD to confirm the surface water RGs are being met. Sediment monitoring will be conducted to confirm that no accumulation of iron and manganese is occurring in the EMD sediment. Sediment monitoring will include collection of sediment samples from the EMD at locations most likely to be impacted by the incoming groundwater that might have elevated iron and manganese concentrations.

Details regarding the scope, including pertinent media and monitoring parameters, and the duration of LTM will be provided in the LTM plan to be developed as part of the remedial design.

Five-Year Reviews

Five-year reviews will be conducted by the Navy, in conjunction with EPA and MassDEP, until groundwater conditions are restored such that the Site is suitable for unrestricted use and unlimited exposure in accordance with CERCLA. During such reviews, the Navy, EPA, and MassDEP will review site conditions and monitoring data to determine whether the continued implementation of the remedy is appropriate.

2.12.3 Expected Outcomes of the Selected Remedy

The expected outcomes of the selected remedy are to: (1) eliminate the potential for human exposure to surface water containing contaminant concentrations in excess of the RGs; (2) eliminate the potential for human exposure to groundwater containing contaminant concentrations in excess of the RGs; and (3) eliminate the potential for human exposure to COCs through vapor intrusion (occupants of future buildings) or trench air (construction workers). Enhanced bioremediation is expected to decrease COC concentrations in the source area TTZs (Figure 2-6) to acceptable levels within approximately 3 years of remedy implementation; the mulch PRBs are expected to decrease COC concentrations in the upland

areas between the TTZs and the EMD to acceptable levels within approximately 55 years. The time frames to achieve site cleanup are estimates based on the currently available information and will be further evaluated as part of the five-year review process.

Alternative G-5A will reduce the toxicity, mobility, and volume of groundwater COCs through in-situ treatment. In-situ enhanced bioremediation will permanently reduce PCE concentrations in groundwater in the TTZs. Passive treatment with the overburden mulch PRBs will permanently remove PCE from the groundwater flowing through it. LUCs will be immediately effective for addressing the human exposure pathway of concern until site cleanup is achieved. This alternative will achieve substantial risk reduction by both treating the source materials constituting principal threats at the Site and providing safe management of the remaining material.

Upon achieving the groundwater and surface water cleanup levels identified in Tables 2-4 and 2-5, the Site will be suitable for the open space and recreational uses allowed by the Reuse Plan and associated zoning. Although the groundwater is not considered a drinking water source, permanent LUCs will prohibit extraction of groundwater for production, supply, and irrigation purposes, and restrict residential use of the site. The permanent and interim LUCs will prevent any unacceptable risk to human health should the current zoning be changed in the future to allow residential uses.

Table 2-8 describes how the selected remedy mitigates risk and achieves RAOs for the Site.

TABLE 2-8. HOW SELECTED REMEDY MITIGATES RISK AND ACHIEVES RAOS

RISK	RAO	COMMENTS
Incidental ingestion and dermal contact with surface water	Prevent the migration of COCs to surface water at concentrations that pose an unacceptable risk to human health.	Engineering controls will prevent contact with surface water until surface water concentrations are reduced to cleanup goals. Treatment with enhanced bioremediation and the PRBs will reduce the source mass plume expansion and migration of COCs to surface water.
Exposure to vapors inside buildings	Prevent exposure of building occupants to VOCs resulting from vapor intrusion into future buildings at the Site at concentrations that pose unacceptable risk.	Interim LUCs will prevent buildings for recreational uses on the Site unless plans are specifically approved until groundwater COC concentrations are reduced to cleanup goals through treatment by enhanced bioremediation and the PRBs. Permanent LUCs restricting residential uses will prevent exposure should zoning change in the future to allow residential use.
Exposure to vapors during excavation activities	Prevent exposure of construction workers during excavation activities to VOCs and COCs in groundwater at concentrations that pose unacceptable risk.	LUCs will prevent excavation activities on the Site without approved plans and procedures until COC concentrations are reduced to the cleanup goals.
Ingestion of groundwater and exposure to vapors downgradient of the Site.	Prevent migration of groundwater containing COCs at concentrations that pose unacceptable risk.	LUCs will prohibit installation of groundwater production, supply, and irrigation wells. Enhanced bioremediation will reduce the COC concentrations in the TTZ and the PRBs will prevent the downgradient migration of groundwater containing COCs.

2.13 STATUTORY DETERMINATIONS

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

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

the interim time until site cleanup objectives are achieved. Site conditions do not pose unacceptable risks to ecological receptors or to human receptors under current site use.

- **Compliance with ARARs** - The selected remedy will comply with all federal and state ARARs as presented in Appendix E.

- **Cost-Effectiveness** - The selected remedy is a cost effective means to achieve site remediation. The costs are proportional to the overall effectiveness during the remediation time frame. Detailed costs for the selected remedy are presented in Appendix B.

- **Utilization of Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable** – The selected remedy will be an effective and permanent means of reducing COC concentrations in the source area through treatment. Multiple source zone injections will be performed and the PRBs will be maintained until the RGs are met.

- **Preference for Treatment Which Permanently and Significantly Reduces the Toxicity, Mobility, or Volume of the Hazardous Substances as a Principal Element** – The selected remedy includes overburden and bedrock source zone treatment to reduce the source mass and break down COCs, thereby reducing the toxicity, mobility, and volume of the groundwater contamination.

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

2.14 DOCUMENTATION OF NO SIGNIFICANT CHANGES

CERCLA Section 117(b) requires an explanation of significant changes from the remedy presented in the Proposed Plan that was published for public comment. Comments received during the public comment period and the February 27, 2013 public hearing were generally supportive of the Proposed Plan. As discussed in Section 2.10, the Navy slightly modified the preferred remedy presented in the Proposed Plan in response to public concerns regarding a potential future use of the Site for residential purposes. Therefore no significant changes to the remedy as originally identified in the Proposed Plan were necessary or appropriate. The comments received on the Proposed Plan during the public comment period are presented in Section 3.0.

3.0 RESPONSIVENESS SUMMARY

3.1 STAKEHOLDER COMMENTS AND LEAD AGENCY RESPONSES

Participants in the public meeting and public hearing held on February 27, 2013, included members of the public and representatives of the Navy, EPA, and MassDEP. Questions and concerns raised at the public hearing and other comments received from the public are addressed in Table 3-1. The public hearing transcript and comment letters received during the 30-day public comment period on the Proposed Plan are included in Appendix F.

TABLE 3-1. SUMMARY OF QUESTIONS FROM PUBLIC HEARING AND COMMENT PERIOD

Question	Response
Ms. Anne Hilbert, North Weymouth, asked when the developer will identify the source of water for their development. She added that the people of Weymouth deserve an answer on the source of water for the development.	The Navy is not able to answer this question and suggests that it be directed to SSTTDC and/or LNR. The LUCs established as part of the SRA remedy will permanently prohibit the extraction of groundwater for production, supply, and irrigation purposes.
Ms. Mary Parsons, Rockland, agreed with Ms. Hilbert's concern and indicated her desire to have permanent LUCs on groundwater for drinking water and also irrigation.	LUCs are established on a site-specific basis. As noted above, a permanent LUC will prevent installation of groundwater production, supply, and irrigation wells at the SRA Site.
Mr. Michael Smart, Weymouth, asked approximately how many acres are in the area shown within the site boundary. He also asked how close to the fenced portion of the Site could recreational facilities be placed if the fence is temporary and can be taken down. How close can people using recreation facilities get to the fence before seeing signage or any notification that the area is restricted? Will there be signage as notification that the area is restricted while the fence is in place and after it is removed?	The SRA Site is approximately 14 acres: 11 acres north of the EMD; and 3 acres south of the EMD on the East Mat. The fence will remain in place to restrict access to surface water in the EMD until the surface water cleanup goals are achieved. Once achieved, there would be no unacceptable risk and the fence could be removed. Details concerning the design of the fence, signage, etc. will be developed during the RD for the selected remedy.
Mr. Daniel Punchard, Rockland, asked if the Navy investigated plant life in areas considered to be contaminated.	The RI included a plant community characterization and wildlife habitat assessment within the SRA Site. The forested wetland, shrub, and herbaceous vegetation are considered suitable habitat for wildlife and songbirds. The ERA evaluated whether chemicals detected in the SRA Site surface soils had impacted terrestrial plants, and concluded that there are no significant impacts on the plants at the Site.
Mr. Dominic Galluzzo, Weymouth, indicated his support for the Navy's efforts to clean up the Base, obtain scientific data, use the data to clean up the land and then transfer the property. He also indicated his appreciation for the Navy's commitment to keep the public and communities informed of progress in a timely manner.	The Navy appreciates Mr. Galluzzo's support. The Navy will implement the selected remedy for the SRA Site and transfer the property only after all remedial actions have been taken and the property is determined to be suitable to transfer. The progress of environmental site cleanup activities at the Base will continue to be shared with the communities at RAB meetings and other public meetings scheduled by the Navy.

TABLE 3-1. SUMMARY OF QUESTIONS FROM PUBLIC HEARING AND COMMENT PERIOD (CONT.)	
Question	Response
Ms. Mary Parsons, Rockland, also provided written comments stating that LUCs should be used to prevent any future zoning changes to the SRA except a change to passive open space. She expressed a concern that the zoning could be changed to residential without the Navy's knowledge.	The Navy cannot restrict or prevent future zoning changes; the remedial alternatives were developed consistent with the current zoning. The zoning and allowable uses for the SRA Site were established by SSTTDC in the Zoning and Land Use By-Laws for NAS South Weymouth. Note that the majority of the SRA Site is currently zoned as open space. The site-specific LUCs will control exposure to contaminants in the groundwater during the cleanup of the Site and will permanently restrict use of groundwater for supply, production and irrigation purposes and prohibit residential uses at the Site. The groundwater restriction will remain in place even if the zoning were changed in the future. Annual LUC compliance inspections will be performed in accordance with the Department of Defense "Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-ROD Actions." The inspections will include an annual check for proposed land use changes.
Ms. Parsons also asked if indoor recreation facilities are built on the Site, will there be air quality control monitoring of vapors.	No vapor intrusion (VI) risks were identified for the area south of the EMD. This part of the Site is zoned for recreational uses. The long-term monitoring (LTM) program data will be used to determine that the VI-based cleanup goals are met. No risk from VI or construction worker exposures to groundwater COCs will remain once the cleanup goals are achieved and the property is determined to be suitable for transfer. The parties developing any recreation facilities will be responsible for construction details.
CDM Smith provided written comments on behalf of Advocates for Rockland, Abington, Weymouth and Hingham (ARAWH). The main issues discussed in the comment letter are summarized below. • The selected remedy includes no LUCs to prohibit residential development or construction of certain types of recreational facilities south of the EMD. The letter expressed concerns about a vapor intrusion (VI) health risk if the current zoning is changed to residential after site cleanup is completed and the property is transferred or if there is any risk from VI exposure during construction of recreation facilities south of the EMD.	• As noted above, the Navy cannot restrict or prevent future zoning changes. The selected remedy and LUCs are consistent with the current zoning. The permanent LUC restricting use of groundwater, and a permanent LUC added subsequent to receipt of these comments to restrict residential uses at the Site, and the interim LUCs to prevent unacceptable risk from exposure to contaminants in groundwater, vapors, and surface water will prevent any unacceptable risk to human health should the current zoning be changed in the future to allow residential uses. A detailed LUC Plan will be developed during the RD. The area of the Site north of the EMD is designated as a public benefit conveyance to the National Park Service (NPS). The NPS will then convey the property to SSTTDC in accordance with a binding agreement which indicates the open space area can include walking/bike trails but no structures. The RI and FS documented no VI risk south of the EMD. The monitoring component of the selected remedy will determine if groundwater concentrations south of the EMD are less than the VI and construction exposure cleanup goals. The Navy will perform five year reviews as long as contaminants remain at concentrations that prevent unrestricted use. These reviews, as well as annual LUC inspections, will determine if zoning is changed either before or after all SRA remedial actions have been taken and the Navy has transferred the property.

TABLE 3-1. SUMMARY OF QUESTIONS FROM PUBLIC HEARING AND COMMENT PERIOD (CONT.)	
Question	Response
• The letter indicated a concern about placement of a groundwater supply well outside the SRA 'groundwater protection zone.' The letter suggested that the Navy: calculate the groundwater drawdown potential if future non-potable and irrigation wells are installed nearby; or perform modeling to simulate impacts on any future wells placed within the influence of the SRA. • The letter suggested that the Navy: 1) consider expanding the bedrock TTZ due to uncertainties in the extent of the bedrock TTZ; 2) consider the use of ZVI in the mulch PRBs; and 3) develop a more extensive groundwater monitoring program, suggesting a number of specific parameters to include.	• The Navy is responsible for the cleanup of the SRA Site; water supply for the development of transferred property is the responsibility of SSTTDC and LNR. Article XIV of the SSTTDC Health Regulations prohibits potable wells within the Base and requires a permit application and approval for any other private wells. The applicant "shall identify all potential sources of contamination which exist or are proposed within two hundred (200) feet of the site." The evaluations suggested in the comment letter therefore would be the responsibility of the party interested in installing a water supply well. Annual LUC inspections will identify if any well permits have been issued or if new water supply wells have been constructed near the Site. • The FS provides a conceptual description of the components of the remedial alternatives. Note that ZVI and mulch PRBs were evaluated in the FS; mulch is more easily regenerated and is more cost effective. As mentioned in the Proposed Plan, a pilot treatability study will be performed during the RD. The pilot study will determine the size of the TTZs, construction details for the TTZs and PRBs, and also include a long-term monitoring program. The LTM program to be developed during the RD will likely include many of the parameters suggested in the comment letter.
Anne Hilbert, North Weymouth, also provided written comments indicating concerns about the allowable uses in the zoning by-laws, LUCs to protect construction workers, signage, the Comparison of Remedial Alternatives in the SRA Proposed Plan and the need for additional permanent wells. A comment was also provided concerning deed restrictions for the FFTA site.	SSTTDC is responsible for establishing the zoning and allowable uses for the Base. The Navy has developed remedial alternatives to be consistent with the established zoning. Details on the LUCs to protect construction workers will be developed as part of the SRA Site RD. Signage details will also be determined as part of the LUC component of the Site RD. The Comparison of Remedial Alternatives table in the SRA Proposed Plan indicates that the Navy's selected remedy, Alternative G-5A, has the best ratings of the six alternatives evaluated for the Site. The need for additional monitoring wells will be determined as part of the long-term monitoring portion of the SRA Site Remedial Design. The comment about the FFTA site is not pertinent to the SRA Site Proposed Plan.

3.2 TECHNICAL AND LEGAL ISSUES

No technical or legal issues associated with the Solvent Release Area ROD were identified.

Administrative Record Reference Table

ADMINISTRATIVE RECORD REFERENCE TABLE

ITEM	REFERENCE PHRASE IN ROD	LOCATION IN ROD	LOCATION OF INFORMATION IN ADMINISTRATIVE RECORD
1	**evaluated**	Table 2-1	Remedial Investigation, Tetra Tech, 2010.
2	**potential alternatives**	Table 2-1	Feasibility Study, Tetra Tech, 2012. Section 4.2
3	**public notice**	Section 2.3	Proposed Plan
4	**flow direction**	Section 2.5.1	Tetra Tech, 2010. Section 3.3.2
5	**human health risk assessment**	Section 2.7	Tetra Tech, 2010. Section 6
6	**ecological risk assessment**	Section 2.7	Tetra Tech, 2010. Section 7
7	**selection of chemicals of concern (COCs)**	Section 2.7.1	Tetra Tech, 2010. Section 6.3
8	**exposure assessment**	Section 2.7.1	Tetra Tech, 2010. Section 6.4
9	**cancer risks**	Section 2.7.1	Tetra Tech, 2010. Section 6.6
10	**non-cancer hazards**	Section 2.7.1	Tetra Tech, 2010. Section 6.6
11	**uncertainty**	Section 2.7.1	Tetra Tech, 2010. Section 6.7
12	**General Response Actions**	Section 2.9	Tetra Tech, 2012. Section 3.1
13	**remedial technologies**	Section 2.9	Tetra Tech, 2012. Section 3.1
14	**process options**	Section 2.9	Tetra Tech, 2012. Section 3.1
15	**30-Year NPW**	Table 2-6	Tetra Tech, 2012. Section 4.2
16	**electron donor**	Table 2-6	Tetra Tech, 2012. Section 4.2.3, 4.2.4
17	**CERCLA evaluation criteria**	Section 2.10	Tetra Tech, 2012. Section 4.1.1

Detailed site information referenced in this ROD in bold blue text is contained in the Administrative Record. For access to information contained in the Administrative Record for "Solvent Release Area – IR Site 11" please contact the former NAS South Weymouth Caretaker Site Office, 1134 Main Street, Building 11, Weymouth, Massachusetts.

Appendix A
Massachusetts Department of Environmental Protection Concurrence Letter

MassDEP
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

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

September 30, 2013

James T. Owens, Director
Office of Site Remediation and Restoration
U.S. Environmental Protection Agency
5 Post Office Square, Suite 100
Mail Code: OSRR07-03
Boston, MA 02114-2023

Re: Record of Decision
Solvent Release Area (OU 14)
Former South Weymouth NAS
MassDEP RTN 4-3002621

Dear Mr. Owens:

The Massachusetts Department of Environmental Protection (MassDEP) reviewed the *Record of Decision, Solvent Release Area, Operable Unit 14, Naval Air Station South Weymouth*, dated September 2013. The Record of Decision summarizes the results from the site investigations, interim removal actions, and feasibility study that were used to characterize and develop cleanup options for the site and documents the Navy's rationale for selecting remedial alternative G-5A: Overburden and Bedrock Source Zone Enhanced Bioremediation, Two Overburden PRBs, Engineering Controls, and LUCs. MassDEP concurs with the selected remedy.

If you have any questions or comments, please contact David Chaffin, Project Manager (617-348-4005), or Anne Malewicz, Federal Facilities Section Chief (617-292-5659).

Sincerely,

Benjamin Ericson
Assistant Commissioner
Bureau of Waste Site Cleanup

cc: D. Barney, USN-S. Weymouth
C. Keating, USEPA
Chief Executive Officer, SSTTDC
RAB Members
J. Naparstek, MADEP-Boston

Appendix B
Cost Estimate

COST ESTIMATE DISCLAIMER

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Solvent Release Area
Alternative G-5A: Overburden and Bedrock Source Zone Enhanced Bioremediation, Two Overburden Mulch PRBs, Monitoring, Engineering Controls, and LUCs
Capital Cost

Item	Quantity	Unit	Unit Cost				Extended Cost				Subtotal
			Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	600	hr			$60.00		$0	$0	$36,000	$0	$36,000
1.2 Prepare LTM Plans	300	hr			$60.00		$0	$0	$18,000	$0	$18,000
1.3 Prepare LUCs	150	hr			$60.00		$0	$0	$9,000	$0	$9,000
1.4 Pilot Study: Mulch Barriers	1	ls	$50,000.00				$50,000	$0	$0	$0	$50,000
1.5 Pilot Study: Bioremediation	1	ls	$75,000.00				$75,000	$0	$0	$0	$75,000
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2 Equipment Mobilization/Demobilization	6	ea			$183.00	$518.00	$0	$0	$1,098	$3,108	$4,206
2.3 One-Pass Trencher Mob/Demob	1	ea	$50,000.00				$50,000	$0	$0	$0	$50,000
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Office Trailer	3	mo				$360.00	$0	$0	$0	$1,080	$1,080
3.2 Field Office Equipment, Utilities, & Support	3	mo		$519.00			$0	$1,557	$0	$0	$1,557
3.3 Storage Trailer	3	mo				$94.00	$0	$0	$0	$282	$282
3.4 Survey Support	5	day	$1,125.00				$5,625	$0	$0	$0	$5,625
3.5 Site Superintendent	55	day		$166.00	$420.00		$0	$9,130	$23,100	$0	$32,230
3.6 Site Health & Safety and QA/QC	55	day		$166.00	$370.00		$0	$9,130	$20,350	$0	$29,480
3.7 Underground Utility Clearance	1	ls	$10,000.00				$10,000	$0	$0	$0	$10,000
4 DECONTAMINATION											
4.1 Decontamination Services	3	mo		$1,220.00	$2,245.00	$1,550.00	$0	$3,660	$6,735	$4,650	$15,045
4.2 Temporary Equipment Decon Pad	1	ls		$1,500.00	$2,000.00	$300.00	$0	$1,500	$2,000	$300	$3,800
4.3 Decon Water	3,000	gal		$0.20			$0	$600	$0	$0	$600
4.4 Decon Water Storage Tank, 6,000 gallon	3	mo				$780.00	$0	$0	$0	$2,340	$2,340
4.5 Clean Water Storage Tank, 4,000 gallon	3	mo				$702.00	$0	$0	$0	$2,106	$2,106
4.6 Disposal of Decon Waste (liquid & solid)	3	mo	$985.00				$2,955	$0	$0	$0	$2,955
5 SITE PREPARATION											
5.1 Clear & Chip Trees	1.5	ac			$2,500.00	$1,875.00	$0	$0	$3,750	$2,813	$6,563
5.2 Material Handling Pad, 100' by 100'	5,000	sf		$5.84	$0.89	$1.34	$0	$29,200	$4,450	$6,700	$40,350
5.3 Fence, Chain Link, 8' high	720	lf	$38.00				$27,360	$0	$0	$0	$27,360
5.4 Gate, Chain Link, 12' wide	1	ea.	$1,725.00				$1,725	$0	$0	$0	$1,725
5.5 Signs on Fence	8	ea.	$122.00				$976	$0	$0	$0	$976
6 OVERBURDEN ENHANCED BIOREMEDIATION											
6.1 Injection Wells, 42 wells	720	lf	$50.00				$36,000	$0	$0	$0	$36,000
6.2 Injection Wells Heads	42	ea	$500.00				$21,000	$0	$0	$0	$21,000
6.3 Inject Pumps	7	day				$500.00	$0	$0	$0	$3,500	$3,500
6.4 Site Labor (2 laborers)	14	day			$274.80		$0	$0	$3,847	$0	$3,847
6.5 Sodium Lactate	2,475	lb		$2.00			$0	$4,950	$0	$0	$4,950
6.6 Sodium Bicarbonate	2,970	lb		$0.30			$0	$891	$0	$0	$891
6.7 Water Tank Truck	7	day				$480.00	$0	$0	$0	$3,360	$3,360
6.8 Injection Water	1,470	gal		$0.20			$0	$294	$0	$0	$294
7 BEDROCK ENHANCED BIOREMEDIATION											
7.1 Injection Wells, 9 wells	340	lf	$50.00				$17,000	$0	$0	$0	$17,000
7.2 Injection Wells Heads	9	ea	$500.00				$4,500	$0	$0	$0	$4,500
7.3 Inject Pumps	4	day				$500.00	$0	$0	$0	$2,000	$2,000
7.4 Site Labor (2 laborers)	8	day			$274.80		$0	$0	$2,198	$0	$2,198
7.5 Sodium Lactate	97	lb		$2.00			$0	$194	$0	$0	$194
7.6 Sodium Bicarbonate	116	lb		$0.30			$0	$35	$0	$0	$35
7.7 Water Tank Truck	4	day				$480.00	$0	$0	$0	$1,920	$1,920
7.8 Injection Water	60	gal		$0.20			$0	$12	$0	$0	$12

