Feasibility Study Report

For

Building 81

Former Naval Air Station South Weymouth
Weymouth, Massachusetts

Naval Facilities Engineering Command
Mid-Atlantic

Contract Number N62470-08-D-1001
Contract Task Order WE11

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FEASIBILITY STUDY REPORT

FOR

BUILDING 81

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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ABBREVIATIONS AND ACRONYMS

AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	Below ground surface
BRAC	Base Realignment and Closure
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cis-1,2-DCE	cis-1,2-Dichloroethene
CLEAN	Comprehensive Long-Term Environmental Action Navy
CMR	Code of Massachusetts Regulations
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COC	Contaminant of concern
cPAH	Carcinogenic Polycyclic Aromatic Hydrocarbon
CTO	Contract Task Order
CVOC	Chlorinated volatile organic compound
CWA	Clean Water Act
DO	Dissolved oxygen
DOD	Department of Defense
DNAPL	Dense non-aqueous phase liquid
DPT	Direct push technology
EBS	Environmental Baseline Survey
ED	Electron Donor
EOS	Emulsified oil substrate
FS	Feasibility Study
Ft	feet
ft/d	Foot per day
GHG	Greenhouse gas
GPM	gallons per minute
GRA	General response action
H_2	Hydrogen
HHRA	Human health risk assessment
HI	Hazard index
HNUS	Halliburton NUS
IR	Installation Restoration

IRA	Immediate Response Action
ISCO	In-situ chemical oxidation
LNAPL	Light non-aqueous phase liquid
LNR	LNR Property Corporation South Shore LLC
LUC	Land use control
MassDEP	Massachusetts Department of Environmental Protection
MassGIS	Massachusetts Geographic Information System
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MCP	Massachusetts Contingency Plan
mg/kg	Milligram per kilogram
MMBTU	Million British thermal Unit
MNA	Monitored natural attenuation
MUVD	Mixed-Use Village District
NA	Natural attenuation
NAPL	Non-aqueous phase liquid
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NCP	National Contingency Plan
NERP	Navy Environmental Restoration Program
NO_X	Nitrogen oxides
NPW	Net Present Worth
NRWQC	National Recommended Water Quality Criteria
O&M	Operation and maintenance
ORC	Oxygen-release compound
ORP	Oxygen reduction potential
OSHA	Occupational Safety and Health Act
OSWER	Office of Solid Waste and Emergency Response
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PM_{10}	Particulate matter less than 10 micrometers in diameter
PMO	Program Management Office
PPE	Personal protective equipment
PRB	Permeable reactive barrier
PRG	Preliminary Remediation Goal
RAM	Release Abatement Measure

RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RecD	Recreation District
RI	Remedial Investigation
RIA	Review Item Area
RME	Reasonable maximum exposure
ROD	Record of Decision
SI	Site Investigation
SO_X	Sulfur oxides
sq. ft.	square feet
SSTTDC	South Shore Tri-Town Development Corporation
SVOC	Semivolatile organic compound
TACAN	Tactical Air Navigation
TBC	To be considered
TCE	Trichloroethene
Tetra Tech	Tetra Tech Inc.
TOC	Total organic carbon
TPH	Total petroleum hydrocarbon
TTZ	Target treatment zone
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
VC	Vinyl chloride
VCD	Village Center District
VOC	Volatile organic compound
µg/L	Microgram per liter
ZVI	Zero valent-iron

1.0 INTRODUCTION

1.1 PURPOSE AND ORGANIZATION OF REPORT

1.1.1 Purpose

This Feasibility Study (FS) was prepared for Building 81 Site (the Site), located at the former Naval Air Station (NAS) South Weymouth, in Weymouth, Massachusetts (the Base), in accordance with Contract Task Order (CTO) WE11 under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62470-08-D-1001. The document was prepared to fulfill the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and is consistent with the United States Environmental Protection Agency (USEPA) "Guidance for Conducting Remedial Investigations (RIs) and FSs Under CERCLA" (1988) and the "Navy Environmental Restoration Program (NERP) Manual," Chapter 8, RI/FS (Navy, 2006). This FS Report describes the formulation and evaluation of remedial alternatives for contaminated groundwater at the Site. The FS establishes Remedial Action Objectives (RAOs) and cleanup goals; screens remedial technologies; and assembles, evaluates, and compares remedial alternatives. The FS was based on data collected during previous investigations, specifically a series of RIs conducted in 2005, 2006, and 2009 and soil investigations conducted from 1995 through 1999. Those investigations culminated in the completion of the RI report for the Site (Tetra Tech, Inc. [Tetra Tech], 2011). The RI evaluated contaminant nature, extent, fate and transport, and calculated the potential risks to human health and the environment that are associated with exposure to the identified contaminants.