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Solvent Release Area
Alternative G-5A: Overburden and Bedrock Source Zone Enhanced Bioremediation, Two Overburden Mulch PRBs, Monitoring, Engineering Controls, and LUCs
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
8 MULCH BARRIERS											
8.1 One-Pass Trencher	275	lf			$110.00	$220.00	$0	$0	$30,250	$60,500	$90,750
8.2 Front-End Loader, 2 each	10	day			$362.80	$933.40	$0	$0	$3,628	$9,334	$12,962
8.3 Equipment Mats	5	day				$165.00	$0	$0	$0	$825	$825
8.4 Pumps & Filters	5	day				$184.00	$0	$0	$0	$920	$920
8.5 Storage Tank, 15,000 gallon	1	mo				$1,560.00	$0	$0	$0	$1,560	$1,560
8.6 Mulch	153	cy		$35.15			$0	$5,378	$0	$0	$5,378
8.7 Sand	153	cy		$20.00			$0	$3,060	$0	$0	$3,060
8.8 Site Labor (3 laborers)	15	day			$274.80		$0	$0	$4,122	$0	$4,122
8.9 Transport & Dispose Excavated Soil, non-hazardous	459	ton	$85.00				$39,015	$0	$0	$0	$39,015
8.10 Replenishment Wells, 11 wells	165	lf	$55.00				$9,075	$0	$0	$0	$9,075
8.11 Replenishment Wells Heads	11	ea	$500.00				$5,500	$0	$0	$0	$5,500
9 MONITORING WELLS											
9.1 Well Installation, 2" dia (overburden)	150	lf	$65.00				$9,750	$0	$0	$0	$9,750
9.2 Well Installation, 2" dia (bedrock)	50	lf	$70.00				$3,500	$0	$0	$0	$3,500
9.3 Well Protective Casing	10	ea	$150.00				$1,500	$0	$0	$0	$1,500
9.4 IDW Transportation & Disposal	20	drum	$150.00				$3,000	$0	$0	$0	$3,000
10 SITE RESTORATION											
10.1 Prepare Wetland Documents & Plans	1	ls			$35,000.00		$0	$0	$35,000	$0	$35,000
10.2 Wetlands Construction	0.3	ac	$110,000.00				$33,000	$0	$0	$0	$33,000
10.3 Area Seeding	15	msf	$117.00				$1,755	$0	$0	$0	$1,755
11 POST CONSTRUCTION COST											
11.1 Contractor Completion Report	400	hr			$60.00		$0	$0	$24,000	$0	$24,000
11.2 Remedial Action Closeout Report	300	hr			$60.00		$0	$0	$18,000	$0	$18,000
Subtotal							$408,236	$70,591	$245,529	$110,798	$835,153
Overhead on Labor Cost @ 30%									$73,659		$73,659
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$40,824	$7,059	$24,553	$11,080	$83,515
Tax on Materials and Equipment Cost @ 6.25%								$4,412		$6,925	$11,337
Total Direct Cost							$449,060	$82,062	$343,740	$128,802	$1,003,663
Indirects on Total Direct Cost @ 25%		(excluding transportation and disposal cost)									$240,423
Profit on Total Direct Cost @ 10%											$100,366
Subtotal											$1,344,453
Health & Safety Monitoring @ 2%											$26,889
Total Field Cost											$1,371,342
Engineering on Total Field Cost @ 10%											$137,134
Contingency on Total Field Cost @ 20%											$274,268
TOTAL CAPITAL COST											**$1,782,745**

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Solvent Release Area
Alternative G-5A: Overburden and Bedrock Source Zone Enhanced Bioremediation, Two Overburden Mulch PRBs, Monitoring, Engineering Controls, and LUCs
O & M Cost: Years 1 & 3 Bioremediation - Follow Up Injection

Item	Quantity	Unit	Unit Cost Subcontract	Material	Labor	Equipment	Extended Cost Subcontract	Material	Labor	Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	250	hr			$60.00		$0	$0	$15,000	$0	$15,000
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	3	ea			$183.00	$518.00	$0	$0	$549	$1,554	$2,103
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	1	mo				$94.00	$0	$0	$0	$94	$94
3.2 Site Superintendent and QA/QC	10	day		$166.00	$420.00		$0	$1,660	$4,200	$0	$5,860
4 DECONTAMINATION											
4.1 Decontamination Services	0.5	mo		$1,220.00	$2,245.00	$1,550.00	$0	$610	$1,123	$775	$2,508
4.2 Temporary Equipment Decon Pad	1	ls		$1,500.00	$2,000.00	$300.00	$0	$1,500	$2,000	$300	$3,800
4.3 Decon Water	500	gal		$0.20			$0	$100	$0	$0	$100
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$780.00	$0	$0	$0	$780	$780
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$702.00	$0	$0	$0	$702	$702
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 MULCH BARRIERS EOS											
5.1 Inject Pumps	8	day				$500.00	$0	$0	$0	$4,000	$4,000
5.2 Site Labor (2 laborers)	16	day			$274.80		$0	$0	$4,397	$0	$4,397
5.3 EOS	0.5	drum		$840.00			$0	$420	$0	$0	$420
5.4 Injection Water	46	gal		$0.20			$0	$9	$0	$0	$9
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	200	hr			$60.00		$0	$0	$12,000	$0	$12,000
Subtotal							$985	$4,299	$39,268	$8,205	$52,758
Overhead on Labor Cost @ 30%									$11,780		$11,780
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$99	$430	$3,927	$821	$5,276
Tax on Materials and Equipment Cost @ 6.25%								$269		$513	$782
Total Direct Cost							$1,084	$4,998	$54,976	$9,538	$70,595
Indirects on Total Direct Cost @ 25%											$17,649
Profit on Total Direct Cost @ 10%											$7,060
Subtotal											$95,304
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$95,304
Engineering on Total Field Cost @ 25%											$23,826
Contingency on Total Field Cost @ 25%											$23,826
TOTAL CAPITAL COST											**$142,955**

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Solvent Release Area
Alternative G-5A: Overburden and Bedrock Source Zone Enhanced Bioremediation, Two Overburden Mulch PRBs, Monitoring, Engineering Controls, and LUCs
O & M Cost: Years 5, 10, 15, 20, 25, and 30 Mulch PRB

Item	Quantity	Unit	Unit Cost				Extended Cost				Subtotal
			Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	150	hr			$60.00		$0	$0	$9,000	$0	$9,000
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	3	ea			$183.00	$518.00	$0	$0	$549	$1,554	$2,103
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	1	mo				$94.00	$0	$0	$0	$94	$94
3.2 Site Superintendent and QA/QC	10	day		$166.00	$420.00		$0	$1,660	$4,200	$0	$5,860
4 DECONTAMINATION											
4.1 Decontamination Services	0.5	mo		$1,220.00	$2,245.00	$1,550.00	$0	$610	$1,123	$775	$2,508
4.2 Temporary Equipment Decon Pad	1	ls		$1,500.00	$2,000.00	$300.00	$0	$1,500	$2,000	$300	$3,800
4.3 Decon Water	500	gal		$0.20			$0	$100	$0	$0	$100
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$780.00	$0	$0	$0	$780	$780
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$702.00	$0	$0	$0	$702	$702
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 MULCH BARRIERS EOS											
5.1 Inject Pumps	8	day				$500.00	$0	$0	$0	$4,000	$4,000
5.2 Site Labor (2 laborers)	16	day			$274.80		$0	$0	$4,397	$0	$4,397
5.3 EOS	68	drum		$840.00			$0	$57,120	$0	$0	$57,120
5.4 Water Tank Truck	8	day				$480.00	$0	$0	$0	$3,840	$3,840
5.5 Injection Water	24,677	gal		$0.20			$0	$4,935	$0	$0	$4,935
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	100	hr			$60.00		$0	$0	$6,000	$0	$6,000
Subtotal							$985	$65,925	$27,268	$12,045	$106,224
Overhead on Labor Cost @ 30%									$8,180		$8,180
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$99	$6,593	$2,727	$1,205	$10,622
Tax on Materials and Equipment Cost @ 6.25%								$4,120		$753	$4,873
Total Direct Cost							$1,084	$76,638	$38,176	$14,002	$129,900
Indirects on Total Direct Cost @ 25%											$32,475
Profit on Total Direct Cost @ 10%											$12,990
Subtotal											$175,365
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$175,365
Engineering on Total Field Cost @ 25%											$43,841
Contingency on Total Field Cost @ 25%											$43,841
TOTAL CAPITAL COST											**$263,047**

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Solvent Release Area
Alternative G-5A: Overburden and Bedrock Source Zone Enhanced Bioremediation, Two Overburden Mulch PRBs, Monitoring, Engineering Controls, and LUCs
Annual Cost

Item	Item Cost year 1	Item Cost years 2 - 3	Item Cost years 4 - 30	Item Cost every 5 years	Notes
Site Inspection: Visit	$2,350	$2,350	$2,350		One-day visit and report to verify LUC RI
Surface Water & Groundwater Sampling	$23,300	$11,650	$5,825		Labor and supplies to collect samples from 26 wells & four surface water samples, quarterly year 1, semi-annually years 2 & 3, annually years 4-3(
Analysis: Groundwater	$25,760	$12,880	$6,440		Analyze groundwater samples for PCE, TCE, Cis-1,2-DCE, VC, PCP, 3,3-DB, Arsenic, Barium, Iron, and Manganese
Analysis: Surface Water	$6,160	$3,080	$1,540		Analyze surface water samples for PCE, TCE, Cis-1,2-DCE, VC, PCB, Iron, & Manganese
Analysis: Sediment	$1,344	$672	$336		Analyze sediment samples for Iron and Manganes
Sampling Report	$48,000	$24,000	$12,000		
Five Year Site Review				$23,000	
Subtotal	$106,914	$54,632	$28,491	$23,000	
Contingency @ 10%	$10,691	$5,463	$2,849	$2,300	
TOTAL	**$117,605**	**$60,095**	**$31,340**	**$25,300**	

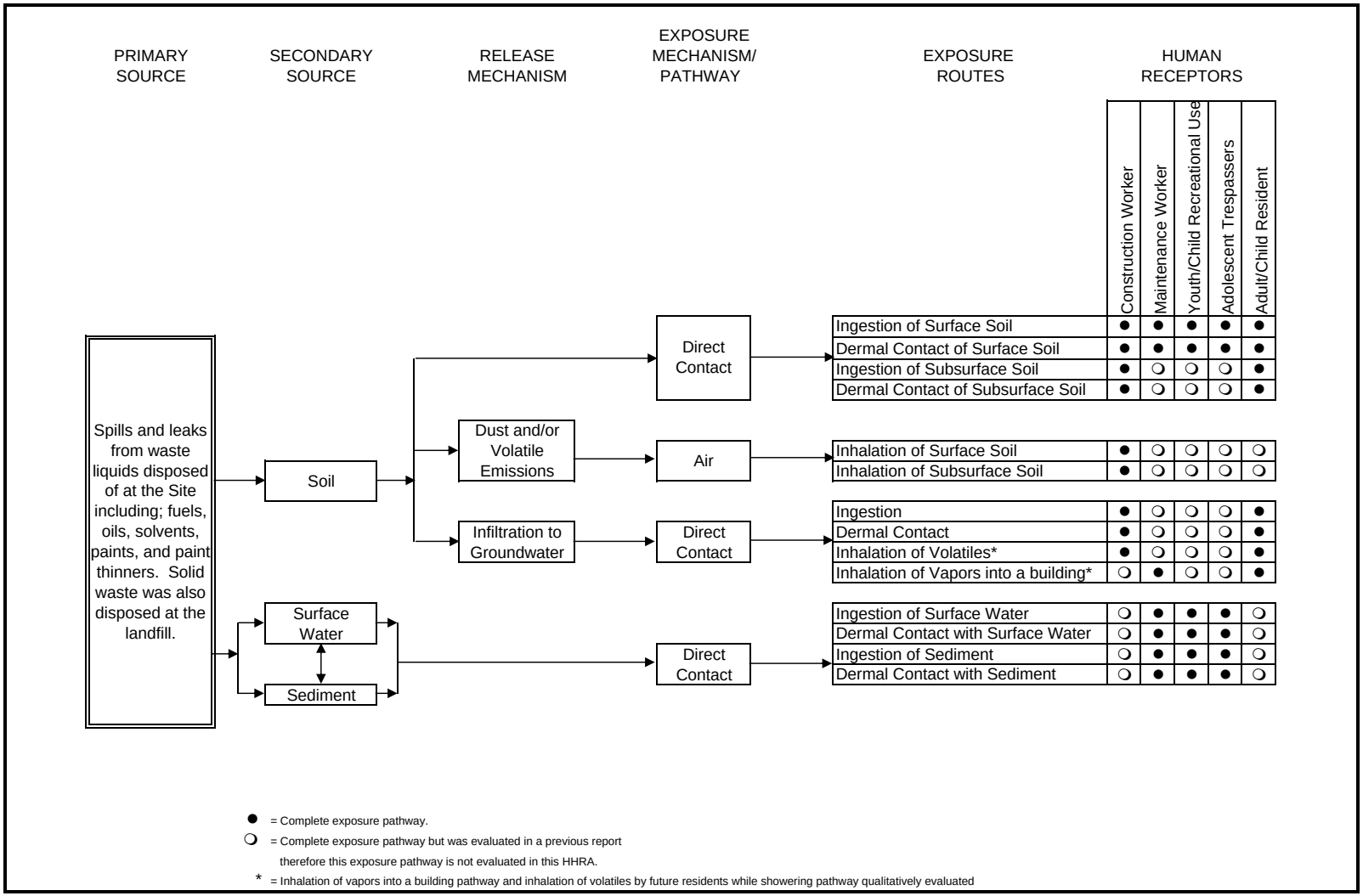
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
Solvent Release Area
Weymouth, MA
Alternative G-5A: Overburden and Bedrock Source Zone Enhanced Bioremediation, Two Overburden Mulch PRBs, Monitoring, Engineering Controls, and LUCs
Present Worth Analysis

Year	Capital Cost	Operation & Maintenance Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$1,782,745			$1,782,745	1.000	$1,782,745
1		$142,955	$117,605	$260,561	0.980	$255,452
2			$60,095	$60,095	0.961	$57,762
3		$142,955	$60,095	$203,051	0.942	$191,339
4			$31,340	$31,340	0.924	$28,953
5		$263,047	$56,640	$319,687	0.906	$289,550
6			$31,340	$31,340	0.888	$27,829
7			$31,340	$31,340	0.871	$27,283
8			$31,340	$31,340	0.853	$26,748
9			$31,340	$31,340	0.837	$26,224
10		$263,047	$56,640	$319,687	0.820	$262,255
11			$31,340	$31,340	0.804	$25,206
12			$31,340	$31,340	0.788	$24,711
13			$31,340	$31,340	0.773	$24,227
14			$31,340	$31,340	0.758	$23,752
15		$263,047	$56,640	$319,687	0.743	$237,532
16			$31,340	$31,340	0.728	$22,830
17			$31,340	$31,340	0.714	$22,382
18			$31,340	$31,340	0.700	$21,943
19			$31,340	$31,340	0.686	$21,513
20		$263,047	$56,640	$319,687	0.673	$215,140
21			$31,340	$31,340	0.660	$20,677
22			$31,340	$31,340	0.647	$20,272
23			$31,340	$31,340	0.634	$19,875
24			$31,340	$31,340	0.622	$19,485
25		$263,047	$56,640	$319,687	0.610	$194,859
26			$31,340	$31,340	0.598	$18,728
27			$31,340	$31,340	0.586	$18,361
28			$31,340	$31,340	0.574	$18,001
29			$31,340	$31,340	0.563	$17,648
30		$263,047	$56,640	$319,687	0.552	$176,490
				TOTAL PRESENT WORTH		**$4,139,772**

Appendix C
Human Health Risk Assessment Summary Tables

FIGURE C-1

CONCEPTUAL SITE MODEL
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS



● = Complete exposure pathway.

❍ = Complete exposure pathway but was evaluated in a previous report therefore this exposure pathway is not evaluated in this HHRA.

* = Inhalation of vapors into a building pathway and inhalation of volatiles by future residents while showering pathway qualitatively evaluated

TABLE C-1
EXPOSURE POINT CONCENTRATION SUMMARY FROM THE HHRA
REASONABLE MAXIMUM EXPOSURE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Solvent Release Area	Benzo(a)pyrene Equivalents	mg/kg	0.054	0.12 (G)	0.27 J	0.12	mg/kg	95% KM (Chebyshev) UCL	ProUCL 4.00.04
	Bis(2-ethylhexyl)phthalate	mg/kg	7.2	75 (NP)	150	75	mg/kg	99% KM (Chebyshev) UCL	ProUCL 4.00.04
	Aroclor-1260	mg/kg	0.027	0.061 (N)	0.27	0.061	mg/kg	95% KM (t) UCL	ProUCL 4.00.04
	Arsenic	mg/kg	1.3	1.6 (G)	3.58 J	1.6	mg/kg	Use 95% Approximate Gamma UCL	ProUCL 4.00.04
	Chromium	mg/kg	8.4	9.4 (N)	15	9.4	mg/kg	Use 95% Student's-t UCL	ProUCL 4.00.04
	Manganese (Soil)	mg/kg	156	200 (G)	369 J	200	mg/kg	Use 95% Approximate Gamma UCL	ProUCL 4.00.04

For non-detects, the sample quantitation limit was used as the input concentration.
G = Gamma
N = Normal
NP = Non-parametric

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE C-2
EXPOSURE POINT CONCENTRATION SUMMARY FROM THE HHRA
REASONABLE MAXIMUM EXPOSURE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Solvent Release Area	Tetrachloroethene	mg/kg	0.1	0.1 (G)	1.2 J	0.1	mg/kg	95% KM (BCA) UCL	ProUCL 4.00.04
	Benzo(a)pyrene Equivalents	mg/kg	0.020	0.037 (G)	0.42 J	0.037	mg/kg	95% KM (t) UCL	ProUCL 4.00.04
	Arsenic	mg/kg	1.2	1.3 (G)	3.5	1.3	mg/kg	Use 95% Approximate Gamma UCL	ProUCL 4.00.04
	Chromium	mg/kg	7.9	8.7 (N)	17	8.7	mg/kg	Use 95% Student's-t UCL	ProUCL 4.00.04
	Manganese (Soil)	mg/kg	237	263 (L)	588 J	263	mg/kg	Use 95% Student's-t UCL	ProUCL 4.00.04

For non-detects, the sample quantitation limit was used as an input concentration.
G = Gamma
L = Lognormal
N = Normal

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE C-3
EXPOSURE POINT CONCENTRATION SUMMARY FROM THE HHRA
REASONABLE MAXIMUM EXPOSURE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Solvent Release Area	Benzene	ug/L	9.8	0.19 (L)	0.55	0.55	ug/L	Maximum Detected Concentration	(1)
	Chloroform	ug/L	9.8	0.13 (N)	0.42	0.42	ug/L	Maximum Detected Concentration	(1)
	cis-1,2-Dichloroethene	ug/L	34.4	64.6 (G)	785	785	ug/L	Maximum Detected Concentration	(1)
	Tetrachloroethene	ug/L	1200	2041 (G)	16000	16000	ug/L	Maximum Detected Concentration	(1)
	Trichloroethene	ug/L	14	8.4 (G)	59 J	59	ug/L	Maximum Detected Concentration	(1)
	Vinyl chloride	ug/L	10	0.23 (N)	0.58	0.58	ug/L	Maximum Detected Concentration	(1)
	3,3'-Dichlorobenzidine	ug/L	0.2	NA	3	3	ug/L	Maximum Detected Concentration	(1)
	Naphthalene	ug/L	0.074	0.12 (N)	0.22	0.22	ug/L	Maximum Detected Concentration	(1)
	Pentachlorophenol	ug/L	2.0	0.33 (N)	1.8 J	1.8	ug/L	Maximum Detected Concentration	(1)
	Arsenic	ug/L	0.93	1.4 (G)	5.5	5.5	ug/L	Maximum Detected Concentration	(1)
	Barium	ug/L	173	975 (NP)	4620	4620	ug/L	Maximum Detected Concentration	(1)
	Manganese (Water)	ug/L	307	1850 (L)	1850	1850	ug/L	Maximum Detected Concentration	(1)
	Selenium	ug/L	2.3	6.0 (N)	30	30	ug/L	Maximum Detected Concentration	(1)
	Vanadium	ug/L	1.9	6.0 (NP)	22.6 J	22.6	ug/L	Maximum Detected Concentration	(1)

For non-detects, the sample quantitation limit was used as the input concentration.
G = Gamma
L = Lognormal
N = Normal
NP = Nonparametric

1 - The maximum detected concentration is used as the exposure point concentration for groundwater.

TABLE C-4
EXPOSURE POINT CONCENTRATION SUMMARY FROM THE HHRA
REASONABLE MAXIMUM EXPOSURE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Solvent Release Area	Tetrachloroethene	ug/L	6.9	20 (G)	28	20	mg/kg	95% KM (Chebyshev) UCL	ProUCL 4.00.04
	Trichloroethene	mg/kg	2.0	4.6 (N)	11.5	4.6	mg/kg	95% KM (t) UCL	ProUCL 4.00.04
	Vinyl chloride	mg/kg	0.36	NA	1.2	1.2	mg/kg	Maximum Concentration	Only 2 detections[(1)]
	Benzo(a)pyrene Equivalents	mg/kg	NA	NA	0.26 J	0.26	mg/kg	Maximum Concentration	Only 1 detection[(1)]
	Aroclor-1248	mg/kg	NA	NA	0.34 J	0.34	mg/kg	Maximum Concentration	Only 1 detection[(1)]
	Arsenic	mg/kg	0.332	0.469 (G)	0.868 J	0.469	mg/kg	95% KM (BCA) UCL	ProUCL 4.00.04
	Chromium	mg/kg	0.934	1.06 (N)	1.36	1.06	mg/kg	95% KM (t) UCL	ProUCL 4.00.04
	Manganese (Water)	mg/kg	180	261 (N)	434	261	mg/kg	Use 95% Student's-t UCL	ProUCL 4.00.04

For non-detects, the sample quantitation limit was used as an input concentration.
1 - The maximum concentration is used as the exposure point concentration if there are less than 3 positive detections.
G = Gamma
N = Normal
NP = Non-parametric

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE C-5
EXPOSURE POINT CONCENTRATION SUMMARY FROM THE HHRA
REASONABLE MAXIMUM EXPOSURE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Solvent Release Area	Benzo(a)pyrene Equivalents	mg/kg	0.22	0.46 (G)	0.94 J	0.46	mg/kg	Use 95% Approximate Gamma UCL	ProUCL 4.00.04
	Aroclor-1260	mg/kg	0.20	1.1 (L)	1.5	1.1	mg/kg	97.5% KM (Chebyshev) UCL	ProUCL 4.00.04
	Arsenic	mg/kg	1.25	1.6 (G)	2.32	1.60	mg/kg	Use 95% Approximate Gamma UCL	ProUCL 4.00.04
	Manganese (Soil)	mg/kg	138	178 (NP)	299 J	178	mg/kg	or 95% Modified-t UCL	ProUCL 4.00.04

For non-detects the sample quantitation limit was used as an input concentration.
G = Gamma
L = Lognormal
NP = Non-parmetric
J - Estimated value.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE C-6

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CONSTRUCTION WORKER - SOIL

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Worker	Adult	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	330	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 2002b	BW x AT
				EF	Exposure Frequency	130	days/year	(1)	
				ED1	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal	Construction Worker	Adult	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	5,729	cm2	USEPA, 1997	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.13	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	130	days/year	(1)	
				ED1	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes:

1 - Professional judgment.

2 - Assumes 50th percentile value for surface area of hands, forearms, lower legs, feet for adult. Tables 6-2 and 6-3.

3 - Adherence factor calculated in Table 5-3.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 2002a:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake = 2.40E-08 Cancer Dermal Intake = 5.41E-08

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.68E-06 Noncancer Dermal Intake = 3.79E-06

TABLE C-7

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CONSTRUCTION WORKER - SOIL TO AIR

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Worker	Adult	SRA	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m3) =
				Cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	130	days/year	(1)(2)	AT x 24 hours/day
				ED	Exposure Duration	1	years	(1)	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.50E+06	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	14.31	g/m2-s per kg/m3	USEPA, 2002a	
				F_D	dispersion correction factor	0.185	unitless	USEPA, 2002a	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	EPA, 1996	
				Um	Mean annual windspeed	3.4	m/sec	EPA, 1985 (3)	
				V	Fraction of vegetative cover	0.5	unitless	EPA, 1996	
				F(x)	Function dependent of Um/Ut	0.0072	unitless	EPA, 1985	

Notes:

1 - Professional judgment.

2 - 5 days per week for 6 months

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Carcinogenic Chemicals	Noncarcinogenic Chemicals
Cancer Inhalation Intake = 1.70E-03	Noncancer Inhalation Intake = 1.19E-01
0.00E+00	

TABLE C-8

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CONSTRUCTION WORKER - GROUNDWATER

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Worker	Adult	SRA	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	ug/L	USEPA, 1992	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	USEPA, 1991	
				IR-GW	Ingestion Rate of Groundwater	0.01	L/day	(1)	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	65	days/year	(2)	BW x AT
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal	Construction Worker	Adult	SRA	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				t	Lag time	Chemical Specific	hr/event	USEPA, 2004	See text for calculation of DAevent.
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	
				SA	Skin Surface Available for Contact	5,729	cm2	USEPA, 1997	
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	65	days/year	(2)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

2 - 2.5 days/week, 6 months per year.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1997. Exposure Factors Handbook. Volume I. EPA 600/P-95/002Fa. August, 1997. 50th percentile value for surface area of hands, forearms, lower legs, feet for adult. Tables 6-2 and 6-3.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED x CF)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake = 3.63E-10 Cancer Dermal Intake = 2.08E-01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.54E-08 Noncancer Dermal Intake = 1.46E+01

TABLE C-9

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CONSTRUCTION WORKER - GROUNDWATER TO AIR

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Worker	Adult	SRA	CA	Chemical concentration in air	Calculated	mg/m3	VDEQ, 2004	Exposure Concentration (mg/m3) =
				CW	Chemical concentration in water.	Maximum	ug/L	--	
				CF	Conversion Factor	0.001	mg/ug	--	CA x ET x EF x ED
				ET	Exposure Time	2	hours/day	(1)	AT x 24 hours/day
				EF	Exposure Frequency	65	days/year	(1)(2)	
				ED	Exposure Duration	1	years	(1)	CA = CW x CF x VF
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
				VF	Volatilization Factor	Calculated	(mg/m3)/(mg/L)	VDEQ, 2004	

Notes:

1 - Professional judgment.

2 - 2.55 days per week for 6 months/year.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

Unit Intake Calculations

Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Carcinogenic Chemicals	Noncarcinogenic Chemicals
Cancer Inhalation Intake = 2.12E-04	Noncancer Inhalation Intake = 1.48E-02

TABLE C-10

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - MAINTENANCE WORKER - SOIL

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Maintenance Worker	Adult	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 2002b	BW x AT
				EF	Exposure Frequency	250	days/year	(1)	
				ED1	Exposure Duration	25	years	(1) USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
Dermal	Maintenance Worker	Adult	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3,300	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.20	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	250	days/year	(1)	
				ED1	Exposure Duration	25	years	(1) USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	

1 - Professional judgement. Consistent with values used for other sites at NAS South Weymouth.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991. Human Health Evaluation Manual. Supplemental Guidance: "Standard Default Exposure Factors."

USEPA, 2002a:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake = 3.49E-07 Cancer Dermal Intake = 2.31E-06

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 9.78E-07 Noncancer Dermal Intake = 6.46E-06

TABLE C-11

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - MAINTENANCE WORKER - SURFACE WATER

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Maintenance Worker	Adult	SRA	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	(3)	
				CF	Conversion factor	0.001	ug/mg	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	12	events/year	(1)	BW x AT
				ED	Exposure Duration	25	years	(1) USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
Dermal	Maintenance Worker	Adult	SRA	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3,300	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	12	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	25	years	(1) USEPA, 1991	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	

Notes:

1 - Best professional judgment. Exposure frequency or exposure time is consistent with assumptions for other sites at NAS South Weymouth.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, INDUSTRIAL WORKERS will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Assumed exposure to 1/5 the amount assumed for swimming in Risk Assessment Guidance for Superfund, Vol. I. Human Health Evaluation Manual (Part A). U.S. EPA, 1989.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991. Human Health Evaluation Manual. Supplemental Guidance: "Standard Default Exposure Factors."

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake = 3.35E-09 Cancer Dermal Intake = 5.54E-01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 9.39E-09 Noncancer Dermal Intake = 1.55E+00

TABLE C-12

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - MAINTENANCE WORKER - SEDIMENT

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Maintenance Worker	Adult	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	(3)	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	12	days/year	(1)	
				ED	Exposure Duration	25	years	(1) USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
Dermal	Maintenance Worker	Adult	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3,300	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	(4)	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	12	days/year	(1)	
				ED	Exposure Duration	25	years	(1) USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	

Notes:

1 - Professional judgment. Assume two days a week in warm weather months for RME and one day a week for CTE.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, INDUSTRIAL WORKERS will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Assumed to be one-half soil ingestion rate.

4 - Soil adherence factor used for sediment.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake = 8.39E-09 Cancer Dermal Intake re Duration = 1.11E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.35E-08 Noncancer Dermal Intake = 3.10E-07

TABLE C-13

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - ADOLESCENT TRESPASSER - SOIL

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespasser	Adolescent	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	39	days/year	(1)	
				ED1	Exposure Duration	10	years	(2)	
				BW	Body Weight	39	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
Dermal	Trespasser	Adolescent	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	4,184	cm2	(3)	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.05	mg/cm2/event	(4) USEPA, 1997	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	39	days/year	(1)	
				ED1	Exposure Duration	10	years	(2)	
				BW	Body Weight	39	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	

Notes:

For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

1 - Assume one day a week nine months of the year for RME; values are consistent with those used at other sites at NAS South Wyemouth.

2 - Best professional judgment. Exposure frequency or exposure time is consistent with assumptions for other sites

3 - Assumes head, hands, forearms, lower legs, and feet are exposed.

4 - Calculated in the Work Plan.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake = 3.91E-08 Cancer Dermal Intake = 8.19E-08

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.74E-07 Noncancer Dermal Intake = 5.73E-07

TABLE C-14

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - ADOLESCENT TRESPASSER - SURFACE WATER

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespasser	Adolescent	SRA	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	(3) USEPA, 1989	
				CF	Conversion factor	0.001	ug/mg	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	39	events/year	(1)	BW x AT
				ED	Exposure Duration	10	years	1)(2), USEPA, 1989, 2005	
				BW	Body Weight	39	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
Dermal	Trespasser	Adolescent	SRA	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(4)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	4,184	cm2	USEPA, 1997	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	39	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	10	years	1)(2), USEPA, 1989, 200	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	39	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	

Notes:

1 - Assume one day a week nine months of the year for RME; values are consistent with those used at other sites at NAS South Wyemouth.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adolescent trespassers will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Assumed exposure to 1/5 the amount assumed for swimming.

4 - Best professional judgement.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake = 7.83E-09 Cancer Dermal Intake = 1.64E+00

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 5.48E-08 Noncancer Dermal Intake = 1.15E+01

TABLE C-15

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - ADOLESCENT TRESPASSER - SEDIMENT

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespasser	Adolescent	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	(3)	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	39	days/year	(1)	
				ED	Exposure Duration	10	years	(1)	
				BW	Body Weight	39	kg	(5) USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
Dermal	Trespasser	Adolescent	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	4,184	cm2	(4) USEPA, 1997	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	39	days/year	(1)	
				ED	Exposure Duration	10	years	(1)	
				BW	Body Weight	39	kg	(5) USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	

Notes:

1 - Professional judgment. Consistent with values used for other sites at NAS South Weymouth.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adolescent trespassers will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Assumed to be 1/2 RME soil ingestion rate.

4 - Assumed hands, forearms, lower legs, and feet of 6 to <16 year old.

5 - 50th percentile body weight for 6-16 year old, Table 7-3, U.S. EPA, 1997a.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake = 1.96E-08 Cancer Dermal Intake re Duration = 3.28E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.37E-07 Noncancer Dermal Intake = 2.29E-06

TABLE C-16

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CHILD RECREATIONAL USER - SOIL

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1994	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	104	days/year	(1)(2)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Recreational User	Child	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.20	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	104	days/year	(2)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Best professional judgement.

2 - Assume two days a week for 9 months.

3 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 1994. U.S. EPA Region I Risk Update. August 1994.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 1.09E-07 Cancer Dermal Intake (Age 0 - 2) = 3.04E-07

Cancer Ingestion Intake (Age 2 - 6) = 2.17E-07 Cancer Dermal Intake (Age 2 - 6) = 6.08E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 3.80E-06 Noncancer Dermal Intake = 1.06E-05

TABLE C-17

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CHILD RECREATIONAL USER - SURFACE WATER

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	SRA	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hr	(4)	
				CF	Conversion factor	0.001	ug/mg	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	104	events/year	(3)	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Recreational User	Child	SRA	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(3)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	104	days/year	(3)	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1994, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1994, 2005	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Professional judgment.

2 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Exposure frequency or exposure time consistent with assumptions used for other NAS South Weymouth sites for residents exposed to sediment and surface water.

4 - Assumed exposure to 1/5 the amount assumed for swimming in (U.S. EPA 1989. Risk Assessment Guidance for Superfund, Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 1994. U.S. EPA Region I Risk Update. August 1994.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 1.09E-08 Cancer Dermal Intake (Age 0 - 2) = 1.52E+00

Cancer Ingestion Intake (Age 2 - 6) = 2.17E-08 Cancer Dermal Intake (Age 2 - 6) = 3.04E+00

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 3.80E-07 Noncancer Dermal Intake = 5.32E+01

TABLE C-18

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CHILD RECREATIONAL USER - SEDIMENT

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	(4)	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	104	days/year	(3)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Recreational User	Child	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	104	days/year	(3)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Professional judgment.

2 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Exposure frequency or exposure time consistent with assumptions used for other NAS South Weymouth sites for residents exposed to sediment and surface water.

4 - One-half soil ingestion rate.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 1994. U.S. EPA Region I Risk Update. August 1994.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 5.43E-08 Cancer Dermal Intake (Age 0 - 2) = 3.04E-07

Cancer Ingestion Intake (Age 0 - 2) = 1.09E-07 Cancer Dermal Intake (Age 2 - 6) = 6.08E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.90E-06 Noncancer Dermal Intake = 1.06E-05

TABLE C-19

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - ADULT RECREATIONAL USER - SOIL

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1994	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	39	days/year	(1)(2)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(3), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(3), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Recreational User	Adult	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	39	days/year	(1)(2)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(3), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(3), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Best professional judgement.

2 - Assume one day a week for 9 months.

3 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994. U.S. EPA Region I Risk Update. August 1994.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 2.18E-08 Cancer Dermal Intake (Age 6 - 16) = 8.70E-08

Cancer Ingestion Intake Age 16 - 30) = 3.05E-08 Cancer Dermal Intake (Age 16 - 30) = 1.22E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.53E-07 Noncancer Dermal Intake = 6.09E-07

TABLE C-20

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - ADULT RECREATIONAL USER - SURFACE WATER

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	SRA	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	(3)	
				CF	Conversion factor	0.001	ug/mg	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	12	events/year	(1)	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Recreational User	Adult	SRA	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	12	days/year	(1)	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1994, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1994, 2005	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Exposure frequency or exposure time consistent with assumptions used for other NAS South Weymouth sites.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Assumed exposure to 1/5 the amount assumed for swimming in (U.S. EPA 1989. Risk Assessment Guidance for Superfund, Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994. U.S. EPA Region I Risk Update. August 1994.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.34E-09 Cancer Dermal Intake (Age 6 - 16) = 3.82E-01

Cancer Ingestion Intake (Age 16 - 30) = 1.88E-09 Cancer Dermal Intake (Age 16 - 30) = 5.35E-01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 9.39E-09 Noncancer Dermal Intake = 2.68E+00

TABLE C-21

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - ADULT RECREATIONAL USER - SEDIMENT

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	(3)	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	12	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Recreational User	Adult	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	12	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Exposure frequency or exposure time consistent with assumptions used for other NAS South Weymouth sites.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - One-half soil ingestion rate.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994. U.S. EPA Region I Risk Update. August 1994.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 3.35E-09 Cancer Dermal Intake (Age 6 - 16) = 7.65E-08

Cancer Ingestion Intake (Age 6 - 16) = 4.70E-09 Cancer Dermal Intake (Age 16 - 30) = 1.07E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.35E-08 Noncancer Dermal Intake = 5.35E-07

TABLE C-22

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENT - SOIL

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1994	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.20	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 2002a:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 3.65E-07 Cancer Dermal Intake (Age 0 - 2) = 1.02E-06

Cancer Ingestion Intake (Age 2 - 6) = 7.31E-07 Cancer Dermal Intake (Age 2 - 6) = 2.05E-06

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.28E-05 Noncancer Dermal Intake = 3.58E-05

TABLE C-23

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENT - GROUNDWATER

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SRA	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002a	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	1.5	L/day	USEPA, 1997	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 1991	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	SRA	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				t	Lag time	Chemical Specific	hr/event	USEPA, 2004	See text for calculation of DAevent.
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	
				tevent	Duration of event	1	hr/event	USEPA, 2004	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	
				SA	Skin Surface Available for Contact	6,600	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1994	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa

USEPA, 2002:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED x CF)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 2.74E-06 Cancer Dermal Intake (Age 0 - 2) = 1.21E+01

Cancer Ingestion Intake (Age 2 - 6) = 5.48E-06 Cancer Dermal Intake (Age 2 - 6) = 2.41E+01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 9.59E-05 Noncancer Dermal Intake = 4.22E+02

TABLE C-24

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENT - SURFACE WATER

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SRA	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hr	(2)	
				CF	Conversion factor	0.001	ug/mg	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	104	events/year	(1)	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	SRA	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	104	days/year	(1)	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 1994, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 1994, 2005	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Exposure frequency or exposure time consistent with assumptions used for other NAS South Weymouth sites.

2 - Assumed exposure to 1/5 the amount assumed for swimming in (U.S. EPA 1989. Risk Assessment Guidance for Superfund, Volume 1. Human Health Evaluation Manual (Part A).

3 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 1.09E-08 Cancer Dermal Intake (Age 0 - 2) = 1.52E+00

Cancer Ingestion Intake (Age 2 - 6) = 2.17E-08 Cancer Dermal Intake (Age 2 - 6) = 3.04E+00

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 3.80E-07 Noncancer Dermal Intake = 5.32E+01

TABLE C-25

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - CHILD RESIDENT - SEDIMENT

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	(3)	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	104	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	104	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Exposure frequency or exposure time consistent with assumptions used for other NAS South Weymouth sites.

2 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - One-half soil ingestion rate.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 5.43E-08 Cancer Dermal Intake (Age 0 - 2) = 3.04E-07

Cancer Ingestion Intake (Age 0 - 2) = 1.09E-07 Cancer Dermal Intake (Age 2 - 6) = 6.08E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.90E-06 Noncancer Dermal Intake = 1.06E-05

TABLE C-26

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENT - SOIL

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1994	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	SRA	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.96E-07 Cancer Dermal Intake (Age 6 - 16) = 7.81E-07

Cancer Ingestion Intake Age 16 - 30) = 2.74E-07 Cancer Dermal Intake (Age 16 - 30) = 1.09E-06

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.37E-06 Noncancer Dermal Intake = 5.47E-06

TABLE C-27

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENT - GROUNDWATER

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SRA	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	2	L/day	USEPA, 1991	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 1991	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	SRA	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				t	Lag time	Chemical Specific	hr/event	USEPA, 2004	See text for calculation of DAevent.
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	
				tevent	Duration of event	0.58	hr/event	USEPA, 2004	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	
				SA	Skin Surface Available for Contact	18,000	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED x CF)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 3.91E-06 Cancer Dermal Intake (Age 6 - 16) = 3.52E+01

Cancer Ingestion Intake Age 16 - 30) = 5.48E-06 Cancer Dermal Intake (Age 16 - 30) = 4.93E+01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.74E-05 Noncancer Dermal Intake = 2.47E+02

TABLE C-28

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENT - SURFACE WATER

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SRA	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	(3)	
				CF	Conversion factor	0.001	ug/mg	- -	
				ET	Exposure Time	2	hours/event	(1)	CW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	12	events/year	(1)	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	SRA	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	12	days/year	(1)	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1994, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1994, 2005	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Exposure frequency or exposure time consistent with assumptions used for other NAS South Weymouth sites.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult residents will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - Assumed exposure to 1/5 the amount assumed for swimming in (U.S. EPA 1989. Risk Assessment Guidance for Superfund, Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.34E-09 Cancer Dermal Intake (Age 6 - 16) = 3.82E-01

Cancer Ingestion Intake (Age 16 - 30) = 1.88E-09 Cancer Dermal Intake (Age 16 - 30) = 5.35E-01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 9.39E-09 Noncancer Dermal Intake = 2.68E+00

TABLE C-29

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURES - ADULT RESIDENT - SEDIMENT

NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	(3)	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	Cs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	12	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	SRA	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	12	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 1994, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(2), USEPA, 1994, 2005	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Exposure frequency or exposure time consistent with assumptions used for other NAS South Weymouth sites.