The purpose of the FS is to gather and evaluate information sufficient to develop and evaluate a range of remedial alternatives designed to mitigate potential risks to human health resulting from past Navy activities at the Site. Within an FS report, the results of an RI are used to develop and evaluate potential remedial alternatives that permanently and significantly reduce the risks to human health and the environment identified at the Site. The alternatives should provide cost-effective methods to mitigate the identified risks, and the range of alternatives should be adequate so that consensus can be reached between the Navy and regulatory agencies regarding the selected response action.

Subsequent to the FS, the Navy will present the preferred remedial alternative in a Proposed Plan for public comment. Following a 30-day public comment review period, the Navy will select the remedial alternative(s) and will seek concurrence of the USEPA and the Massachusetts Department of Environmental Protection (MassDEP). The final remedial alternative(s) will be presented in a Record of Decision (ROD).

1.1.2 Document Organization

This document has been organized with the intent of meeting the general format requirements specified in the RI/FS Guidance Document (USEPA, 1988). The report is divided into the following sections:

- Section 1.0 – Introduction: summarizes the purpose of the report, provides site background information, summarizes the findings of the RI, and provides the report outline.
- Section 2.0 - RAOs and General Response Actions (GRAs): presents the RAOs, identifies Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) criteria, develops groundwater cleanup goals and associated GRAs, and provides estimates of the volumes of contaminated media to be remediated.
- Section 3.0 - Screening of Remediation Technologies and Process Options: provides a two-tiered screening of potentially applicable soil and groundwater remediation technologies and identifies the technologies that were assembled into remedial alternatives.
- Section 4.0 - Assembly and Detailed Analysis of Remedial Alternatives: assembles the remedial technologies retained from the Section 3.0 screening process into multiple soil and groundwater remedial alternatives, describes these alternatives, and performs a detailed analysis of these alternatives in accordance with seven of the nine remedy selection criteria set forth in 40 Code of Federal Regulations (CFR) Part 300.430 of USEPA's National Contingency Plan (NCP).
- Section 5.0 - Comparative Analysis of Remedial Alternatives: compares the groundwater remedial alternatives on a criterion-by-criterion basis, for each of the seven CERCLA analysis criteria used in Section 4.

Appendix A contains selected data tables from the RI Report. The RI Report includes all of the analytical data, figures and a comprehensive discussion of the information summarized in Section 1.3. Appendix B contains calculations for vapor intrusion preliminary remediation goals (PRGs). Appendix C contains computations of contaminated media volumes. Appendix D contains remedial alternatives conceptual design calculations. Appendix E contains the Biochlor Model. Appendix F contains the Sustainable Remediation Evaluation. Appendix G contains the cost estimates. Appendix H contains an evaluation and cost estimate for soil excavation in the source area.

1.2 BACKGROUND INFORMATION

The following paragraphs provide background information about the Base and the Building 81 Site including Base history, study area setting, and site description and history.

1.2.1 NAS South Weymouth

The former NAS South Weymouth is comprised of approximately 1,442 acres located approximately 20 miles southeast of Boston. The Base is located primarily in the Town of Weymouth, Norfolk County, Massachusetts. Portions of the Base also extend into the adjacent towns of Abington and Rockland, Massachusetts; the town of Hingham forms the northeast boundary of the Base. The Base is located in an urban area, with primary access from Route 18 in Weymouth as illustrated in Figure 1-1.