2 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult residents will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

3 - One-half soil ingestion rate.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1994: USEPA Region I Risk Updates, August 1994.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Carcinogenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 3.35E-09 Cancer Dermal Intake (Age 6 - 16) = 7.65E-08

Cancer Ingestion Intake (Age 6 - 16) = 4.70E-09 Cancer Dermal Intake (Age 16 - 30) = 1.07E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.35E-08 Noncancer Dermal Intake = 5.35E-07

TABLE C-30
CANCER TOXICITY DATA -- ORAL/DERMAL
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source	Date
Volatile Organic Compounds								
BENZENE	5.5E-02	$(mg/kg/day)^{-1}$	1	5.5E-02	$(mg/kg/day)^{-1}$	A	IRIS	1/2010
CHLOROFORM	3.1E-02	$(mg/kg/day)^{-1}$	1	3.1E-02	$(mg/kg/day)^{-1}$	B1	Cal EPA[1]	12/2009
CIS-1,2-DICHLOROETHENE	NA	NA	NA	NA	NA	D	IRIS	1/2010
TETRACHLOROETHENE	5.4E-01	$(mg/kg/day)^{-1}$	1	5.4E-01	$(mg/kg/day)^{-1}$	NA	EPA[2]	6/12/2003
TRICHLOROETHENE	5.9E-03	$(mg/kg/day)^{-1}$	1	5.9E-03	$(mg/kg/day)^{-1}$	B1	Cal EPA[2]	12/2002
VINLY CHLORIDE (Adult)	7.2E-01	$(mg/kg/day)^{-1}$	1	7.2E-01	$(mg/kg/day)^{-1}$	A	IRIS	1/2010
VINYL CHLORIDE (Early Life)	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	1/2010
Semivolatile Organic Compounds								
3,3'-DICHLOROBENZIDINE	4.5E-01	$(mg/kg/day)^{-1}$	1	4.5E-01	$(mg/kg/day)^{-1}$	B2	IRIS	1/2010
BENZO(A)PYRENE EQUIVALENTS[3]	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	1/2010
BENZO(A)ANTHRACENE[3]	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	EPA[1]	7/1993
BENZO(A)PYRENE[3]	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	1/2010
BENZO(B)FLUORANTHENE[3]	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	EPA[1]	7/1993
BENZO(K)FLUORANTHENE[3]	7.3E-02	$(mg/kg/day)^{-1}$	1	7.3E-02	$(mg/kg/day)^{-1}$	B2	EPA[1]	7/1993
BIS(2-ETHYLHEXYL)PHTHALATE	1.4E-02	$(mg/kg/day)^{-1}$	1	1.4E-02	$(mg/kg/day)^{-1}$	B2	IRIS	1/2010
DIBENZO(A,H)ANTHRACENE[3]	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2	EPA[1]	7/1993
INDENO(1,2,3-CD)PYRENE[3]	7.3E-01	$(mg/kg/day)^{-1}$	1	7.3E-01	$(mg/kg/day)^{-1}$	B2	EPA[1]	7/1993
NAPHTHALENE	NA	NA	NA	NA	NA	C	IRIS	1/2010
PENTACHLOROPHENOL	1.2E-01	$(mg/kg/day)^{-1}$	1	1.2E-01	$(mg/kg/day)^{-1}$	B2	IRIS	1/2010
Pesticides/PCBs								
AROCLOR 1248	2.0E+00	$(mg/kg/day)^{-1}$	1	2.0E+00	$(mg/kg/day)^{-1}$	B2	EPA[2]	9/1996
AROCLOR 1260	2.0E+00	$(mg/kg/day)^{-1}$	1	2.0E+00	$(mg/kg/day)^{-1}$	B2	EPA[2]	9/1996
Inorganics								
ARSENIC	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	1/2010
BARIUM	NA	NA	NA	NA	NA	D	IRIS	1/2010
CHROMIUM[4]	5.0E-01	$(mg/kg/day)^{-1}$	1	5.0E-01	$(mg/kg/day)^{-1}$	D	IRIS	1/2010
MANGANESE	NA	NA	NA	NA	NA	D	IRIS	6/2008
SELENIUM	NA	NA	NA	NA	NA	D	IRIS	1/2010
VANADIUM	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

1 - USEPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment), Final EPA15401R1991005

2 - Adjusted dermal cancer slope factor = oral cancer slope factor/oral absorption efficiency for dermal

3 - The carcinogenic PAHs are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

4 - Values are for hexavalent chromium.

EPA Group:

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .

C - Possible human carcinogen.

D - Not classifiable as a human carcinogen.

E - Evidence of noncarcinogenicity.

Definitions:

IRIS = Integrated Risk Information System.

NA = Not Available.

Cal EPA(1) = California EPA

Cal EPA(2) = California EPA, Technical Support Document for Describing Available Cancer Potency Factors, December 2002.

NA = Not Available.

EPA(1) = U.S. EPA, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, July 1993, EPA/600/R-93/089.

EPA(2) = USEPA, PCBs: Cancer Dose-Response Assessment and Applications to Environmental Mixtures, September 1996, EPA/600/P-96/001F

TABLE C-31
CANCER TOXICITY DATA - INHALATION
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source	Date
Volatile Organic Compounds							
BENZENE	7.8E-06	$(ug/m^3)^{-1}$	2.7E-02	$(mg/kg/day)^{-1}$	A	IRIS	1/2010
CHLOROFORM	2.30E-05	$(ug/m^3)^{-1}$	8.1E-02	$(mg/kg/day)^{-1}$	B2	IRIS	1/2010
CIS-1,2-DICHLOROETHENE	NA	NA	NA	NA	D	IRIS	1/2010
TETRACHLOROETHENE	5.9E-06	$(ug/m^3)^{-1}$	2.1E-02	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
TRICHLOROETHENE	2.0E-06	$(ug/m^3)^{-1}$	7.0E-03	(mg/kg/day)-1	B1	Cal EPA	12/2002
VINLY CHLORIDE (Early life)	8.8E-06	$(ug/m^3)^{-1}$	3.1E-02	$(mg/kg/day)^{-1}$	A	IRIS	1/2010
VINYL CHLORIDE (Adult)	4.4E-06	$(ug/m^3)^{-1}$	1.5E-02	$(mg/kg/day)^{-1}$	A	IRIS	1/2010
Semivolatile Organic Compounds							
3,3'-DICHLOROBENZIDINE	3.4E-04	$(ug/m^3)^{-1}$	1.2E+00	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
BENZO(A)PYRENE EQUIVALENTS[2]	1.1E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
BENZO(A)ANTHRACENE[2]	1.1E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
BENZO(A)PYRENE[2]	1.1E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
BENZO(B)FLUORANTHENE[2]	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
BENZO(K)FLUORANTHENE[2]	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
BIS(2-ETHYLHEXYL)PHTHALATE	2.4E-06	$(ug/m^3)^{-1}$	8.4E-03	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
DIBENZO(A,H)ANTHRACENE[2]	1.2E-03	$(ug/m^3)^{-1}$	4.2E+00	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
INDENO(1,2,3-CD)PYRENE[2]	1.1E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
NAPHTHALENE	3.4E-05	$(ug/m^3)^{-1}$	1.2E-01	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
PENTACHLOROPHENOL	5.1E-06	$(ug/m^3)^{-1}$	1.8E-02	$(mg/kg/day)^{-1}$	NA	Cal EPA	12/2009
Pesticides/PCBs							
AROCLOR 1248	5.7E-04	$(ug/m^3)^{-1}$	2.0E+00	$(mg/kg/day)^{-1}$	B2	EPA[1]	9/1996
AROCLOR 1260	5.7E-04	$(ug/m^3)^{-1}$	2.0E+00	$(mg/kg/day)^{-1}$	B2	EPA[1]	9/1996
Inorganics							
ARSENIC	4.3E-03	$(ug/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A	IRIS	1/2010
BARIUM	NA	NA	NA	NA	NA	NA	NA
CHROMIUM[3]	8.4E-02	$(ug/m^3)^{-1}$	2.9E+02	$(mg/kg/day)^{-1}$	A	IRIS	1/2010
MANGANESE	NA	NA	NA	NA	D	IRIS	1/2010
SELENIUM	NA	NA	NA	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA	NA	NA	NA

1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

2 - The carcinogenic PAHs are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

3 - Values are for hexavalent chromium.

Definitions:

IRIS = Integrated Risk Information System.

HEAST= Health Effects Assessment Summary Tables

USEPA(1) = USEPA, PCBs: Cancer Dose-Response Assessment and Applications to Environmental Mixtures, September 1996, EPA/600/P-96/001F.

Cal EPA = California EPA

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .

C - Possible human carcinogen.

D - Not classifiable as a human carcinogen.

E - Evidence of noncarcinogenicity.

TABLE C-32
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH MASSACHUSETTS

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source	Date
Volatile Organic Compounds										
BENZENE	Chronic	4.0E-03	mg/kg/day	1	4.0E-03	mg/kg/day	Blood	300/1	IRIS	1/2010
CHLOROFORM	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000/1	IRIS	1/2010
CIS-1,2-DICHLOROETHENE	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Blood	3000	PPRTV	3/2006
TETRACHLOROETHENE	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000/1	IRIS	1/2010
TRICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VINYL CHLORIDE	Chronic	3.0E-03	mg/kg/day	1	3.0E-03	mg/kg/day	Liver	30/1	IRIS	1/2010
Semivolatile Organic Compounds										
3,3'-DICHLOROBENZIDINE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE EQUIVALENTS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000/1	IRIS	1/2010
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight	3000/1	IRIS	1/2010
PENTACHLOROPHENOL	Chronic	3.0E-02	mg/kg/day	1	3.0E-02	mg/kg/day	Liver/Kidney	100/1	IRIS	1/2010
Pesticides/PCBs										
AROCLOR 1248	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR 1260	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics										
ARSENIC	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRIS	1/2010
BARIUM	Chronic	2.0E-01	mg/kg/day	0.07	1.4E-02	mg/kg/day	Kidney	300/1	IRIS	1/2010
CHROMIUM[3]	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	Fetotoxicity, GS, Bone	300/3	IRIS	1/2010
MANGANESE (DIET)	Chronic	1.4E-01	mg/kg/day	1	1.4E-01	mg/kg/day	CNS	1/3	IRIS	1/2010
MANGANESE (WATER)	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	CNS	1/3	IRIS	1/2010
SELENIUM	Chronic	5.0E-03	mg/kg/day	1	5.0E-03	mg/kg/day	Hair Loss, Skin, CNS	3/1	IRIS	1/2010
VANADIUM	Chronic	7.0E-05	mg/kg/day	1	7.0E-05	mg/kg/day	Kidney	300	PPRTV	12/2009

Notes:

1 - USEPA, July 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.

3 - Values are for hexavalent chromium.

Definitions:

CNS = Central nervous system

CVS = Cardiovascular system

GS = Gastrointestinal System

HEAST= Health Effects Assessment Summary Tables

IRIS = Integrated Risk Information System

NA = Not applicable

NCEA = USEPA National Center for Environmental Assessment

TABLE C-33
NON-CANCER TOXICITY DATA -- INHALATION
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s)
Volatile Organic Compounds									
BENZENE	Chronic	3.0E-02	mg/m^3	8.6E-03	(mg/kg/day)	Blood	300/1	IRIS	1/2010
CHLOROFORM	Chronic	9.8E-02	mg/m^3	2.8E-02	(mg/kg/day)	Liver	NA	NCEA	4/2005
CIS-1,2-DICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
TETRACHLOROETHENE	Chronic	2.7E-01	mg/m^3	7.7E-02	(mg/kg/day)	Liver	NA	ATSDR MRL	01/2010
TRICHLOROETHENE	Chronic	1.0E-02	mg/m3	2.9E-03	(mg/kg/day)	CNS	NA	NYSDOH	10/2006
VINYL CHLORIDE	Chronic	1.0E-01	mg/m^3	2.9E-02	(mg/kg/day)	Liver	30/1	IRIS	1/2010
Semivolatile Organic Compounds									
3,3'-DICHLOROBENZIDINE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE EQUIVALENTS	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE	Chronic	0.003	mg/m^3	8.6E-04	(mg/kg/day)	Nasal Effects	3000/1	IRIS	1/2010
PENTACHLOROPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs									
AROCLOR 1248	NA	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR 1260	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics									
ARSENIC	Chronic	1.5E-05	mg/m^3	4.3E-06	(mg/kg/day)	NA	NA	Cal EPA	12/2009
BARIUM	Chronic	5.0E-04	mg/m^3	1.4E-04	(mg/kg/day)	Fetotoxicity	1000/1	HEAST	7/1997
CHROMIUM[2]	Chronic	1.0E-04	mg/m^3	2.9E-05	(mg/kg/day)	Lungs	300/1	IRIS	1/2010
MANGANESE	Chronic	5.0E-05	mg/m^3	1.4E-05	(mg/kg/day)	CNS	1000/1	IRIS	1/2010
SELENIUM	Chronic	2.0E-02	mg/m^3	5.7E-03	(mg/kg/day)	Hair Loss, Skin, CNS	NA	Cal EPA	12/2009
VANADIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

1 - Extrapolated RfD = RfC *$20m^3$/day / 70 kg

2 - Values are for hexavalent chromium.

Definitions:

Cal EPA = California EPA

IRIS = Integrated Risk Information System

NA = Not applicable

RS = Reproductory System

CNS = Central Nervous System

HEAST= Health Effects Assessment Summary Tables

NA = Not Applicable

PPRTV - Provisional Peer Review Toxicity Value

TABLE C-34
SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME) - SITE-RELATED CHEMICALS[1]
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, MASSACHUSETTS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Construction/Excavation Worker	Subsurface Soil	Ingestion	2.E-07	- -	- -	- -	0.02	- -
		Dermal Contact	5.E-09	- -	- -	- -	0.0005	- -
		Inhalation	8.E-07	- -	- -	- -	0.4	- -
		Total	1.E-06	- -	- -	- -	0.4	- -
	Surface Soil	Ingestion	1.E-07	- -	- -	- -	0.01	- -
		Dermal Contact	7.E-09	- -	- -	- -	0.001	- -
		Inhalation	9.E-07	- -	- -	- -	0.3	- -
		Total	1.E-06	- -	- -	- -	0.3	- -
	Groundwater	Ingestion	3.E-06	- -	- -	TETRACHLOROETHENE	0.04	- -
		Dermal Contact	2.E-04	TETRACHLOROETHENE	- -	- -	3	TETRACHLOROETHENE
		Inhalation (in a trench)	1.E-04	- -	TETRACHLOROETHENE	- -	6	TETRACHLOROETHENE
		Total	4.E-04	TETRACHLOROETHENE	- -	- -	9	TETRACHLOROETHENE
		Total Subsurface Soil	1.E-06				0.4	
		Total Surface Soil	1.E-06				0.3	
		Total Groundwater	4.E-04				9	
		Total Across the Entire Site	**4.E-04**				**10**	

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Maintenance Worker	Sediment	Ingestion	2.E-08	- -	- -	- -	--	- -
		Dermal Contact	3.E-08	- -	- -	- -	--	- -
		Total	5.E-08	- -	- -	- -	--	- -
	Surface Soil	Ingestion	2.E-06	- -	- -	CHROMIUM	0.01	- -
		Dermal Contact	3.E-07	- -	- -	- -	0.002	- -
		Total	2.E-06	- -	- -	CHROMIUM	0.01	- -
	Surface Water	Ingestion	5.E-08	- -	- -	- -	0.00004	- -
		Dermal Contact	3.E-06	- -	- -	AROCLOR-1248	0.0004	- -
		Total	3.E-06	- -	- -	AROCLOR-1248	0.0004	- -
		Total Sediment	5.E-08				--	
		Total Surface Soil	2.E-06				0.01	
		Total Surface Water	3.E-06				0.0004	
		Total Across the Entire Site	**5.E-06**				**0.01**	

TABLE C-34
SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME) - SITE-RELATED CHEMICALS[1]
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, MASSACHUSETTS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Child Recreational User	Sediment	Ingestion	4.E-07	- -	- -	- -	--	- -
		Dermal Contact	3.E-07	- -	- -	- -	--	- -
		Total	6.E-07	- -	- -	- -	--	- -
	Surface Soil	Ingestion	9.E-06	- -	- -	CHROMIUM	0.03	- -
		Dermal Contact	1.E-07	- -	- -	- -	0.004	- -
		Total	9.E-06	- -	- -	CHROMIUM	0.04	- -
	Surface Water	Ingestion	8.E-07	- -	- -	- -	0.002	- -
		Dermal Contact	2.E-05	- -	- -	TETRACHLOROETHENE, AROCLOR-1248	0.01	- -
		Total	2.E-05	- -	- -	TETRACHLOROETHENE, AROCLOR-1248	0.02	- -
		Total Sediment	6.E-07				--	
		Total Surface Soil	9.E-06				0.04	
		Total Surface Water	2.E-05				0.02	
		Total Across the Entire Site	**3.E-05**				**0.05**	

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Adolescent Trespasser	Sediment	Ingestion	4.E-08	- -	- -	- -	--	- -
		Dermal Contact	1.E-07	- -	- -	- -	--	- -
		Total	1.E-07	- -	- -	- -	--	- -
	Surface Soil	Ingestion	6.E-07	- -	- -	- -	0.002	
		Dermal Contact	1.E-08	- -	- -	- -	0.0002	
		Total	6.E-07	- -	- -	- -	0.002	
	Surface Water	Ingestion	1.E-07	- -	- -	- -	0.0002	- -
		Dermal Contact	7.E-06	- -	- -	TETRACHLOROETHENE, AROCLOR-1248	0.003	- -
		Total	8.E-06	- -	- -	TETRACHLOROETHENE, AROCLOR-1248	0.003	- -
		Total Sediment	1.E-07				--	
		Total Surface Soil	6.E-07				0.002	
		Total Surface Water	8.E-06				0.003	
		Total Across the Entire Site	**8.E-06**				**0.006**	

TABLE C-34
SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME) - SITE-RELATED CHEMICALS[1]
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, MASSACHUSETTS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Adult Recreational User	Sediment	Ingestion	2.E-08	- -	- -	- -	--	- -
		Dermal Contact	6.E-08	- -	- -	- -	--	- -
		Total	7.E-08	- -	- -	- -	--	- -
	Surface Soil	Ingestion	5.E-07	- -	- -	- -	0.001	- -
		Dermal Contact	3.E-08	- -	- -	- -	0.0002	- -
		Total	5.E-07	- -	- -	- -	0.001	- -
	Surface Water	Ingestion	5.E-08	- -	- -	- -	0.00004	- -
		Dermal Contact	4.E-06	- -	- -	AROCLOR-1248	0.0007	- -
		Total	4.E-06	- -	- -	AROCLOR-1248	0.0007	- -
		Total Sediment	7.E-08				--	
		Total Surface Soil	5.E-07				0.001	
		Total Surface Water	4.E-06				0.0007	
		Total Across the Entire Site	**5.E-06**				**0.002**	

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Child Resident	Subsurface Soil	Ingestion	3.E-05	- -	CHROMIUM	CPAHS, ARSENIC	0.1	- -
		Dermal Contact	8.E-07	- -	- -	- -	0.005	- -
		Total	3.E-05	- -	CHROMIUM	CPAHS, ARSENIC	0.1	- -
	Sediment	Ingestion	4.E-06	- -	- -	- -	--	- -
		Dermal Contact	2.E-06	- -	- -	- -	--	- -
		Total	6.E-06	- -	- -	- -	--	- -
	Surface Soil	Ingestion	4.E-05	- -	CHROMIUM	- -	0.2	- -
		Dermal Contact	2.E-06	- -	- -	- -	0.02	- -
		Total	4.E-05	- -	CHROMIUM	- -	0.2	- -
	Surface Water	Ingestion	8.E-07	- -	- -	- -	0.006	- -
		Dermal Contact	2.E-05	- -	- -	TETRACHLOROETHENE, AROCLOR-1248	0.05	- -
		Total	2.E-05	- -	- -	TETRACHLOROETHENE, AROCLOR-1248	0.05	- -
	Groundwater	Ingestion	7.E-02	TETRACHLOROETHENE	ARSENIC	TRICHLOROETHENE, VINYL CHLORIDE, 3,3'-DICHLOROBENZIDINE, PENTACHLOROPHENOL	204	CIS-1,2-DICHLOROETHENE, TETRACHLOROETHENE, ARSENIC, BARIUM
		Dermal Contact	3.E-02	TETRACHLOROETHENE	- -	3,3 -DICHLOROBENZIDINE	66	TETRACHLOROETHENE
		Inhalation	7.E-02	TETRACHLOROETHENE	- -	TRICHLOROETHENE, VINYL CHLORIDE	153	TETRACHLOROETHENE
		Total	2.E-01	TETRACHLOROETHENE	ARSENIC	TRICHLOROETHENE, VINYL CHLORIDE, 3,3'-DICHLOROBENZIDINE, PENTACHLOROPHENOL	424	CIS-1,2-DICHLOROETHENE, TETRACHLOROETHENE, ARSENIC, BARIUM
		Total Subsurface Soil	3.E-05				0.1	
		Total Sediment	6.E-06				--	
		Total Surface Soil	4.E-05				0.2	
		Total Surface Water	2.E-05				0.05	
		Total Groundwater	2.E-01				424	
		Total Across the Entire Site	**2.E-01**				**424**	

TABLE C-34
SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME) - SITE-RELATED CHEMICALS[1]
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, MASSACHUSETTS

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Future Adult Resident	Subsurface Soil	Ingestion	5.E-06	- -	- -	CHROMIUM	0.01	- -
		Dermal Contact	2.E-07	- -	- -	- -	0.0007	- -
		Total	5.E-06	- -	- -	CHROMIUM	0.01	- -
	Sediment	Ingestion	9.E-08	- -	- -	- -	--	- -
		Dermal Contact	2.E-07	- -	- -	- -	--	- -
		Total	3.E-07	- -	- -	- -	--	- -
	Surface Soil	Ingestion	6.E-06	- -	- -	CHROMIUM	0.02	- -
		Dermal Contact	8.E-07	- -	- -	- -	0.003	- -
		Total	7.E-06	- -	- -	CHROMIUM	0.02	- -
	Surface Water	Ingestion	6.E-08	- -	- -	- -	0.00014	- -
		Dermal Contact	4.E-06	- -	- -	AROCLOR-1248	0.0023	- -
		Total	4.E-06	- -	- -	AROCLOR-1248	0.0024	- -
	Groundwater	Ingestion	8.E-02	TETRACHLOROETHENE	ARSENIC	TRICHLOROETHENE, VINYL CHLORIDE, 3,3'-DICHLOROBENZIDINE, PENTACHLOROPHENOL	58	TETRACHLOROETHENE, CIS-1,2-DICHLOROETHENE
		Dermal Contact	5.E-02	TETRACHLOROETHENE	- -	3,3 -DICHLOROBENZIDINE	29	TETRACHLOROETHENE
		Inhalation	8.E-02	TETRACHLOROETHENE	- -	TRICHLOROETHENE, VINYL CHLORIDE	44	TETRACHLOROETHENE
		Total	2.E-01	TETRACHLOROETHENE	ARSENIC, 3,3'-DICHLOROBENZIDINE	TRICHLOROETHENE, VINYL CHLORIDE, 3,3'-DICHLOROBENZIDINE, PENTACHLOROPHENOL	131	CIS,1-2-DICHLOROETHENE, TETRACHLOROETHENE
		Total Subsurface Soil	5.E-06				0.01	
		Total Sediment	3.E-07				--	
		Total Surface Soil	7.E-06				0.02	
		Total Surface Water	4.E-06				0.002	
		Total Groundwater	2.E-01				131	
		Total Across the Entire Site	**2.E-01**				**131**	