NAS South Weymouth was commissioned during the 1940s to support dirigible aircraft used to patrol the North Atlantic during World War II. The facility was closed in 1949 and then reopened in 1953 as a naval air station for aviation training. NAS South Weymouth was designated for closure under the Base Realignment and Closure Act of 1990 (BRAC), as part of the BRAC Commission's 1995 Base Closure List (BRAC IV). In September 1996, operational closure of NAS South Weymouth began with the transfer of aircraft to other Navy facilities, and through personnel reduction. Between 1996 and 1997, NAS South Weymouth provided facilities for limited ground training to Marine and Naval reserve units (EA, 1998). NAS South Weymouth was closed administratively under BRAC on September 30, 1997. Because of the closure, the facility was placed in caretaker status under the supervision of the Naval Facilities Engineering Command (NAVFAC) and is currently under the supervision of the NAVFAC BRAC Program Management Office (PMO) Northeast. Portions of the Base property have been transferred by the Navy to the local reuse authority and are undergoing redevelopment.

As part of the Base closure, an environmental baseline survey (EBS) was conducted to support the Navy's compliance with CERCLA Section 120, as amended by Public Law 102-426, Community Environmental Response Facilitation Act, and state and local real property transfer disclosure notification regulations. The purpose of the EBS was to support environmental restoration programs, base closure, and property transfers/leases. The Phase I EBS investigation was conducted for those areas of the base property not already addressed by the Installation Restoration (IR) program or the Massachusetts Contingency Plan (MCP). The information collected during the Phase I EBS was used to identify specific areas of environmental concern and to recommend the level of further investigation required for each of these areas. Areas targeted for additional investigation were designated as Phase II EBS review item areas (RIAs) in the Phase I EBS Report. Phase II EBS investigations were conducted at these RIAs. The investigations included collecting environmental samples (soil, groundwater, sediment, surface water) from each RIA and analyzing these samples for target contaminants. Results of environmental sample analyses were evaluated and those RIAs with laboratory results exceeding screening criteria became Areas of Concern (AOCs). AOCs were then investigated in accordance with CERCLA requirements, under the IR program.

1.2.2 Building 81

The Building 81 Site is located in the central portion of former NAS South Weymouth, approximately 4,500 feet (ft.) southeast of the main entrance to the Base on Route 18. The Site is fenced and is bounded by Shea Memorial Drive to the west, Redfield Road to the north, an overgrown, heavily vegetated area to the east, and Building 140 to the south. The fenced area of the Site is comprised of approximately 1 acre of level land occupied by the former Building 81 foundation (a concrete slab) and paved areas to the east and south. A large excavated area that has been backfilled but not repaved is located on the Site east of the building slab as depicted in Figure 1-2.

Building 81 was used for motor pool (i.e., vehicle maintenance) activities from the time of its construction until Base closure. The exact age of Building 81 is not available; however, facility drawings dated March 1955 indicate that the building was present at that time and was used by the National Guard for motor pool activities. The facility was later taken over by Marine reservists; approximately 25 people typically worked at Building 81 on a full-time basis. Up to 200 Marine Reservists may have used Building 81 during training on weekends, which occurred up to three times per month when the Base was operational.

Building 81 was a one-story structure measuring 80 ft. by 100 ft. The building was constructed on a concrete slab foundation and was divided into several rooms. The southern half of the building consisted of a large open area with small service/utility rooms in the northeast and southwest corners. The northern half was divided into several smaller rooms including a classroom, storage area, ordnance vault, locker room, kitchen, offices, and bathrooms. The building had two floor drains: one in the western part of the large open bay, which was connected into the sanitary sewer; and the other in the service room in the southwest corner of the building, which was connected to the storm drain system. Information about the floor drain system and subsurface utilities is provided below:

- The floor drain in the Assembly Hall (Figure 1-3) leads to the former kitchen. According to plot plans, wastewater from the kitchen discharged from the former building via a 6-inch sanitary sewer line oriented east-west that connects to a 10-inch sanitary sewer line oriented north-south on the west side of Shea Memorial Drive. The 6-inch pipeline is depicted on Figure 1-2 between the “M” and “E” in Memorial.
- The floor drain in the former service room leads to a 4-inch clay pipe (storm drain) oriented north-south that discharges into a catch basin located between the Building 81 footprint and Building 140. A 10-inch storm drain extends east-west from the aforementioned catch basin and connects to the 24-inch storm drain oriented north-south on the west side of Shea Memorial Drive.

- The drain line shown on Figure 1-2 to the north of Building 81 is a 10-inch storm drain that is oriented east-west and connects to the 24-inch storm drain oriented north-south on the west side of Shea Memorial Drive.
- The utility lines depicted along Shea Memorial Drive extend the length of the street.
- There are no known subsurface utility lines between the east side of the former Building 81 footprint and the fence.
- Additional information about the utility lines will be obtained for use in the remedial design of the selected remedy for the Site.

Building 81 was demolished after 1997 as part of Base closure activities. Only the building's slab foundation currently remains.

Waste materials generated by vehicle maintenance activities at Building 81 included hydraulic oil, crankcase oil, brake fluid, ethylene glycol, solvents, oil filters, and other wastes typical of routine vehicle maintenance. Building 81 previously had a 500-gallon, steel, underground storage tank (UST) on-site that was used for the storage of waste oil generated during vehicle maintenance activities. The UST was installed in 1983 and consisted of a tank mounted on a buried concrete pad. The UST was reportedly installed so that the top of the tank was exposed and readily accessible for waste oil disposal. During its use, the tank was periodically emptied by a licensed contractor. The UST and associated piping were removed in August 1991 when the Base converted to above ground storage of waste oil in 55-gallon steel drums. After 1991, the wastes generated at the Site were segregated by waste stream and accumulated in 55-gallon drums stored inside enclosed sheds located on the northeast side of the Building 81 parking area, which is shown on Figure 1-3. Once they were full, individual drums were moved to the NAS South Weymouth hazardous waste storage facility, located approximately 250 ft southeast of the Site (Halliburton NUS (HNUS), 1995).

No significant holes, cracks or other damage to the tank or piping were observed during removal of the UST in August 1991. However, contaminated soil was observed in the tank excavation and a post-removal soil sample from the tank excavation contained 33,000 milligrams per kilogram (mg/kg) total petroleum hydrocarbons (TPH). The TPH contamination in the soil was attributed to periodic tank overfills, minor spills, potentially insecure fittings, or improperly closed valves.

The collection and analysis of a soil sample during the 1991 UST removal marked the beginning of the environmental investigation of the Site. A series of sequential investigations and removal actions have been conducted since 1991 to evaluate the nature and extent of contamination in Site soil and groundwater and to remove the continuing source of contamination (waste-oil contaminated soils surrounding the former UST). Tetrachloroethene (PCE) was first analyzed for and detected in site

groundwater in 1995. Subsequent investigations concluded that the presence of both the petroleum hydrocarbons and PCE could be attributed to waste oil releases from or around UST.

1.2.3 Site Investigations and Removal Actions

Prior to or during implementation of this FS, several environmental studies and removal actions were completed for Building 81, which were presented in detail in various reports. The following is a list of key reports containing Site information:

- Phase I Initial Site Investigation Report, Building 81 – Former Waste Oil Tank Area, HNUS, April 1995 – In June 1993, a voluntary Phase I Limited Site Investigation (SI) was conducted under the MCP to investigate the contamination associated with the former UST. An Immediate Response Action (IRA) was conducted under the MCP in August 1994 to address the release of oil that had been confirmed during the previous investigation. The Phase I Initial SI was conducted under the MCP in January and February 1995 to determine the nature and extent of the release and identify potential human and environmental receptors. The results of all three investigations are presented in the *Phase I Initial SI Report* (HNUS, 1995).
- Interim Phase II Comprehensive Site Assessment, Building 81, Brown and Root Environmental, April 1997 – A Phase II Comprehensive Site Assessment was initiated in June 1996 to collect additional information sufficient to characterize the Site and complete the requirements of a Phase II investigation under the MCP.
- Supplemental Phase II Comprehensive Site Assessment, Building 81, Brown and Root Environmental, September 1997 – The Supplemental Phase II Comprehensive Site Assessment was conducted in June and July 1997 to determine the source and extent of PCE.
- Release Abatement Measure Completion and Additional PCE Assessment Report, Building 81 Site, Tetra Tech, May 1999 – In July and August 1998 a soil removal action, termed a Release Abatement Measure (RAM) under the MCP was performed to remove the remaining source of waste oil contamination at the Site by excavating the light non-aqueous phase liquid (LNAPL) impacted subsurface soil in the vicinity of the former UST. In January, February, and November 1998, additional fieldwork was performed to assess the potential migration of PCE in groundwater; evaluate the potential for PCE to exist as dense non-aqueous phase liquid (DNAPL); and evaluate the presence and potential migration pathways for PCE in bedrock.
- NAS South Weymouth, Building 81 Site, September 1999 Bedrock Characterization, ENSR, October 1999 – A bedrock characterization study was conducted in 1999 to obtain additional data to support a potential in-situ chemical oxidation (ISCO) pilot test at the Site. The investigation included bedrock coring, discrete interval groundwater sampling, injection testing, bedrock well installation, and geophysical testing.