TABLE C-34
SUMMARY OF CANCER RISKS AND HAZARD INDICES - REASONABLE MAXIMUM EXPOSURE (RME) - SITE-RELATED CHEMICALS[1]
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, MASSACHUSETTS

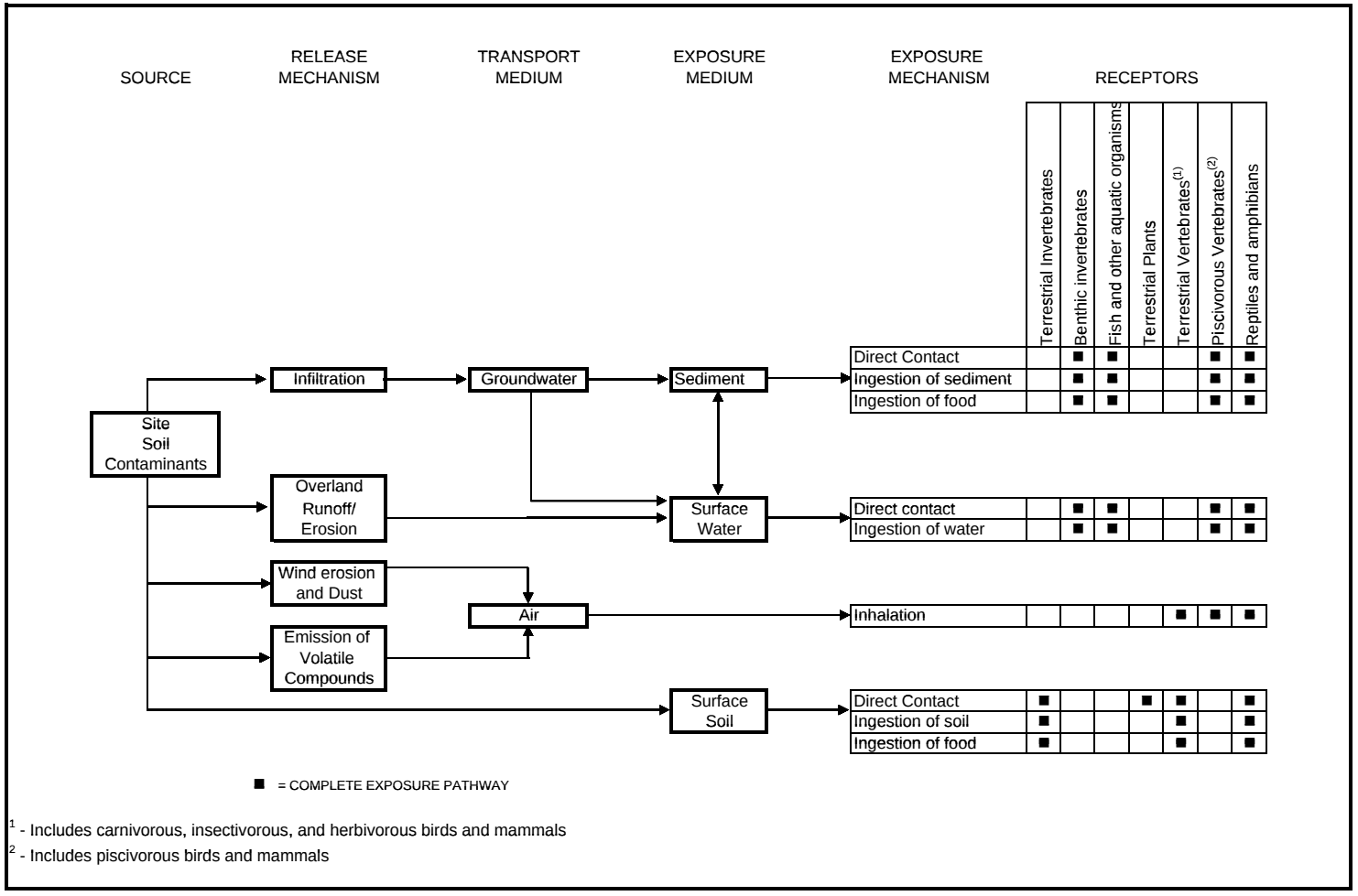
Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Lifelong Resident	Subsurface Soil	Ingestion	3.E-05	- -	CHROMIUM	CPAHS, ARSENIC	NA	- -
		Dermal Contact	1.E-06	- -	- -	- -	NA	- -
		Total	4.E-05	- -	CHROMIUM	CPAHS, ARSENIC	NA	- -
	Sediment	Ingestion	4.E-07	- -	- -	- -	NA	- -
		Dermal Contact	3.E-07	- -	- -	- -	NA	- -
		Total	7.E-07	- -	- -	- -	NA	- -
	Surface Soil	Ingestion	3.E-05	- -	CHROMIUM	BIS(2-ETHYLHEXYL)PHTHALATE	NA	- -
		Dermal Contact	6.E-07	- -	- -	- -	NA	- -
		Total	3.E-05	- -	CHROMIUM	BIS(2-ETHYLHEXYL)PHTHALATE	NA	- -
	Surface Water	Ingestion	8.E-07	- -	- -	- -	NA	- -
		Dermal Contact	2.E-05	- -	AROCLOR-1248	TETRACHLOROETHENE	NA	- -
		Total	3.E-05	- -	AROCLOR-1248	TETRACHLOROETHENE	NA	- -
	Groundwater	Ingestion	1.E-01	TETRACHLOROETHENE	-DICHLOROBENZIDINE, ARSE	TRICHLOROETHENE, VINYL CHLORIDE, PENTACHLOROPHENOL	NA	- -
		Dermal Contact	7.E-02	TETRACHLOROETHENE	- -	3,3'-DICHLOROBENZIDINE	NA	- -
		Inhalation	1.E-01	TETRACHLOROETHENE	- -	TRICHLOROETHENE, VINYL CHLORIDE		
		Total	4.E-01	TETRACHLOROETHENE	3,3'-DICHLOROBENZIDINE, ARSENIC	TRICHLOROETHENE, VINYL CHLORIDE, PENTACHLOROPHENOL	NA	- -
		Total Subsurface Soil	4.E-05				NA	
		Total Sediment	7.E-07				NA	
		Total Surface Soil	3.E-05				NA	
		Total Surface Water	3.E-05				NA	
		Total Groundwater	4.E-01				NA	
		Total Across the Entire Site	**4.E-01**				NA	

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 1E-4	Chemicals with Cancer Risks > 1E-5 and ≤ 1E-4	Chemicals with Cancer Risks > 1E-6 and ≤ 1E-5	Hazard Index (HI)	Chemicals with HI > 1
Lifelong Recreational User	Sediment	Ingestion	4.E-07	- -	- -	- -	NA	- -
		Dermal Contact	3.E-07	- -	- -	- -	NA	- -
		Total	7.E-07	- -	- -	- -	NA	- -
	Surface Soil	Ingestion	9.E-06	- -	- -	- -	NA	- -
		Dermal Contact	1.E-07	- -	- -	- -	NA	- -
		Total	9.E-06	- -	- -	- -	NA	- -
	Surface Water	Ingestion	8.E-07	- -	- -	- -	NA	- -
		Dermal Contact	2.E-05	- -	AROCLOR-1248	TETRACHLOROETHENE	NA	- -
		Total	3.E-05	- -	AROCLOR-1248	TETRACHLOROETHENE	NA	- -
		Total Sediment	7.E-07				NA	
		Total Surface Soil	1.E-06				NA	
		Total Surface Water	3.E-05				NA	
		Total Across the Entire Site	**4.E-05**				NA	

1 - Risks presented do not include chemicals present at concentrations that are within background levels.
NA = Not applicable

Appendix D
Ecological Risk Assessment Summary Tables

FIGURE D-1
ECOLOGICAL CONCEPTUAL SITE MODEL
SOLVENT RELEASE AREA
NAVAL AIR STATION, SOUTH WEYMOUTH, MASSACHUSETTS



[1] - Includes carnivorous, insectivorous, and herbivorous birds and mammals
[2] - Includes piscivorous birds and mammals

TABLE D-1
OCCURRENCE, DISTRIBUTION, AND SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Parameter	Frequency of Detection	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Sample with Maximum Detection	Average Concentration[2]	Average of Positive Detects[3]	Base Background	Ecological Screening Level	Source of Screening Level	Ecological Effects Quotient [4]	Retained as a COPC for Plants/ Invertebrates?	COPC Rationale
Volatile Organics (µg/kg)												
2-butanone	8/24	3.25	76	SRA-SB-SB10-409-0002	13.6	29.3	100	NA	NA	NA	Yes	NSL
4-isopropyltoluene	2/18	1 J	2 J	SRA-SB-SB10-502-0002	1.96	1.5	NA	NA	NA	NA	Yes	NSL
Acetone	8/25	3 J	1250 J	SRA-SB-SB10-412-0002-AVG	70.5	188	2200	NA	NA	NA	Yes	NSL
cis-1,2-dichloroethene	1/24	4 J	4 J	SRA-SB-SB10-503-0002-AVG	2.3	4	NA	200	TV	0.02	No	BSL
Tetrachloroethene	5/25	4	18	SRA-SB-SB10-505-0002	3.78	9.6	15	3800	SQG	0.005	No	BSL
Total 1,2-dichloroethene	1/24	4 J	4 J	SRA-SB-SB10-503-0002-AVG	2.3	4	NA	200	TV [6]	0.020	No	BSL
Total chlorinated ethenes	6/25	4	18	SRA-SB-SB10-505-0002	3.8	9.14	NA	NA	NA	NA	No	NSL*
Total chlorinated vocs	6/25	4	18	SRA-SB-SB10-505-0002	4.34	9.14	NA	NA	NA	NA	No	NSL*
Trichloroethene	2/24	0.7	2.15 J	SRA-SB-SB10-503-0002-AVG	1.2	1.42	NA	3000	SQG	0.0007	No	BSL
Semivolatile Organics (µg/kg)												
4-methylphenol	1/15	134 J	134 J	SRA-SB-SB10-503-0002-AVG	225	134	NA	500	Reg 4	0.27	No	BSL
Acenaphthene	4/21	2.8 J	37.5 J	SRA-SB-SB20-501-0002-AVG	5.62	12.9	NA	29000	ECO-SSL	0.0013	No	BSL
Acenaphthylene	6/21	1.9 J	47	SRA-SB-SB10-405-0002	7.16	14.4	210	29000	ECO-SSL	0.0016	No	BSL
Anthracene	11/22	2.2 J	77.5 J	SRA-SB-SB20-501-0002-AVG	12.5	20.8	170	29000	ECO-SSL	0.0027	No	BSL
Benzaldehyde	5/21	47 J	210 J	SRA-SB-SB10-506-0002	185	89.5	NA	NA	NA	NA	Yes	NSL
Benzo(a)anthracene	19/22	3.7	220	SRA-SB-SB20-501-0002-AVG	31.7	36.4	810	1100	ECO-SSL*	0.20	No	BSL
Benzo(a)pyrene	17/22	5.4	165	SRA-SB-SB20-501-0002-AVG	30.6	38.6	1829	1100	ECO-SSL*	0.15	No	BSL
Benzo(b)fluoranthene	20/22	4	315	SRA-SB-SB20-501-0002-AVG	50.8	55.3	770	1100	ECO-SSL*	0.29	No	BSL
Benzo(g,h,i)perylene	19/22	4.2	120	SRA-SB-SB10-405-0002	21.6	24.7	310	1100	ECO-SSL*	0.11	No	BSL
Benzo(k)fluoranthene	16/22	4.2	89	SRA-SB-SB20-501-0002-AVG	17.7	22.5	2700	1100	ECO-SSL*	0.081	No	BSL
Bis(2-chloroethyl)ether	1/21	16 J	16 J	SRA-SB-SB10-405-0002	5.37	16	NA	NA	NA	NA	Yes	NSL
Bis(2-ethylhexyl)phthalate	20/22	68 J	150000	SRA-SB-SB10-501-0002-20060707	7160	7860	46000	100	TV	1500	Yes	ASL
Butyl benzyl phthalate	1/21	86 J	86 J	SRA-SB-SB10-409-0002	212	86	270	100	TV	0.86	No	BSL
Caprolactam	1/21	61 J	61 J	SRA-SB-SB10-409-0002	211	61	NA	NA	NA	NA	Yes	NSL
Chrysene	19/22	5.9	200	SRA-SB-SB20-501-0002-AVG	35.2	40.5	1400	1100	ECO-SSL*	0.18	No	BSL
Dibenzo(a,h)anthracene	11/22	4.4 J	38	SRA-SB-SB20-501-0002-AVG	8.99	13.7	96	1100	ECO-SSL*	0.035	No	BSL
Diethyl phthalate	1/21	76 J	76 J	SRA-SB-SB10-501-0002-20060707	212	76	NA	100000	ORNL Plant	0.0008	No	BSL
Fluoranthene	22/22	4.3 J	585 J	SRA-SB-SB20-501-0002-AVG	79.3	79.3	2400	29000	ECO-SSL	0.0202	No	BSL
Fluorene	5/21	4.3	40 J	SRA-SB-SB20-501-0002-AVG	6.22	11.7	NA	29000	ECO-SSL	0.0014	No	BSL
High molecular weight PAHs	22/22	10.1	2272.5 J	SRA-SB-SB20-501-0002-AVG	351	351	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	14/22	4.2	162 J	SRA-SB-SB20-501-0002-AVG	62.5	30.3	175	1100	ECO-SSL*	0.147	No	BSL
Low molecular weight PAHs	19/25	4.9	554.2 J	SRA-SB-SB20-501-0002-AVG	56.8	73.7	NA	NA	NA	NA	NA	NA
Naphthalene	1/24	14.2 J	14.2 J	SRA-SB-SB20-501-0002-AVG	4.4	14.2	NA	29000	ECO-SSL	0.0005	No	BSL
Phenanthrene	19/22	4.9	385 J	SRA-SB-SB20-501-0002-AVG	44.3	50.6	1500	29000	ECO-SSL	0.0133	No	BSL
Phenol	1/21	19 B	19 B	SRA-SB-SB10-405-0002	18.3	19	70	30000	ORNL Invert	0.0006	No	BSL
Pyrene	22/22	4.5	405 J	SRA-SB-SB20-501-0002-AVG	61	61	1500	1100	ECO-SSL*	0.37	No	BSL
Total PAHs	22/25	10.1	2826.7 J	SRA-SB-SB20-501-0002-AVG	365	414	12160	NA	NA	NA	NA	NA
Pesticides/PCBs (µg/kg)												
4,4'-DDD	4/22	0.63 J	37 J	SRA-SB-SB10-411-0002	3.42	13.8	6.6	21	ECO-SSL*	1.8	Yes	ASL
4,4'-DDE	8/22	0.48 J	4.5 J	SRA-SB-SB10-405-0002	1.37	1.75	320	21	ECO-SSL*	0.21	No	BSL
4,4'-DDT	8/22	0.64 J	38	SRA-SB-SB10-411-0002	4.24	9.71	325	21	ECO-SSL*	1.8	Yes	ASL

TABLE D-1
OCCURRENCE, DISTRIBUTION, AND SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Parameter	Frequency of Detection	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Sample with Maximum Detection	Average Concentration[2]	Average of Positive Detects[3]	Base Background	Ecological Screening Level	Source of Screening Level	Ecological Effects Quotient [4]	Retained as a COPC for Plants/ Invertebrates?	COPC Rationale
Aldrin	1/22	0.372 J	0.372 J	SRA-SB-SB20-501-0002-AVG	0.65	0.372	15	2.5	Reg 4	0.1	No	BSL
Alpha-chlordane	1/22	0.685 J	0.685 J	SRA-SB-SB20-501-0002-AVG	0.665	0.685	4	0.03	TV	22.8	Yes	ASL
Aroclor-1242	2/22	30 J	32 J	SRA-SB-SB10-408-0002	10.9	31	NA	20	Reg 4	1.6	Yes	ASL
Aroclor-1260	4/22	25.5 J	270	SRA-SB-SB10-411-0002	26.5	104	106	20	Reg 4	13.5	Yes	ASL
beta-BHC	1/22	1.3 J	1.3 J	SRA-SB-SB10-409-0002	0.687	1.3	NA	9	TV	0.14	No	BSL
Dieldrin	5/22	0.32 J	6.3 J	SRA-SB-SB10-411-0002	1.35	1.67	52	4.9	ECO-SSL*	1.29	Yes	ASL
Endosulfan I	2/22	0.44 J	0.46 J	SRA-SB-SB20-502D-0002	0.654	0.45	NA	0.01	TV	46	Yes	ASL
Endosulfan II	2/22	0.585 J	0.6 J	SRA-SB-SB20-504D-0002	1.25	0.592	NA	0.01	TV	60	Yes	ASL
Endosulfan sulfate	3/22	0.805 J	1.95 J	SRA-SB-SB20-501-0002-AVG	1.31	1.24	18	0.01	TV	195	Yes	ASL
Endrin aldehyde	1/22	12 J	12 J	SRA-SB-SB10-411-0002	1.69	12	9.5	0.04	TV	300	Yes	ASL
Endrin ketone	1/22	0.81 J	0.81 J	SRA-SB-SB20-502D-0002	1.26	0.81	NA	0.04	TV	20.25	Yes	ASL
Gamma-BHC	1/22	0.662	0.662	SRA-SB-SB20-501-0002-AVG	0.664	0.662	15	0.05	TV	13.24	Yes	ASL
Heptachlor Epoxide	2/22	0.37 J	0.43 J	SRA-SB-SB20-501-0002-AVG	0.647	0.4	26	0.0002	TV	2150	Yes	ASL
Total aroclor	6/22	25.5 J	270	SRA-SB-SB10-411-0002	28.5	79.4	NA	20	Reg 4	13.5	Yes	ASL
Total DDx	11/22	0.48 J	75 J	SRA-SB-SB10-411-0002	7.19	13.3	NA	21	ECO-SSL*	3.6	Yes	ASL
Inorganics (mg/kg)												
Aluminum	21/21	5800	15500	SRA-SB-SB10-412-0002-AVG	8950	8950	10499	pH<5.5	ECO-SSL	NA [5]	Yes	ASL
Arsenic	21/21	0.359	3.58 J	SRA-SB-SB10-412-0002-AVG	1.3	1.3	5.31	18	ECO-SSL	0.20	No	BSL
Barium	21/21	16.6 J	47.6	SRA-SB-SB10-412-0002-AVG	24.6	24.6	49.9	330	ECO-SSL	0.14	No	BSL
Beryllium	20/21	0.15	0.47	SRA-SB-SB10-406-0002	0.292	0.303	0.3	21	ECO-SSL*	0.022	No	BSL
Cadmium	17/21	0.04 J	0.459	SRA-SB-SB10-411-0002	0.195	0.237	0.9	0.36	ECO-SSL*	1.3	Yes	ASL
Calcium	21/21	498 J	2380 J	SRA-SB-SB10-405-0002	1200	1200	6360	NUT	NA	NA	No	NUT
Chromium	21/21	5.2	15	SRA-SB-SB20-504D-0002	8.4	8.4	10.1	26	ECO-SSL*	0.58	No	BSL
Cobalt	21/21	0.694 J	5.93	SRA-SB-SB10-411-0002	2.38	2.38	3.98	13	ECO-SSL	0.46	No	BSL
Copper	21/21	1.6 J	9.81	SRA-SB-SB10-411-0002	5.08	5.08	26.22	28	ECO-SSL*	0.35	No	BSL
Cyanide	7/15	0.12 J	0.23	SRA-SB-SB10-405-0002	0.113	0.163	NA	0.9	SQG	0.26	No	BSL
Iron	21/21	4700 J	19000	SRA-SB-SB10-411-0002	9760	9760	11300	pH<5, pH>8	ECO-SSL	NA [5]	No	BSL
Lead	21/21	3.68 J	51.1	SRA-SB-SB10-412-0002-AVG	12.6	12.6	301.7	11	ECO-SSL*	4.6	Yes	ASL
Magnesium	21/21	620	3360 J	SRA-SB-SB10-407-0002	1380	1380	1963	NUT	NA	NA	No	NUT
Manganese	21/21	56.6 J	369 J	SRA-SB-SB10-407-0002	156	156	314	220	ECO-SSL	1.7	Yes	ASL
Mercury	8/21	0.0082 J	0.156	SRA-SB-SB10-412-0002-AVG	0.0172	0.0353	0.49	0.1	ORNL Invert	1.6	Yes	ASL
Nickel	21/21	2.4	10.8	SRA-SB-SB10-407-0002	5.56	5.56	17.2	38	ECO-SSL	0.28	No	BSL
Potassium	15/21	234	846 J	SRA-SB-SB10-412-0002-AVG	326	375	631	NUT	NA	NA	No	NUT
Selenium	15/21	0.0565 J	1.8	SRA-SB-SB10-412-0002-AVG	0.313	0.362	3	0.52	ECO-SSL	3.5	Yes	ASL
Silver	19/21	0.01 J	0.19 J	SRA-SB-SB10-412-0002-AVG	0.0492	0.0533	NA	4.2	ECO-SSL*	0.045	No	BSL
Sodium	13/21	46.4 J	194	SRA-SB-SB20-501-0002-AVG	69	89.5	272	NUT	NA	NA	No	NUT
Thallium	9/21	0.0214 J	0.158 J	SRA-SB-SB10-412-0002-AVG	0.0482	0.0682	1.8	1	ORNL Plant	0.16	No	BSL
Vanadium	21/21	13.1	36.4 J	SRA-SB-SB10-412-0002-AVG	19.3	19.3	89.1	7.8	ECO-SSL*	4.7	Yes	ASL
Zinc	21/21	10.2 J	43.9 J	SRA-SB-SB10-408-0002	21.6	21.6	73.8	46	ECO-SSL*	0.95	No	BSL

TABLE D-1
OCCURRENCE, DISTRIBUTION, AND SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Parameter	Frequency of Detection	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Sample with Maximum Detection	Average Concentration[2]	Average of Positive Detects[3]	Base Background	Ecological Screening Level	Source of Screening Level	Ecological Effects Quotient [4]	Retained as a COPC for Plants/ Invertebrates?	COPC Rationale
Miscellaneous Parameters												
Total Organic Carbon (%)	1/2	1.3 J	1.3 J	SRA-SB-SB10-405-0002	0.925	1.3	NA	NA	NA	NA	NA	NA

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria and it indicates that the shaded chemical was retained as a COPC.

1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations detected concentrations and as one sample when determining the frequency of detection.
2 - Average of all analytical results are calculated using half of the detection limit for nondetects.
3 - Average of positive analytical results only.
4 - The ecological effects quotient quotient is the maximum detected concentration divided by the screening level.
5 - pH was measured as 5.37 at one historic surface soil location (BL-05).
6 - Ecological screening level for cis-1,2-dichloroethene used as a surrogate for total 1,2-dichloroethene.
COPC = Chemical of Potenial Concern
NA = Not Available or Not Applicable.
DDx = Sum of positive detections of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.

Screening Level Sources and Order of Preference:
1. Eco SSL – EPA Ecological Soil Screening Levels (U.S. EPA, 2003, 2005, 2006, 2007)
2. Region 4 – EPA Region IV Soil Screening Levels (U.S. EPA, 2001b)
3. SQG - Canadian Soil Quality Guideline for environmental health soil contact value (EC 1999a,b; CCME 2006)
4a. ORNL Plant - Oak Ridge National Laboratory Plant Toxicological Bencmark (Efroymson, et al. 1997a).
4b. ORNL Invert - Oak Ridge National Laboratory Invertebrate Toxicological Bencmark (Efroymson, et al. 1997b).
5. TV - Target Value (MHSPE, 2000)

***** Eco SSL is based on mammals or birds. Chemicals with maximum detected concentrations less than these values are not included in the food chain models.

Rationale Codes:
For Selection as a COPC or for Further Evaluation:
ASL = Above COPC Screening Level
BSL = Below COPC Screening Level
NSL = No Screening Level Available
NSL* = No screening level, but risks are accounted for by individual constituents.
NUT = Essential Nutrient

SURFACE SOIL NUTRIENT SCREEN

Nutrient	Screening Benchmarks: Maximum Tolerable Dietary Conc. (mg/kg)*	Sediment Screen: Surface Soil Maximum Concentration (mg/kg)	Sediment Screen: Ingestion Rate for Maximum Sed. Conc.*** (mg/kg BW/day)	Sediment Screen: Maximum Ingestion Rate > Maximum Tolerable Ingestion Rate?
Calcium	10000	2380	10.71	no
Magnesium	3000	3360	15.12	no
Potassium	30000	846	3.807	no
Sodium	20000	142	0.639	no

Notes:
* - Maximum tolerable nutrient concentration for swine and other animals (NRC, 1980)
** - Max. tolerable intake rate = Max. tolerable dietary conc. (mg/kg diet) X Dietary intake (kg diet/day) / Body Weight (kg).
Values for swine (3.41 kg diet/day, 227 kg body weight) from Kenaga, 1972.
*** - Max. Soil Ingestion Rate = Soil conc. (mg/kg soil) X Fraction diet as soil (0.3) X
Dietary Intake (kg diet/day)/Body Weight (kg).
Nutrient screening conducted as presented in ENSR (1999).

TABLE D-2
OCCURRENCE, DISTRIBUTION, AND SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN - SEDIMENT
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Parameter	Frequency of Detection	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Sample with Maximum Detection	Average Concentration[2]	Average of Positive Detects[3]	Base Background	Number of Samples Greater than Basewide Background	Upstream Concentration Max.	Ecological Screening Level	Source of Screening Level	Number of Samples Greater than Screening Level	Ecological Effects Quotient [4]	Retained as a COPC for Aquatic Organisms?	COPC Rationale
Volatile Organics (µg/kg)															
1,2,4-Trichlorobenzene	1/10	1.5 J	1.5 J	SRA-SD-110-0107-AVG	1.72	1.5	NA	NA	NA	9600	SCV	0	0.0002	No	BSL
2-Butanone	1/10	7 J	7 J	SRA-SD-110-0107-AVG	2.28	7	330	0	NA	270	SCV	0	0.026	No	BSL
Acetone	6/10	3 J	70 J	SRA-SD-105-0107	14	22.2	417	0	32	9	SCV	4	7.8	Yes	ASL
BTEX	5/10	1	45 J	SRA-SD-109-0107	6.08	10.4	NA	NA	NA	NA	NA	NA	NA	No	NSL*
Cis-1,2-Dichloroethene	1/10	3	3	SRA-SD-110-0107-AVG	1.88	3	NA	NA	NA	400	SCV	0	0.0075	No	BSL
Ethylbenzene	5/10	1	6 J	SRA-SD-109-0107	2	2.3	NA	NA	NA	89	SCV	0	0.067	No	BSL
M+P-Xylenes	1/10	26 J	26 J	SRA-SD-109-0107	4.5	26	NA	NA	NA	25	SCV	1	1.04	Yes	ASL
Methylene Chloride	1/10	8 J	8 J	SRA-SD-109-0107	2.38	8	21	0	NA	370	SCV	0	0.022	No	BSL
O-Xylene	6/10	1	7 J	SRA-SD-109-0107	2.05	2.25	NA	NA	NA	160	SCV	0	0.044	No	BSL
Tetrachloroethene	3/10	10 J	57 J	SRA-SD-110-0107-AVG	12.7	38.5	2.6	3	NA	410	SCV	0	0.14	No	BSL
Toluene	2/10	1.5 J	6 J	SRA-SD-109-0107	2.12	3.75	25	0	NA	50	SCV	0	0.12	No	BSL
Total 1,2-Dichloroethene	1/10	3	3	SRA-SD-110-0107-AVG	1.88	3	NA	NA	NA	400	SCV [5]	NA	0.0075	No	BSL
Total Chlorinated Ethenes	3/10	28 J	90 J	SRA-SD-110-0107-AVG	17.6	55.5	NA	NA	NA	NA	NA	NA	NA	No	NSL*
Total Chlorinated Vocs	3/10	36 J	91 J	SRA-SD-110-0107-AVG	18.7	58.7	NA	NA	NA	NA	NA	NA	NA	No	NSL*
Total Xylenes	1/10	33 J	33 J	SRA-SD-109-0107	5.45	33	NA	NA	NA	160	SCV	0	0.21	No	BSL
Trichloroethene	2/10	18 J	30 J	SRA-SD-110-0107-AVG	5.07	24	NA	NA	NA	220	SCV	0	0.14	No	BSL
Semivolatile Organics (µg/kg)															
2,4-Dinitrotoluene	2/10	53 J	360 J	SRA-SD-104-0107	218	206	NA	NA	NA	41.6	Reg 3.	2	8.7	Yes	ASL
2-Methylnaphthalene	3/10	5.1 J	100 J	SRA-SD-104-0107	12.6	36.8	NA	NA	NA	65	ER-L	1	1.5	Yes	ASL
2-Methylphenol	1/10	4.6 J	4.6 J	SRA-SD-105-0107	2.42	4.6	NA	NA	NA	12	SCV	0	0.38	No	BSL
4-Methylphenol	1/10	72 J	72 J	SRA-SD-108-0107	204	72	NA	NA	NA	12	SCV	1	6	Yes	ASL
Acenaphthene	6/10	5.1	280	SRA-SD-104-0107	38.4	62.5	83	1	NA	150	ER-L	1	1.9	Yes	ASL
Acenaphthylene	9/10	7.9	37	SRA-SD-104-0107	12.8	13.9	258	0	25	150	ER-L	0	0.25	No	BSL
Anthracene	9/10	13.5	570	SRA-SD-104-0107	90.2	100	436	1	51	57	TEC	3	10	Yes	ASL
Benzo(a)anthracene	10/10	9.6	810	SRA-SD-104-0107	164	164	1400	0	69	108	TEC	3	7.5	Yes	ASL
Benzo(a)pyrene	10/10	12	620	SRA-SD-104-0107	148	148	3447	0	150	150	TEC	3	4.1	Yes	ASL
Benzo(b)fluoranthene	10/10	21	890	SRA-SD-104-0107	223	223	2000	0	280	1800	NOAA	0	0.49	No	BSL
Benzo(g,h,i)perylene	9/10	21	350	SRA-SD-104-0107	81.3	90.1	375	0	45	170	LEL	1	2.1	Yes	ASL
Benzo(k)fluoranthene	10/10	7.1	370	SRA-SD-104-0107	80.4	80.4	1100	0	80	240	LEL	1	1.5	Yes	ASL
bis(2-ethylhexyl)phthalate	1/10	850	850	SRA-SD-105-0107	284	850	640	1	NA	890000	SCV	0	0.0010	No	BSL
Carbazole	2/10	71 J	270 J	SRA-SD-104-0107	211	170	226	1	NA	NA	NA	NA	NA	Yes	NSL
Chrysene	10/10	13	730	SRA-SD-104-0107	165	165	1700	0	100	166	TEC	3	4.4	Yes	ASL
Dibenzo(a,h)anthracene	9/10	8	110	SRA-SD-104-0107	27.5	30.4	190	0	21	33	TEC	3	3.3	Yes	ASL
Dibenzofuran	1/10	210 J	210 J	SRA-SD-104-0107	220	210	57	1	NA	420	SCV	0	0.50	No	BSL
Fluoranthene	10/10	27	2000	SRA-SD-104-0107	402	402	3000	0	300	420	TEC	3	4.8	Yes	ASL
Fluorene	8/10	3.2	380	SRA-SD-104-0107	48.1	59.5	130	1	6.5	77.4	TEC	1	4.9	Yes	ASL
Indeno(1,2,3-Cd)Pyrene	10/10	5.7	360 J	SRA-SD-104-0107	87.4	87.4	490	0	61	200	LEL	1	1.8	Yes	ASL
Naphthalene	4/10	4.9	190	SRA-SD-104-0107	21.8	51.8	NA	NA	NA	176	TEC	1	1.1	Yes	ASL
Phenanthrene	10/10	11	1800	SRA-SD-104-0107	280	280	1400	1	110	204	TEC	3	8.8	Yes	ASL
Phenol	2/10	11	32	SRA-SD-108-0107	6.05	21.5	NA	NA	NA	48	NOAA	0	0.67	No	BSL
Pyrene	10/10	26 J	1500	SRA-SD-104-0107	311	311	2300	0	300	195	TEC	3	7.7	Yes	ASL
Total PAHs	10/10	132 J	11097 J	SRA-SD-104-0107	2190	2190	14819	0	1598.5	1610	TEC	3	6.9	Yes	ASL
Pesticides/PCBs (µg/kg)															
4,4'-DDD	8/10	3.1	290 J	SRA-SD-110-0107-AVG	40.8	50.8	730	0	48	4.88	TEC	7	59	Yes	ASL
4,4'-DDE	5/10	2.3 J	97.5 J	SRA-SD-110-0107-AVG	13.1	23.8	234	0	NA	3.16	TEC	4	31	Yes	ASL
4,4'-DDT	6/10	4.6	76 J	SRA-SD-107-0107-AVG	17.7	26.1	290	0	9.3	4.16	TEC	6	18	Yes	ASL
Alpha-Chlordane	4/10	1.4 J	6.6 J	SRA-SD-105-0107	2.89	3.5	12	0	18	3.24	TEC	2	2.0	Yes	ASL
Aroclor-1242	1/10	30 J	30 J	SRA-SD-103-0107	22	30	NA	NA	NA	59.8	TEC	0	0.50	No	BSL
Aroclor-1254	1/10	52	52	SRA-SD-103-0107	24.2	52	NA	NA	NA	59.8	TEC	0	0.87	No	BSL
Aroclor-1260	8/10	24	1500	SRA-SD-107-0107-AVG	198	245	230	1	120	59.8	TEC	4	25	Yes	ASL
Dieldrin	3/10	2.5 J	11 J	SRA-SD-107-0107-AVG	3.98	5.37	17	0	10	1.9	TEC	3	5.8	Yes	ASL
Endrin Aldehyde	2/10	3.7 J	25 J	SRA-SD-107-0107-AVG	5.36	14.4	11	1	NA	2.22	TEC	2	11	Yes	ASL
Gamma-Chlordane	3/10	2.1 J	4.1 J	SRA-SD-105-0107	2.39	2.83	14	0	11	3.24	TEC	1	1.3	Yes	ASL
Total Aroclor	9/10	24	1500	SRA-SD-107-0107-AVG	205	226	NA	NA	120	59.8	TEC	5	25	Yes	ASL
Total DDD/DDE/DDT	9/10	5	388 J	SRA-SD-110-0107-AVG	68.3	75.7	NA	NA	57.3	5.28	TEC	8	73	Yes	ASL

Parameter	Frequency of Detection	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Sample with Maximum Detection	Average Concentration[2]	Average of Positive Detects[3]	Base Background	Number of Samples Greater than Basewide Background	Upstream Concentration Max.	Ecological Screening Level	Source of Screening Level	Number of Samples Greater than Screening Level	Ecological Effects Quotient [4]	Retained as a COPC for Aquatic Organisms?	COPC Rationale
Inorganics (mg/kg)															
Aluminum	10/10	3780	8400	SRA-SD-112-0107	6020	6020	8767	0	7970	25500	NOAA	0	0.33	No	BSL
Arsenic	10/10	0.738	2.32	SRA-SD-110-0107-AVG	1.25	1.25	8.9	0	2.46	9.79	TEC	0	0.24	No	BSL
Barium	10/10	10.2	23.3	SRA-SD-108-0107	17.2	17.2	202	0	21.6	48	NOAA	0	0.49	No	BSL
Beryllium	10/10	0.257 J	0.702 J	SRA-SD-109-0107	0.414	0.414	0.46	5	0.448	NA	NA	NA	NA	Yes	NSL
Cadmium	10/10	0.221 J	0.553	SRA-SD-111-0107	0.378	0.378	1.95	0	0.42	0.99	TEC	0	0.56	No	BSL
Calcium	10/10	1040	2640	SRA-SD-111-0107	1510	1510	13900	0	1290	NA	NA	NA	NA	No	NUT
Chromium	10/10	5.29 J	11.2 J	SRA-SD-111-0107	8.16	8.16	11.9	0	9.65	43.4	TEC	0	0.26	No	BSL
Cobalt	10/10	1.87	5.78	SRA-SD-110-0107-AVG	3.15	3.15	25.7	0	3.14	50	LEL	0	0.12	No	BSL
Copper	10/10	3.98	16.6	SRA-SD-112-0107	7.56	7.56	53.3	0	12.3	31.6	TEC	0	0.53	No	BSL
Iron	10/10	6230	14400	SRA-SD-112-0107	9410	9410	24000	0	15600	20000	LEL	0	0.72	No	BSL
Lead	10/10	11.6	40.5	SRA-SD-112-0107	22.8	22.8	201	0	35.9	35.8	TEC	1	1.1	Yes	ASL
Magnesium	10/10	1010	2320	SRA-SD-107-0107-AVG	1680	1680	1683	4	2130	NA	NA	NA	NA	No	NUT
Manganese	10/10	91.2 J	299 J	SRA-SD-111-0107	138	138	3690	0	263	460	LEL	0	0.65	No	BSL
Mercury	3/10	0.0106 J	0.0254 J	SRA-SD-110-0107-AVG	0.00721	0.0162	0.28	0	0.0131	0.18	TEC	0	0.14	No	BSL
Nickel	10/10	4.08 J	8.5	SRA-SD-106-0107	6.3	6.3	11.71	0	7.53	22.7	TEC	0	0.37	No	BSL
Potassium	10/10	161 J	326	SRA-SD-108-0107	258	258	603	0	286	NA	NA	NA	NA	No	NUT
Selenium	10/10	0.0906 J	0.351 J	SRA-SD-112-0107	0.186	0.186	0.67	0	0.239	1	NOAA	0	0.35	No	BSL
Silver	8/10	0.0471 J	0.0758 J	SRA-SD-104-0107	0.0565	0.0638	0.2	0	0.0577	0.5	LEL	0	0.15	No	BSL
Sodium	5/10	46.3	59.7 J	SRA-SD-112-0107	30.8	52.5	2180	0	59.1	NA	NA	NA	NA	No	NUT
Thallium	10/10	0.0131 J	0.0366 J	SRA-SD-109-0107	0.024	0.024	NA	NA	0.0268	NA	NA	NA	NA	Yes	NSL
Vanadium	10/10	10.9	19.6	SRA-SD-112-0107	15.7	15.7	38	0	22.9	57	NOAA	0	0.34	No	BSL
Zinc	10/10	27.1	62.8	SRA-SD-104-0107	41	41	549	0	89.8	121	TEC	0	0.52	No	BSL
Miscellaneous Parameters															
Sieve 3/8"	10/10	0	13	2 max samples	6.54	6.54	NA	NA	9.3	NA	NA	NA	NA	NA	NA
Sieve No. 004	10/10	0.6	13	SRA-SD-104-0107	6.37	6.37	NA	NA	7.1	NA	NA	NA	NA	NA	NA
Sieve No. 010	10/10	4.1	18	SRA-SD-104-0107	10.5	10.5	NA	NA	12	NA	NA	NA	NA	NA	NA
Sieve No. 020	10/10	9	20	SRA-SD-104-0107	14.2	14.2	NA	NA	15	NA	NA	NA	NA	NA	NA
Sieve No. 040	10/10	9.7	28	SRA-SD-105-0107	17.8	17.8	NA	NA	31	NA	NA	NA	NA	NA	NA
Sieve No. 060	10/10	7.9	21	SRA-SD-105-0107	13.7	13.7	NA	NA	20	NA	NA	NA	NA	NA	NA
Sieve No. 140	10/10	5.7	23	SRA-SD-105-0107	16.2	16.2	NA	NA	17	NA	NA	NA	NA	NA	NA
Sieve No. 200	10/10	0.9	7.8	SRA-SD-111-0107	4.5	4.5	NA	NA	4	NA	NA	NA	NA	NA	NA
Sieve No. 230	10/10	1.3	25	SRA-SD-108-0107	10.3	10.3	NA	NA	8.1	NA	NA	NA	NA	NA	NA
Total Organic Carbon	1/10	1.4	1.4	SRA-SD-109-0107	0.725	1.4	NA	NA	1.8	NA	NA	NA	NA	NA	NA

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria and it indicates that the shaded chemical was retained as a COPC.

1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations detected concentrations and as one sample when determining the frequency of detection.
2 - Average of all analytical results are calculated using half of the detection limit for nondetects.
3 - Average of positive analytical results only.
4 - The ecological effects quotient quotient is the maximum detected concentration divided by the screening level.
5 - Ecological screening level for cis-1,2-dichloroethene used as a surrogate for total 1,2-dichloroethene.
COPC = Chemical of Potenial Concern
NA = Not Available or Not Applicable.
DDx = Sum of positive detections of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.

Screening Level Sources and Order of Preference:
1. TEC - Consensus-Based Threshold Effect Concentrations (MacDonald et al., 2000)
2. LEL - Lowest Effects Level from the Ontario Ministry of the Environment (OMOE) (Persaud, et al., 1993)
3. ER-L - Effects-Range Low from Long and Morgan (1991).
4. SCV - Secondary Chronic Values (Table 3 in Jones et al., 1997)
5. NOAA - National Oceanographic and Atmospheric Administration sediment benchmarks (Buchman, 1999)
6. Reg 3 - USEPA Region 3 BTAG Freshwater Sediment Screening Levels

Rationale Codes:
For Selection as a COPC or for Further Evaluation:
ASL = Above COPC Screening Level
BSL = Below COPC Screening Level
NSL = No Screening Level Available
NSL* = No screening level, but risks are accounted for by individual constituents.
NUT = Essential Nutrient

SEDIMENT NUTRIENT SCREEN

Nutrient	Screening Benchmarks		Sediment Screen		
	Maximum Tolerable Dietary Conc. (mg/kg)*	Maximum Tolerable Ingestion Rate (mg/kg BW/day)**	Sediment Maximum Concentration (mg/kg)	Ingestion Rate for Maximum Sediment Conc.*** (mg/kg BW/day)	Maximum Ingestion Rate > Maximum Tolerable Ingestion Rate ?
Calcium	10000	150	2640	11.88	no
Magnesium	3000	45	2320	10.44	no
Potassium	30000	450	326	1.467	no
Sodium	20000	300	60	0.26865	no

Notes:
* - Maximum tolerable nutrient concentration for swine and other animals (NRC, 1980)
** - Max. tolerable intake rate = Max. tolerable dietary conc. (mg/kg diet) X Dietary intake (kg diet/day) / Body Weight (kg).
Values for swine (3.41 kg diet/day, 227 kg body weight) from Kenaga, 1972.
*** - Max. Soil Ingestion Rate = Soil conc. (mg/kg soil) X Fraction diet as soil (0.3) X Dietary Intake (kg diet/day)/Body Weight (kg).
Nutrient screening conducted as presented in ENSR (1999).