- ISCO Pilot Test Performance Assessment, Building 81 Site, NAS South Weymouth, Tetra Tech, March 2002 – In 2001 and 2002, various activities were conducted in support of an ISCO pilot test to assess potential effectiveness of ISCO in a full-scale application at the Site. The activities included monitoring well installation and groundwater sampling prior to the implementation of the ISCO, installation of injection wells and other ISCO equipment, performance of the pilot test in two phases, and post-injection monitoring.
- RI Report, Building 81 Site, Tetra Tech, October 2011 – The investigation further explored the nature and extent of soil, groundwater, and vapor phase contamination at the Site, identified the sources of the contamination, assessed the environmental fate and transport of the contaminants, and evaluated the potential risks to human health and the environment as a result of exposure to the contaminants.

1.3 SUMMARY OF REMEDIAL INVESTIGATION FINDINGS

1.3.1 Site Geology

Three general geologic units have been identified at the Building 81 Site: fill (artificially placed), native overburden, and bedrock; these units have been subdivided based primarily on evaluation of boring logs. A cross-section location map and several geologic cross-sections are provided in Figures 1-4 through 1-7.

Overburden and Fill Characterization

Overburden at the Site consists of approximately 15 to 20 ft of unconsolidated materials, including fill, where present. The native overburden materials are predominantly comprised of sands with varying amounts of silt and gravel. Based on boring log descriptions, the native overburden materials at the Site have been subdivided into four main geologic units: sand, sand and gravel, silty sand, and silty sand with gravel. These units and the non-native fill materials are described below.

Fill – Two known areas of fill are present at the Site: the areas that were excavated and backfilled during the 1998 removal activities. The fill generally consists of loose, fine to coarse sand with variable amounts of fine to medium gravel. Fill is likely present in other parts of the Site, particularly in the utility trenches and beneath the roadway, the building foundation, and the paved areas. However, other than the known removal action backfilled areas named above, the Site subsurface soils are grouped based on the associated material descriptions from the boring logs rather than on interpretive descriptions (e.g. “possible fill”, etc.).

Sand – This unit consists of fine-to-coarse sand with a maximum thickness of approximately 15 ft. The sand unit is identified by well-graded sands with trace percentages of gravel and silt. It is discontinuous across the Site and sometimes difficult to distinguish from sandy fill. This unit was generally observed as the uppermost overburden unit but it is sometimes overlain by a silty sand unit or sand and gravel unit. At depth, this unit is infrequently interbedded with relatively thin, discontinuous silty sand lenses. The sand unit is thickest along the southern edge of the Site and across Shea Memorial Drive (southwest of the building foundation).

Sand and Gravel – This unit is identified by generally well-graded fine-to-coarse sands with more than trace percentages of subrounded to subangular gravel with lesser amounts of silt, interpreted to have been deposited by glacial meltwater streams. This unit is discontinuous across the Site, with a maximum thickness of approximately 10 ft. The sand and gravel unit is thickest in areas both north and south of the 1998 excavation area and in the area between the Transportation Building and Shea Memorial Drive. Occasionally, a thin layer of this unit was observed in the silty sand with gravel unit (described below).

Silty Sand – This unit consists of silty fine sand, ranging in thickness from approximately 2 to 14 ft, where present. It is discontinuous across the Site. A lack of gravel in this unit was used to help distinguish it from the other sandy units. Some of these materials may have been glaciolacustrine (deposited in glacial meltwater lakes and ponds) in origin. Silty sands were observed occasionally as the uppermost overburden unit, but were generally located at depth. Silty sands were observed along the western perimeter of the Building 81 fence line, in a small area south of the 1998 excavation area, beneath the eastern perimeter of the Building 81 foundation, and in the easternmost portion of the Site.

Silty Sand with Gravel – The silty sand with gravel unit is the most prevalent geologic unit observed at the Site, and consists of mostly sand with varying amounts of silt and gravel. This unit ranges from approximately 1 to 17 ft in thickness and has been interpreted as a till-like material, similar to the sandy ablation till documented in other areas at the Base. It mantles the bedrock surface across much of the Site. However, there are several locations where this unit is absent. This deposit is differentiated from the sand unit and the sand and gravel unit based on the angularity of gravels, a mixture of particle sizes ranging from silt, sand, gravel, cobbles, and boulders, and increased blow counts needed for each 6 inches of drilling.

Site Bedrock Characterization

The bedrock at the Site is characterized as a granite and is variably weathered/altered, highly fractured, mostly coarse-grained, and equigranular to slightly porphyritic; consistent with published description for the Dedham Granite (Zen, et al., 1983). The depth to bedrock ranges from about 14 to 21 ft below

ground surface (bgs) across the site. The bedrock surface beneath the Site is irregular and perhaps undulated. Based on boring log interpretations, the bedrock surface beneath the Site gradually dips toward the west or southwest, and in local areas toward the south and toward the east. Potential small bedrock mounds and bedrock depressions were interpreted across the Site. The approximate bedrock surface topography is shown on Figure 1-8.

Boring logs were completed for 54 of the bedrock boreholes advanced for installation of bedrock wells at the Site. The logs consistently describe the bedrock at the Site as fractured or highly fractured throughout most or all of the borings, including several borings that penetrate 100 ft into the bedrock. Most of the fractures were high angle with varying apertures.

Weathered rock is interpreted to be the upper portion of the rock that is highly fractured or that shows evidence of chemical or mechanical alteration. At Building 81, a zone of weathered rock was identified in nearly 45 percent of the drilling locations. This unit is not continuous. None of the rock was so weakened by weathering that it was decomposed or disintegrated to a soil. The transition between weathered rock and competent rock is gradational based on examination of available core samples. None of the on-site wells are screened entirely within the weathered zone. Where the weathered bedrock zone exists, it serves as a transition zone between the overburden and the deeper less fractured underlying bedrock. It does not appear to be a barrier to flow based on the presence of contaminants at depth.

Based on the results of the injection testing, drilling programs, geophysical testing, and hydraulic conductivity testing, the bedrock aquifer appears transmissive, with connected fractures. However, only localized areas store and transmit significant amounts of water.

1.3.2 Hydrogeology

The measured depths to groundwater at the Site during several water level events ranged from approximately 5 to 8 ft bgs in September 2006 and approximately 2 to 7 ft bgs in April 2007 and April 2009. Groundwater contour maps were prepared for the four domains evaluated in the RI as discussed below:

- The shallow overburden groundwater contour maps were prepared using water level measurements from wells with screened intervals beginning at less than or equal to 7 ft bgs.
- The deep overburden groundwater contour maps were prepared using water level measurements from wells with screened intervals greater than 7 ft bgs and less than 20 ft bgs.

- The shallow bedrock groundwater contour maps were prepared using water level measurements from wells with monitored zones (either screens or open boreholes) beginning approximately 17 to 31 ft bgs.
- The deep bedrock groundwater contour maps were prepared using water level measurements from wells with screened intervals beginning approximately 45 ft bgs or deeper. Some of the deep bedrock wells extend as much as 120 ft bgs. The deep bedrock open boreholes have monitored zones starting above 45 ft bgs, but due to their overall depth in bedrock, these wells were not included on the groundwater contour map.

The groundwater contour maps indicate that the overall groundwater flow direction at the Site is generally toward the west-southwest. In the northern and eastern areas of the Site, there is a localized northwest component to groundwater flow that is apparent in three of the four geologic units for which groundwater contours were prepared (all except the deep bedrock unit). Toward the west, the contours progressively flatten out and the groundwater flow direction becomes more westerly or southwesterly with distance from east to west across the Site. The most recent groundwater elevations were collected in February 2010. These groundwater contours support previous findings with some exceptions as illustrated in Figures 1-9 through 1-12.

Groundwater flow velocities in the shallow and deep overburden and in the shallow and deep bedrock were estimated for the each groundwater level monitoring event. The estimated groundwater flow velocities were generally faster during seasonal high water level periods relative to seasonal low water level periods as a result of a steeper horizontal hydraulic gradient. Based on the seasonal high water level data, the groundwater flow velocity estimates were approximately 0.05 ft per day (ft/d) for shallow overburden, 0.6 ft/d for deep overburden, 0.9 ft/d for shallow bedrock, and 0.09 ft/d for deeper bedrock. No highly conductive zones are apparent in either the overburden or bedrock units based on review of the slug test data.