TABLE D-3
OCCURRENCE, DISTRIBUTION, AND SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Parameter	Frequency of Detection	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Sample with Maximum Detection	Average Concentration[2]	Average of Positive Detects[3]	Base Background	Number of Samples Greater than Basewide Background	Upstream Concentration (maximum detection)	Ecological Screening Level	Source of Screening Level	Number of Samples Greater than Screening Level	Ecological Effects Quotient [4]	Retained as a COPC for Aquatic Organisms?	COPC Rationale
Volatile Organics (µg/L)															
1,1,2-trichlorotrifluoroethane	2/10	0.29 J	0.42 J	SRA-SW-108-0107	0.271	0.355	NA	NA	NA	NA	NA	NA	NA	Yes	NSL
BTEX	2/10	0.4 J	0.82	SRA-SW-109-0107	0.322	0.61	NA	NA	NA	NA	NA	NA	NA	No	NSL*
cis-1,2-dichloroethene	4/10	0.82	12	SRA-SW-110-0107-AVG	1.98	4.58	NA	NA	NA	590	SCV	0	0.020	No	BSL
Methylene chloride	2/10	0.495	0.51	SRA-SW-103-0107	0.3	0.502	2	0	NA	2200	SCV	0	0.0002	No	BSL
Tetrachloroethene	8/10	0.42 J	28	SRA-AQ-SW-112-0107	6.88	8.54	NA	NA	NA	98	SCV	0	0.29	No	BSL
Toluene	2/10	0.4 J	0.82	SRA-SW-109-0107	0.322	0.61	NA	NA	NA	9.8	SCV	0	0.084	No	BSL
Total 1,2-dichloroethene	4/10	0.82	12	SRA-SW-110-0107-AVG	1.98	4.58	NA	NA	NA	590	NA [5]	NA	0.020	No	BSL
Total chlorinated ethenes	8/10	0.42 J	44.7	SRA-SW-110-0107-AVG	10.7	13.3	NA	NA	NA	NA	NA	NA	NA	No	NSL*
Total chlorinated vocs	8/10	0.42 J	44.7 J	SRA-SW-110-0107-AVG	10.9	13.6	NA	NA	NA	NA	NA	NA	NA	No	NSL*
Trichloroethene	4/10	1.02	11.5	SRA-SW-110-0107-AVG	2	4.63	NA	NA	NA	21900	LOEL	0	0.0005	No	BSL
Vinyl chloride	2/10	0.4 J	1.2	SRA-SW-110-0107-AVG	0.36	0.8	NA	NA	NA	NA	NA	NA	NA	Yes	NSL
PAHs (µg/L)															
Benzo(a)anthracene	1/10	0.1	0.1	SRA-SW-107-0107-AVG	0.055	0.1	0.2	0	NA	0.027	SCV	1	3.7	Yes	ASL
Benzo(a)pyrene	1/10	0.16 J	0.16 J	SRA-SW-107-0107-AVG	0.061	0.16	0.2	0	NA	0.014	SCV	1	11	Yes	ASL
Benzo(b)fluoranthene	1/10	0.225 J	0.225 J	SRA-SW-107-0107-AVG	0.0675	0.225	0.3	0	NA	0.6774	FCV	0	0.33	No	BSL
Benzo(g,h,i)perylene	1/10	0.145 J	0.145 J	SRA-SW-107-0107-AVG	0.0595	0.145	0.08	1	NA	0.4391	FCV	0	0.33	No	BSL
Benzo(k)fluoranthene	1/10	0.095	0.095	SRA-SW-107-0107-AVG	0.0545	0.095	0.3	0	NA	0.6415	FCV	0	0.15	No	BSL
Chrysene	1/10	0.1	0.1	SRA-SW-107-0107-AVG	0.055	0.1	0.2	0	NA	2.042	FCV	0	0.049	No	BSL
Fluoranthene	1/10	0.085	0.085	SRA-SW-107-0107-AVG	0.0535	0.085	0.3	0	NA	7.109	FCV	0	0.012	No	BSL
Indeno(1,2,3-cd)pyrene	1/10	0.135 J	0.135 J	SRA-SW-107-0107-AVG	0.0585	0.135	0.07	1	NA	0.275	FCV	0	0.49	No	BSL
Pyrene	1/10	0.08	0.08	SRA-SW-107-0107-AVG	0.053	0.08	19	0	NA	10.11	FCV	0	0.008	No	BSL
PCBs (µg/L)															
Aroclor-1248	1/10	0.34 J	0.34 J	SRA-SW-111-0107	0.124	0.34	NA	NA	NA	0.014	NRWQC	1	24	Yes	ASL
Total Inorganics (µg/L)															
Aluminum	10/10	130	1400 J	SRA-SW-111-0107	414	414	727	1	377	87	NRWQC	10	16	Yes	ASL
Arsenic	9/10	0.212 J	0.868 J	SRA-SW-111-0107	0.332	0.363	NA	NA	NA	150	NRWQC	0	0.0058	No	BSL
Barium	10/10	3.22	41.4	SRA-SW-109-0107	18.2	18.2	62.16	0	19.8	4	SCV	9	10	Yes	ASL
Beryllium	8/10	0.0576 J	0.143 J	SRA-SW-111-0107	0.0682	0.0799	NA	NA	0.0573	5.3	LOEL	0	0.027	No	BSL
Cadmium	5/10	0.0719 J	0.236 J	SRA-AQ-SW-112-0107	0.093	0.139	NA	NA	0.189	0.11	NRWQC[6]	3	2.15	Yes	ASL
Calcium	10/10	5360	8940	SRA-SW-106-0107	7160	7160	17000	0	14900	116000	LCV	0	0.077	No	NUT
Chromium	7/10	0.802 J	1.36	SRA-SW-106-0107	0.934	0.977	2.8	0	NA	31	NRWQC[6]	0	0.044	No	BSL
Cobalt	8/10	0.401 J	0.998 J	SRA-SW-111-0107	0.463	0.548	7.2	0	0.508	23	SCV	0	0.043	No	BSL
Iron	10/10	79.5	9040	SRA-SW-111-0107	2340	2340	34800	0	811	1000	NRWQC	5	9.0	Yes	ASL
Lead	10/10	0.688 J	11.6	SRA-SW-111-0107	2.97	2.97	5.86	1	4.99	0.65	NRWQC[6]	10	17.8	Yes	ASL
Magnesium	10/10	2010	2940 J	SRA-SW-111-0107	2630	2630	5120	0	3380	82000	LCV	0	0.036	No	NUT
Manganese	10/10	6.96	434	SRA-SW-110-0107-AVG	180	180	1408.29	0	167	120	SCV	6	3.6	Yes	ASL
Nickel	8/10	1.32 J	2.47 J	SRA-SW-106-0107	1.5	1.76	NA	NA	2.22	18.2	NRWQC[6]	0	0.136	No	BSL
Potassium	10/10	460	1040	SRA-SW-106-0107	642	642	6802.65	0	1300	53000	LCV	0	0.020	No	NUT
Selenium	4/10	0.104 J	0.156 J	SRA-SW-104-0107	0.0879	0.137	NA	NA	0.193	5	NRWQC	0	0.031	No	BSL
Sodium	10/10	7830 J	18500	SRA-SW-106-0107	10700	10700	163000	0	12400	680000	LCV	0	0.027	No	NUT
Vanadium	10/10	0.758 J	7.17	SRA-SW-111-0107	1.94	1.94	NA	NA	1.52	20	SCV	0	0.36	No	BSL
Zinc	10/10	14.6	36.4	SRA-SW-111-0107	24.4	24.4	54.6	0	86.6	41.6	NRWQC[6]	0	0.88	No	BSL

TABLE D-3
OCCURRENCE, DISTRIBUTION, AND SELECTION OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Parameter	Frequency of Detection	Minimum Detected Concentration[1]	Maximum Detected Concentration[1]	Sample with Maximum Detection	Average Concentration[2]	Average of Positive Detects[3]	Base Background	Number of Samples Greater than Basewide Background	Upstream Concentration (maximum detection)	Ecological Screening Level	Source of Screening Level	Number of Samples Greater than Screening Level	Ecological Effects Quotient [4]	Retained as a COPC for Aquatic Organisms?	COPC Rationale
Filtered Inorganics (µg/L)															
Aluminum	10/10	33.6 J	627	SRA-SW-106-0107	192	192	437.3	1	233	87	NRWQC	7	7.2	Yes	ASL
Arsenic	8/10	0.176 J	0.502 J	SRA-SW-110-0107-AVG	0.216	0.25	NA	NA	NA	150	NRWQC	0	0.0033	No	BSL
Barium	10/10	1.33	21.9	SRA-AQ-SW-112-0107	11.6	11.6	52.6	0	16.9	4	SCV	8	5.5	Yes	ASL
Beryllium	6/10	0.0473 J	0.0894 J	SRA-AQ-SW-112-0107	0.048	0.0656	NA	NA	0.0635	5.3	LOEL	0	0.017	No	BSL
Cadmium	1/10	0.224 J	0.224 J	SRA-AQ-SW-112-0107	0.0647	0.224	NA	0	0.137	0.1	NRWQC[6]	1	2.24	Yes	ASL
Calcium	10/10	5340	8650	SRA-SW-103-0107	7060	7060	18406.45	0	14700	116000	LCV	0	0.075	No	NUT
Chromium	2/10	0.934 J	1.26	SRA-SW-106-0107	0.513	1.1	NA	NA	NA	26.7	NRWQC[6]	0	0.047	No	BSL
Cobalt	8/10	0.522 J	4.6	SRA-SW-110-0107-AVG	2.11	2.48	6.5	0	NA	23	SCV	0	0.20	No	BSL
Iron	10/10	154	5090 J	SRA-SW-110-0107-AVG	1120	1120	22467.53	0	551	1000	NRWQC	3	5.1	Yes	ASL
Lead	6/10	0.128 J	2.12	SRA-AQ-SW-112-0107	0.811	1.2	NA	NA	0.456	0.63	NRWQC[6]	4	3.4	Yes	ASL
Magnesium	10/10	1940	2930	SRA-SW-103-0107	2560	2560	6319.35	0	3410	82000	LCV	0	0.036	No	NUT
Manganese	9/10	16.7	558	SRA-SW-110-0107-AVG	189	209	1782.47	0	166	120	SCV	5	4.7	Yes	ASL
Mercury	1/10	0.0282 J	0.0282 J	SRA-AQ-SW-112-0107	0.0241	0.0282	0.01	1	NA	0.77	0.77	0	0.0	No	BSL
Nickel	8/10	0.904 J	2.75 J	SRA-SW-106-0107	1.54	1.72	NA	NA	NA	18.1	NRWQC[6]	0	0.152	No	BSL
Potassium	10/10	307	949	SRA-SW-106-0107	596	596	23881.87	0	1260	53000	LCV	0	0.018	No	NUT
Selenium	6/10	0.094 J	0.199 J	SRA-SW-111-0107	0.116	0.156	NA	NA	0.339	5	NRWQC	0	0.040	No	BSL
Sodium	10/10	7770 J	17800	SRA-SW-106-0107	10500	10500	76278.24	0	12700	680000	LCV	0	0.026	No	NUT
Vanadium	9/10	0.386 J	3.84	SRA-SW-106-0107	0.923	1.01	NA	NA	0.848	20	SCV	0	0.19	No	BSL
Zinc	7/10	14.7	34.9	SRA-SW-103-0107	19.5	25.4	14.05	7	70.3	41	NRWQC[6]	0	0.85	No	BSL

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria and it indicates that the shaded chemical was retained as a COPC.

1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations detected concentrations and as one sample when determining the frequency of detection.
2 - Average of all analytical results are calculated using half of the detection limit for nondetects.
3 - Average of positive analytical results only.
4 - The ecological effects quotient quotient is the maximum detected concentration divided by the screening level.
5 - Ecological screening level for cis-1,2-dichloroethene used as a surrogate for total 1,2-dichloroethene.
6 - Ecological screening level calculated based on hardness values; filtered ecological screening level is calculated using conversions factors from total values. Both conversions are provided in USEPA AWQC (2006) Appendix B . A hardness of 28.7 mg/L was used for the calculations based on the average hardness in the total inorganic samples.
COPC = Chemical of Potenial Concern
NA = Not Available or Not Applicable.

Screening Level Sources and Order of Preference:
1. NRWQC - USEPA chronic freshwater National Recommended Ambient Water Quality Criteria (AWQC) (EPA, 2006)
2. FCV - Final Chronic Value (EPA, 2003)
3. LOEL - Lowest observed effects level freshwater chronic criteria (Buchman, 1999)
4. SCV - Secondary chronic value from Table 1 in Suter and Tsao (1996)
5. LCV - Secondary chronic value from Table 1 in Suter and Tsao (1996)

Rationale Codes:
For Selection as a COPC or for Further Evaluation:
ASL = Above COPC Screening Level
BSL = Below COPC Screening Level
NSL = No Screening Level Available
NSL* = No Screening Level, but risks are accounted for by individual constituents.
NUT = Essential Nutrient

TABLE D-4
FOOD CHAIN MODEL FOR SURFACE SOIL/WETLAND SEDIMENT RECEPTORS - AVERAGE SCENARIO
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

	White-Footed Mouse		Short-tailed Shrew		American Robin		Star-nosed Mole		Carolina wren	
CHEMICALS	**NOAEL-based EEQ**	**LOAEL-based EEQ**	**NOAEL-based EEQ**	**LOAEL-based EEQ**	**NOAEL-based EEQ**	**LOAEL-based EEQ**	**NOAEL-based EEQ**	**LOAEL-based EEQ**	**NOAEL-based EEQ**	**LOAEL-based EEQ**
Semivolatile Organic Compounds										
BIS(2-ETHYLHEXYL)PHTHALATE	6.1E-03	6.1E-04	1.1E-02	1.1E-03	3.3E-01	3.3E-02	1.6E-02	1.6E-03	4.6E-01	4.6E-02
Pesticides/PCBs										
AROCLOR-1260	1.2E-02	2.3E-03	1.0E-01	2.1E-02	1.2E-01	1.2E-02	1.3E-01	2.7E-02	2.2E-01	2.2E-02
ENDRIN ALDEHYDE	4.9E-03	4.9E-04	4.8E-02	4.8E-03	6.8E-01	6.8E-02	6.1E-02	6.1E-03	1.2E+00	1.2E-01
TOTAL AROCLOR	1.2E-02	2.5E-03	1.1E-01	2.3E-02	1.3E-01	1.3E-02	1.4E-01	2.9E-02	2.4E-01	2.4E-02
TOTAL DDT	5.0E-03	2.7E-04	4.4E-02	2.4E-03	4.4E-02	1.8E-03	5.6E-02	3.0E-03	7.8E-02	3.2E-03
Inorganics										
ALUMINUM	5.4E+01	5.4E+00	5.1E+02	5.1E+01	1.4E+01	1.4E+00	6.6E+02	6.6E+01	2.4E+01	2.4E+00
IRON	9.3E-03	9.3E-04	6.2E-02	6.2E-03	8.2E-01	8.2E-02	9.3E-02	9.3E-03	1.1E+00	1.1E-01
LEAD	2.3E-02	5.7E-04	1.2E-01	3.0E-03	6.2E-01	2.3E-02	1.6E-01	4.1E-03	8.9E-01	3.2E-02
MERCURY	7.3E-02	1.5E-02	6.9E-01	1.4E-01	5.3E+00	5.3E-01	8.7E-01	1.7E-01	9.5E+00	9.5E-01
SELENIUM	3.7E-02	2.2E-02	1.7E-01	1.1E-01	1.7E-01	8.3E-02	2.2E-01	1.3E-01	2.2E-01	1.1E-01
THALLIUM	8.2E-02	8.2E-03	7.1E-01	7.1E-02	NA	NA	9.3E-01	9.3E-02	NA	NA
VANADIUM	7.6E-03	4.1E-03	3.8E-02	2.0E-02	9.4E-01	1.9E-01	6.9E-02	3.7E-02	8.5E-01	1.7E-01
ZINC	3.3E-02	8.3E-03	2.5E-01	6.4E-02	4.2E-01	1.1E-01	3.2E-01	8.0E-02	6.9E-01	1.7E-01

Cells are shaded if the value is greater than 1.0

NA - Value Not Available
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE D-5
FOOD CHAIN MODEL FOR SEDIMENT RECEPTORS - AVERAGE SCENARIO
SOLVENT RELEASE AREA
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

CHEMICALS	Belted Kingfisher Ecological Effects Quotients	
	NOAEL-based	LOAEL-based
Semivolatile Organic Compounds		
2,4-DINITROTOLUENE	2.5E+00	4.9E-01
Pesticides/PCBs		
AROCLOR-1260	3.9E+00	3.9E-01
ENDRIN ALDEHYDE	4.9E+00	4.9E-01
TOTAL AROCLOR	4.1E+00	4.1E-01

Cells are shaded if the value is greater than 1.0
This table only shows the chemicals with hazard quotients greater than 1.0 in the conservative food chain model that were detected at concentrations greater than background concentrations.

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level

Appendix E
ARARs and To Be Considered Guidance

TABLE E-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBs, MONITORING, ENGINEERING CONTROLS, AND LUCs
SOLVENT RELEASE AREA FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal				
Cancer Slope Factors (CSFs)	US EPA, Integrated Risk Information System	To be considered (TBC)	Guidance used to compute individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. This alternative will meet the risk-based cleanup goals developed through the use of this guidance because the fence and PRBs will prevent exposure to COCs in surface water, source area treatment and PRBs will reduce the concentrations of COCs in groundwater, and LUCs will prevent exposure to COCs in groundwater.
Reference Doses (RfDs)	US EPA, Integrated Risk Information System	TBC	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants. This alternative will meet the risk-based cleanup goals developed through the use of this guidance because the fence and PRBs will prevent exposure to COCs in surface water, source area treatment and PRBs will reduce the concentrations of COCs in groundwater, and LUCs will prevent exposure to COCs in groundwater.

TABLE E-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBs, MONITORING, ENGINEERING CONTROLS, AND LUCs
SOLVENT RELEASE AREA FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (Continued)				
Guidelines for Carcinogen Risk Assessment	EPA/630/p-03/001F March 2005	TBC	Guidelines for assessing cancer risk	Used to calculate potential carcinogenic risks caused by exposure to contaminants. This alternative will meet the risk-based cleanup goals developed through the use of this guidance because the fence and PRBs will prevent exposure to COCs in surface water, source area treatment and PRBs will reduce the concentrations of COCs in groundwater, and LUCs will prevent exposure to COCs in groundwater.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA.630/r-03/003F March 2005	TBC	Guidance for assessing cancer risks in children	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. This alternative will meet the risk-based cleanup goals developed through the use of this guidance because the fence and PRBs will prevent exposure to COCs in surface water, source area treatment and PRBs will reduce the concentrations of COCs in groundwater, and LUCs will prevent exposure to COCs in groundwater.

TABLE E-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBs, MONITORING, ENGINEERING CONTROLS, AND LUCs
SOLVENT RELEASE AREA FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (Continued)				
Draft Guidance for Evaluating Vapor Intrusion to Indoor Air Pathways from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)	EPA 530-D-02-004 November, 2002	TBC	Guidance for assessing vapor intrusion risk.	Since the future use includes structures on the site, assessment of potential vapor intrusion risks will be conducted in accordance with the guidance and LUCs that address building design and construction methods will control exposure.
Health Advisories	EPA Office of Drinking Water, EPA-822-R-04-003, January, 2004	TBC	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants which do not have chemical-specific ARARs where groundwater may be used for drinking water. The non-enforceable federal guideline Health Advisory for manganese is 0.3 mg/l.	This alternative will achieve these guidelines since non-carcinogenic risk resulting from exposure to compounds identified in the Health Advisory (e.g., manganese) will be addressed by monitoring. Land use controls will prevent short-term exposure until protective levels are reached. Would not be considered where the background concentration is greater than the health advisory value.

TABLE E-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBs, MONITORING, ENGINEERING CONTROLS, AND LUCs
SOLVENT RELEASE AREA FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State				
Massachusetts Contingency Plan – GW-3 Standards	310 CMR 40.0974(2)	TBC	These standards are applicable in areas where groundwater is considered to be GW-1, GW-2, or GW-3 per 310 CMR 40.0932.	Risk-based PRGs will be compared to the GW-3 standards, and the GW-3 standards will be used when less than the risk-based PRGs.
Massachusetts Surface Water Quality Standards	314 CMR 4.00	TBC	Establishes enforceable water quality standards for surface water.	Surface water monitoring will be performed for this alternative to ensure protection to surface water.

TABLE E-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs - ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBs, MONITORING, ENGINEERING CONTROLS, AND LUCs
SOLVENT RELEASE AREA FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Floodplain Management and Protection of Wetlands	44 Code of Federal Regulations (CFR) 9	Relevant and Appropriate	FEMA regulations that set forth the policy, procedure and responsibilities to implement and enforce Executive Order 11990, Protection of Wetlands.	Remedial alternatives such as source area treatment conducted within federal jurisdictional wetlands will be implemented in compliance with these standards.
Clean Water Act, Section 404; Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	33 United States Code (USC) 1344; 40 CFR 230, 231 and 33 CFR 320-323	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative with lesser effects is available. If activity takes place, impacts must be minimized to the maximum extent. Controls discharges of dredged or fill material to protect aquatic ecosystems. Filling or discharge of dredged material will only occur where there is no other practicable alternative and any adverse impacts to aquatic ecosystems will be mitigated.	Remedial activities, such as source area treatment will involve fill material discharge to wetlands. If there is no practicable alternative to the discharge, any adverse impacts must be minimized and mitigated. A Least Environmentally Damaging Practicable Alternative determination to protect wetland resources and provide the best balance of addressing contaminated media within and adjacent to wetlands with minimizing both temporary and permanent alteration of wetlands and aquatic habitats on site will be made when the remedy is selected.

TABLE E-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs - ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBs, MONITORING, ENGINEERING CONTROLS, AND LUCs
SOLVENT RELEASE AREA FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal (Continued)				
Fish and Wildlife Coordination Act	16 USC 661 et seq.,	Applicable	Enacted to protect fish and wildlife when federal actions result in the control or modification of a natural stream or body of water. Requires federal agencies to take into consideration the effect that water-related projects would have on fish and wildlife resources; to take action to prevent loss or damage to those resources; and to provide for the development and improvement of those resources.	All construction will be conducted in a manner to mitigate impacts. Actions taken will minimize adverse impacts to fish and wildlife. Relevant federal and state agencies will be contacted and allowed to review the proposed work plan for the fence, source area treatment, PRB installation, and monitoring well installation prior to implementation.
State				
Massachusetts Endangered Species Act	Massachusetts General Laws (MGL) Ch.,131A 321; Code of Massachusetts Regulations (CMR) 10.00	Applicable	Sets out authority to research, list, and protect any species deemed endangered, threatened, or of other special concern. Actions must be conducted in a manner that minimizes the effect on listed Massachusetts species.	A state-listed species of special concern (Eastern Box Turtle) has been observed at the base, but not at the SRA site. Appropriate measures will be taken during remedial actions to ensure that the species is not harmed by the alternative.

TABLE E-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs - ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBs, MONITORING, ENGINEERING CONTROLS, AND LUCs
SOLVENT RELEASE AREA FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State (Continued)				
MA Wetlands Protection Act	310 CMR 10.00	Applicable	These regulations govern activities in freshwater wetlands, 100-year floodplains, 100-foot buffer zones beyond such areas, and 200-foot buffer zones to waterways. Regulated activities include certain types of construction and excavation activities. Performance standards are provided and include evaluating the acceptability of various activities.	Any temporary disturbance of a wetland during fence installation, source area treatment, PRB installation, or monitoring well activities will be restored.

TABLE E-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs - ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBS, MONITORING, ENGINEERING CONTROLS, AND LUCs
SOLVENT RELEASE AREA FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal				
Resource Conservation and Recovery Act (RCRA)	42 USC § 6901 et seq.	Applicable	Federal standards used to identify, manage, and dispose of hazardous waste. Massachusetts has been delegated the authority to administer the RCRA standards through its state hazardous waste management regulations.	Specific state hazardous waste standards authorized under the Act would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic, such as contaminated purge water from groundwater sampling or contaminated material generated from well installation or maintenance. Existing data to not indicate that any wastes will be hazardous.
Underground Injection Control (UIC)	40 CFR 144,146, and 147.1100	Applicable	These regulations address the discharge of wastes, chemicals or other substances into the subsurface. The federal UIC program designates injection wells incidental to aquifer remediation and experimental technologies as Class V wells authorized by rule that do not require a separate UIC permit. State requirements apply in this case; see 310 CMR 27.00 below.	These standards regulate the injection of biological or chemical substance into the groundwater. In-situ treatment using bioremediation will be conducted in compliance with these standards.
Clean Water Act Section 402 -- National Pollution Discharge Elimination System (NPDES)	40 CFR 122-125, 131, 136	Applicable	Includes discharge limitations, monitoring requirements, and best management practices. Substantive requirements under NPDES are written such that state and federal ambient water quality criteria (AWQC) are met.	The standards apply to the digging of the trench and any dewatering of wetlands. The standard would apply only if there were a discharge associated with the remedial activities.

TABLE E-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs - ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBS, MONITORING, ENGINEERING CONTROLS, AND LUCs
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Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
CAA National Emission Standards for Hazardous Air Pollutants (NESHAPs)	42 U.S.C § 7412 40 CFR Parts 61 and 63	Applicable	The regulations establish emission standards for 189 hazardous air pollutants. Standards are set for fugitive dust and other release sources.	If remedial activities generate regulated air pollutants, then measures will be implemented to meet the standards.
State				
Hazardous Waste Rules for Identification and Listing of Hazardous Wastes,	310 Code of Massachusetts Regulations (CMR) 30.100	Applicable	Establish requirements for determining whether wastes are hazardous. Defines listed and characteristic hazardous wastes.	These regulations would apply when determining whether or not a solid waste generated as part of this remedial action is classified as hazardous, such as soil cuttings from injection wells, soil from PRB installation, contaminated purge water from groundwater sampling or contaminated material generated from well installation or maintenance. Existing data do not indicate that any wastes will be hazardous, other than soil cuttings from wells in the source area.
Hazardous Waste Management Rules – Requirements for Generators	310 CMR 30.300	Applicable	These regulations contain requirements for generators of hazardous waste. The regulations apply to generators of sampling waste and also apply to the accumulation of waste prior to off-site disposal.	Hazardous wastes generated as part of the remedial action will be handled in compliance with the requirements of these regulations.

TABLE E-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs - ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBS, MONITORING, ENGINEERING CONTROLS, AND LUCs
SOLVENT RELEASE AREA FEASIBILITY STUDY
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WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (Continued)				
Management Procedures for Remedial Wastewater and Remedial Additives	310 CMR 40.0040	Applicable	Establishes requirements and procedures for the management of remedial wastewater and/or remedial additives, and for the construction, installation, modification, operation and maintenance of treatment works for the management of remedial wastewater and/or remedial additives.	These regulations would apply to remedial actions that involve underground injection, such as an electron donor for bioremediation of source area. To ensure that the remedial action complies with the substantive requirements of these regulations, the proposed quantities to be injected will be included in the design and submitted to EPA and MassDEP for comment and concurrence and the groundwater monitoring program will assess the impact of the injected compounds.
Underground Injection Control Program	310 CMR 27.00	Applicable	The federal Underground Injection Control program under the Safe Drinking Water Act has been delegated to the Commonwealth of Massachusetts. Establishes a State Underground Injection Control Program consistent with federal requirements to protect underground sources of drinking water.	The regulations apply to remedial actions involving underground injection, including use of bioremediation agents. To ensure that the remedial action complies with the substantive requirements of these regulations, the proposed quantities to be injected will be included in the design and submitted to EPA and MassDEP for comment and concurrence and the groundwater monitoring program will assess the impact of the injected compounds.

TABLE E-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs - ALTERNATIVE G-5A – OVERBURDEN AND BEDROCK SOURCE ZONES ENHANCED BIOREMEDIATION, TWO OVERBURDEN PRBS, MONITORING, ENGINEERING CONTROLS, AND LUCs
SOLVENT RELEASE AREA FEASIBILITY STUDY
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WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (Continued)				
Certification of Well Drillers and Filing of Well Completion Reports	313 CMR 3.03 (predecessor regulations); 310 CMR 46	Applicable	Requirements relating to well abandonment	Well drillers will follow all regulatory requirements for drilling and decommissioning of wells.
Standard References for Monitoring Wells	WSC-310-91 MADEP April 1991	TBC	This guidance describes the technical requirements for locating, drilling, installing, sampling and decommissioning monitoring wells.	Applies to wells installed for monitoring and/or groundwater treatment.
Erosion and Sediment Control Guidance		To Be Considered	This guidance includes standards for preventing erosion and sedimentation.	Remedial actions, particularly installation and maintenance of wells and other components of the remedy, will be managed to control erosion and sedimentation.
Air Pollution Control - Dust, Odor, Construction and Demolition	310 CMR 7.09	Applicable	Requires control of dust and particulate emissions from construction operations.	Water sprays and other dust suppression methods will control dust from excavation and backfill of PRBs.

Appendix F
Public Hearing Transcript and Comments Received on the Solvent Release Area Site Proposed Plan

Proposed Plan

Solvent Release Area (SRA) - Operable Unit 14

Former Naval Air Station South Weymouth

Weymouth, Massachusetts

Public Hearing

8:00 p.m.

New England Wildlife Center

500 Columbian Street

South Weymouth, MA

Wednesday, February 27, 2013

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Hearings ◆ Conferences ◆ Legal Proceedings

P R O C E E D I N G S

MR. GOODRICH: If there is anybody who wasn't here at the beginning of the public meeting, please be sure that you signed in over there. And if anyone who is going to make a formal comment for the public hearing, would you just state your name and any affiliation for the record.

I just want to draw your attention to this first page here and repeat what Dave mentioned in his information presentation, that you have several ways that you can present formal comments. Tonight you can read them into the record or you can provide written comments by the March 23rd deadline, either by mail to Brian Helland or by email to Brian Helland.

Is there anybody who would like to make a statement for the record during the hearing tonight?

Yes, please.

MS. HILBERT: Anne Hilbert, Weymouth. Right from the beginning when this was turned over to the three towns it was mentioned that we could get water. There was a pond that we could get water

from down below. And from the language that I just heard tonight, I don't have much faith. They haven't identified their water source. I don't feel confident.

MR. GOODRICH: Any other comments?

MS. HILBERT: Another thing. When are we going to identify their water source and make a lot of people very happy?

MR. GOODRICH: As a public hearing you can make comments but there are no answers to the questions.

Yes.

MS. PARSONS: Mary Parsons, Rockland. I would agree with Anne. I would really like to have some kind of permanent land use controls or institutional controls on the groundwater, not only for drinking water but also for irrigation because this was a well-hidden base. Quite frankly unless the regulator is right there, they can drop a well and have it running. They may not get anything but it may be quite a while before someone comes across that well. They've already been caught doing other things that they're not supposed to.

MR. GOODRICH: Yes.

MR. SMART: Michael Smart, Weymouth. I guess I just have a question with regard to the boundaries of what you had up on the slide which is that yellow area.

One would be approximately how many acres or how big is that area?

The second question is how close where this is in the mixed use open space and rec area, how close could they put a park or ball field or walking trail if that fence is temporary and comes down? How close can those people get to walk near that or be near that or a building or a ball field or something like that to either notify or signify that that area is restricted, a land use control and the restrictions that are in there, will there be any signs? Once the fence is gone who would be able to tell us what is there?

MR. GOODRICH: Yes. Please state your name.

MR. PUNCHARD: Daniel Punchard. Have you ever investigated plant life in areas that are considered contaminated?

MR. GOODRICH: We're in the public hearing now. You can make a comment but there are no answers to questions during the public hearing.

MR. PUNCHARD: Okay.

MR. GOODRICH: Yes.

MS. HILBERT: Also the people of Weymouth deserve an answer on the water, and I would like that read into the record because 2 months ago one of our counselors said it would be coming, and the answer would be coming in six weeks.

MR. GOODRICH: Any other comments tonight for the record? You have until March 23rd to submit written ones. If there are none we'll close the public hearing.

(The proceedings adjourned at 8:17 p.m.)

C E R T I F I C A T E

I hereby certify that the foregoing 4 pages contain a full, true and correct transcription of all my stenographic notes to the best of my ability taken in the above-captioned matter at said time and place.

Carol DiFazio
Registered Professional Reporter

[redacted] [redacted]

COMMENT SHEET – Proposed Plan for the SRA Site

Use this space to write your comments or to be added to the mailing list.

The Navy encourages your written comments on the Proposed Plan for the SRA Site, Former NAS South Weymouth, Weymouth, Massachusetts. You can use the form below to send written comments. If you have questions about how to comment, please contact Brian Helland at (215) 897-4912 or via email at brian.helland@navy.mil.

This form is provided for your convenience. Please mail this form or additional sheets of written comments, postmarked no later than March 23, 2013, to the address shown below:

Mr. Brian Helland
Remedial Project Manager
BRAC Program Management Office, Northeast
4911 South Broad Street
Philadelphia, PA 19112

MR. HELLAND, MARCH 16, 2013

WHILE NOT PERFECT THE NAVY EFFORTS TO CLEAN UP THE NAS SOUTH WEYMOUTH IT IS AS CLOSE AS HUMANLY POSSIBLE.

CONSISTANT TO OBTAIN SCIENTIFIC DATA, DETERMINED TO LET THE DATA LEAD TO A RESPONSIBLE CONCLUSION TO TRANSFER CLEANED LAND PARCELS.

IT IS DIFFICULT TO SEE ELECTED POLITICIANS WHISPER & SPREAD MISINFORMATION IN A NAKED SUPPORT OF A RUSH TO TRANSFER LAND TO A WELL KNOWN GREEDY DEVELOPER (LNR / CERBURUS CAPITAL MANAGEMENT HEDGE FUND)

GO NAVY, THERE ARE THOSE WHO HAVE WATCHED FROM DAY ONE, WE APPRECIATE THE COMMITMENT, THE EFFORT AND THE TIMELY UPDATE REPORTS OF THE PROGRESS THAT KEEP US INFORMED.

Comment Submitted by: DOMINIC GALLUZZO

Address: 86 CANTON ST WEYMOUTH, MA 02189

From: Mary Parsons [mailto:maryaparsons@verizon.net]
Sent: Thursday, March 21, 2013 20:11
To: Barney, David A CIV NAVFACHQ, BRAC PMO; Helland, Brian J CIV NAVFAC MIDLANT, EV
Cc: Anne.Malewicz@state.ma.us; David.Chaffin@state.ma.us; olson.bryan@epamail.epa.gov; Carol Keating; fitzy63@comcast.net; BSortin@aol.com; emily.sweeney@yahoo.com; ESweeney@globe.com; Murphy.Jim@epamail.epa.gov; joanne_marques@yahoo.com; gdgalluzzo@verizon.net; Swabeeone@aol.com; onwhitmanspond@gmail.com
Subject: Comments to Proposed Plan Solvent Release Area(SRA) Operable Unit 14 former Naval Air Station South Weymouth, Massachusetts

Please accept my comments to the Proposed Plan Solvent Release Area(SRA) - Operable Unit 14 Former Naval Air Station South Weymouth, Weymouth, Massachusetts:

Although Alternative G-5A Overburden and Bedrock source Zone Enhanced Bioremediation, Two Overburden PRB's, Engineering Controls, and LUC's is an agressive remediation of the Solvent Release Area(SRA) the issue of zoning changes in the future to the SRA is not addressed. Institutional Land Use Controls should be used to prevent any zoning change to the SRA except a change to passive open space. The SSTTDC could preumably change the zoning without the Navy's knowledge. The issue of controls to prevent housing in or near the affected area is not addressed in the proposed cleanup plan. Also I agree with the ARAWH consultants comments concerning all groundwater issues and would like a written response to these issues and the zoning issues.

The Master developer, Lennar and then LNR South Shore, LLC are home builders and currently do not have a very good track record at the former NAS South Weymouth when it comes to fulfilling other obligations like attracting commercial development and building the amenties they are responsible to build. Currently they are being sold to another large home builder. The unkown is if the zoning will change in the future. It should not be allowed to change to residential in the future. A permanent deed restriction could solve this problem. Children should not be allowed to do sports activities on this property until all remediation is achieved. If indoor recreation is built here, will there be air quality monitoring of vapor issues in this area?

Mary Parsons
754 Union St.
Rockland, MA 02370
maryaparsons@verizon.net

Memorandum

To: *Advocates for Abington, Rockland, Weymouth and Hingham (ARAWH)*

From: *Stephen G. Zemba, Ph.D., P.E., Michael E. Miller, Ph.D., and Richard R. Lester*

Date: *March 22, 2013*

Subject: *Comments on the Navy's Plan for Remediating the Solvent Release Area*

We write to provide comments on the Navy's proposed Plan for remediating the chlorinated solvent plume at the Solvent Release Area (SRA). As you know, the Plan (Alternative G5A) calls for injection of chemicals into groundwater in the most contaminated (source) area, installation of two permeable reactive barriers (PRBs) prior to the point where the overburden aquifer discharges to the East Mat Ditch, and deed restrictions to prevent access to the contaminated groundwater and limit land use to activities that will keep exposure to the contaminants at acceptably minimal levels.

We reiterate our opinion that the Navy should be encouraged to follow through on its intended clean up, as it has selected the most aggressive approach of the options identified in the SRA Feasibility Study (FS). However, potential reasons for concern remain, as there is no guarantee that the selected approach will reach the desired cleanup goals. The Navy has projected a 50+ year horizon for the remediation. This means that institutional controls on the area will likely need to be kept in place for a considerable period (including diligent groundwater monitoring). Moreover, as we note in more specific comments below, the performance of the Navy's planned remedy could potentially be improved by including additional design elements, expanded treatment in certain areas, and additional monitoring of the active treatment zones.

Our comments are structured along the lines of the tasks we outlined in our March 4, 2013 e-mail message. We first review the Navy's responses to our previous comments on the SRA FS and re-examine the adequacy of the risk-based preliminary remediation goals (PRGs) and institutional controls. Next, we examine the possible consequences of wells being installed outside of the region that will be subject to institutional controls, particularly for wells installed for non-potable uses (which could easily evade regulatory oversight). Last, we review the technical components of the Plan's proposed Alternative 5A remedy and (where appropriate) offer suggestions for treatment expansion and data collection that will help monitor the progress and success of the remedial measures.

Review of Previous Responses to Comments

The Navy provided point-by-point responses to comments offered by ARAWH on the April 2012 revised draft final Feasibility Study report for the SRA. Generally, the Navy's responses were satisfactory. However, we remain concerned about one of our comments that focused on the need for additional Land Use Controls (LUCs) to prohibit residential development. LUCs are an essential part of the Plan to prevent opportunities for exposure to contaminants that could lead to significant health risks. We previously commented that restrictions on residential development should be part of the LUCs developed for the site. The Navy disagreed. Selected Alternative G5A includes no residential use restrictions, but rather requires permanent LUCs to prevent the installation of groundwater supply wells on the site and interim LUCs for construction projects. This remedy does not necessarily protect human health. Once the Navy achieves its preliminary remediation goals (PRGs), the SRA land can presumably be transferred to developers. However, the PRGs do not cover vapor intrusion into residences because the SRA site is not currently zoned for residential use. If (1) PRGs are met, (2) the Navy transfers the land, and (3) zoning is changed to allow residential development (say south of the East Mat Ditch), then there could be unacceptable risks to human health.

On a related issue, there was previous discussion of the need for LUCs to prevent the construction of certain types of buildings related to recreational facilities, as these could be located south of the East Mat Ditch under present zoning plans. These LUCs are required to prevent potential risks from vapor intrusion. The Plan does not mention these LUCs, which should be included as part of the remedy.

Installation of Wells Outside of the Groundwater Protection Zone

Given the pressure to find water supplies for the redevelopment of the base, it is possible that groundwater supply wells could be installed even in low yielding aquifers. If installed for irrigation or other non-potable uses, these wells could receive minimal or no regulatory review. Consequently, the Navy should develop calculations to determine how close a non-potable water supply well could be placed to the groundwater restriction zone and safely yield water without the danger of drawing contamination toward it. We cannot locate calculations of groundwater drawdown potential, or related information in the Remedial Investigation (RI) or Feasibility Study (FS) reports.[1] It is thus paramount that the groundwater restriction zone contain a sufficiently large buffer around the contaminated zone, and that plans for ongoing monitoring include a sufficient number of sentinel wells to check for changes in groundwater flow patterns and potential contaminant migration. Alternatively, additional measurements and modeling calculations could be performed to simulate realistic scenarios of existing, planned, or anticipated non-potable water supply wells within the influence of the SRA on the Site.

[1] If such information does exist, please direct us to its location.

Review of the Alternative 5A Remedial Measures

Bedrock Source Zone In-Situ Enhanced Bioremediation. The extent of PCE impacts in bedrock groundwater is not very well defined due to the low density of groundwater monitoring wells in the bedrock aquifer. Thus, both the downgradient extent of the bedrock PCE plume and the extent of the bedrock in-situ bioremediation target treatment zone (TTZ) include a great deal of uncertainty.

The bedrock TTZ was chosen to include areas where groundwater PCE concentrations are estimated to be approximately 8,000 μg/L or higher. The bedrock TTZ is small and limited to the immediate vicinity of monitoring well MW10-405D, where such high PCE concentrations are observed. However, the next nearest bedrock monitoring wells are relatively far away in all directions. There are no bedrock monitoring wells within the footprint of the overburden TTZ, or between the bedrock and overburden TTZs. It seems likely that the area of higher bedrock groundwater PCE concentrations is more extensive and overlaps (at least somewhat) with the overburden hot zone. Thus, in order to provide more thorough, targeted groundwater source reduction, the Navy should review the size and extent of the bedrock TTZ and consider expanding it to at least overlap with the overburden TTZ's footprint.

Permeable Reactive Barrier (PRB). In the FS, the Navy expresses concern that the PRBs may further mobilize arsenic present in the aquifer. To correct this situation if it should arise, they discuss additional treatment consisting of oxygen addition between the PRB and the East Mat Ditch (EMD). The Navy should consider a simpler and more pre-emptive solution to the risk of arsenic mobilization that will also be more protective of the groundwater and surface water in the area. This alternative solution would be to include zero valent iron (ZVI) within the mulch PRB. The ZVI would promote arsenic co-precipitation with the wall-generated iron sulfides, thus completely immobilizing any dissolved arsenic (in both its possible oxidation states). Furthermore, the ZVI would also create more highly reducing conditions, thereby promoting abiotic degradation (in addition to biodegradation) of the PCE without the formation of the intermediate vinyl chloride, which is more toxic than the parent compound.

As proposed, the PRBs will promote anaerobic groundwater chemistry. This could result in greater dissolution of iron, manganese, and arsenic, and the water discharging to the EMD may have greatly increased concentrations of these metals. If this occurs, the iron could precipitate as floc and add to the orange discoloration in the EMD, aesthetically degrading the surface water and potentially increasing ecological stress. This concern may merit further evaluation.

Monitoring of Bioremediation Progress. The planned monitoring program during the remedial phase appears to be limited to a small number of monitoring wells, and only to measure groundwater concentrations of the main chemicals of concern: the chlorinated ethene compounds, arsenic, iron, and manganese. The Navy should consider expanding the monitoring program to more thoroughly follow the groundwater bioremediation processes. The additional data will allow

for periodic review of the remediation program's effectiveness, and further optimization as the remediation progresses.

An expanded groundwater monitoring program would then include wells in both overburden and bedrock located immediately upgradient and downgradient of both PRBs, within the TTZs, and upgradient and downgradient of the TTZs. The Navy should also consider adding analytical chemistry parameters to the monitoring program in order to measure the groundwater biogeochemical changes created by the PRBs and in the TTZs. These non-pollutant parameters would include dissolved organic carbon, total alkalinity, redox potential, pH, dissolved oxygen, nitrate, ferrous iron, sulfate, methane, ethane, and ethene.

Mr. Brian Helland
Remedial Project Manager
BRAC Program Managgement Office, Northeast
4911 South Broad Street
Philadelphia, PA 19112

Attention Mr. Helland

The allowable uses passed by the zoning board should not be alowed. There is a reason why when this land was transfered this piece of land was held back.

The contaminents at this site in your document has (LUC)'s land use controls and should protect the Construction workers at this site. Those working at this site should be informed of these conditions and the dangers it might cause thier health before they take the job.

There also should be signs visable notifying recreational visitors of the danger of these contaminents.

It is for all these reasons on your "comparison Remedial Alternatives" This should be moved from a poor rating to a best in your ratings.

The deed restriction that will be placed on the FFTA site upon land transfer should be public information.

Additional permanent wells are also necessary.

Anne Hilbert
45 Doris Drive
North Weymouth Ma 02191