1.3.3 Surface Water Hydrology

Surface water runoff at the Building 81 Site follows the site topography and empties into the base-wide storm drainage system, flowing toward the Tactical Air Navigation (TACAN) outfall drainage system, and ultimately discharging into French Stream. French Stream is located within the Southeastern Massachusetts Coastal Drainage Basin. There are no surface water bodies at or near the Site.

1.3.4 Ecological Setting

The Building 81 Site occupies roughly 1 acre near the center of the Base as shown in Figure 1-1. This area of the Base is highly industrialized, with most of the ground surface paved or covered with buildings. Most of the Site is covered by pavement or the former Building 81 slab as depicted in Figure 1-2. The only unpaved areas are a narrow grass strip along Shea Memorial Drive (totaling approximately 2,000 square ft (sq. ft.) and two backfilled soil excavation areas (totaling approximately 3,000 sq. ft.). The excavation areas were backfilled at the time of excavation in 1998. The ecological habitat in the immediate vicinity of the Site is limited by the extensive pavement and urbanization. Because the surface of the Site is largely paved and is located in an urbanized area, the Site lacks any significant potential ecological habitat. No federally protected species are expected to live on the Site; however, it is possible that peregrine falcons could occasionally be observed. One state-listed Species of Special Concern, the Eastern box turtle (*Terrapene carolina*) has been observed in open, wooded areas on the east side of the Base. However, this species has not been observed at the Building 81 Site, which does not provide a suitable habitat for this species. No potential vernal pool habitat, as defined in the Massachusetts Wetlands Protection Act (M.G.L. c. 141s. 40) and its implementing regulations (310 Code of Massachusetts Regulations (CMR) 10.00), is present at the Site.

1.3.5 Nature and Extent of Contamination

The predominant contaminants present at the Building 81 Site are volatile organic compounds (VOCs) in groundwater. A dissolved VOC contaminant plume at the Site extends from the vicinity of the former tank approximately 360 ft west-southwest, across Shea Memorial Drive toward the Transportation Building. VOC contaminants are present in groundwater from the shallow overburden down into the deep bedrock; however, the highest concentrations of VOCs are present in the deep overburden and shallow bedrock zones, and the extent of the plume is the greatest in these zones. PCE is the most frequently detected compound in groundwater and is present at the highest concentrations. The orientation of the PCE plume in each of the groundwater domains is shown in Figures 1-13 through 1-16.

VOCs are also present in Site soil, but to a much lesser extent than in groundwater. The VOCs in soil are concentrated mainly in saturated subsurface soils located within the 6 to 20 ft bgs soil interval, which coincides with the overburden aquifer. The maximum concentration of nearly every VOC detected in the 6 to 20 ft bgs soil interval is in a sample collected from 12 to 14 ft bgs in soil boring SO-108, located in the former tank excavation area. The most prevalent VOC detected in saturated soil is PCE.

VOCs are present in soil vapor immediately beneath the Building 81 slab (a gravel layer) and in soil approximately 3 to 4 ft below the slab. The most prevalent VOC detected in soil vapor is PCE. Maximum

concentrations of PCE were detected in the southeast quadrant of the foundation, downgradient of the source area and within the PCE plume.

Semi-volatile organic compound (SVOC) presence at the Site is limited. The majority of SVOCs present in Site soil and groundwater were detected infrequently and usually at low concentrations. Five polycyclic aromatic hydrocarbons (PAHs) that were detected only in soil are products of incomplete combustion. Two PAHs were detected at elevated concentrations in both soil and groundwater and nine SVOCs were detected at elevated concentrations only in groundwater. The highest concentrations of these SVOCs in groundwater were detected in samples from wells within or immediately downgradient of the tank excavation area. Where detected, these SVOCs were co-located with the predominant VOCs.

Pesticide presence in Site soil and groundwater is limited. Several pesticides were detected in both soil and groundwater; however, the pesticides were generally detected infrequently and at low concentrations.

The only polychlorinated biphenyl (PCB) detected on the Site was Aroclor 1260, which was detected in just five soil samples: two of the detections were in subsurface soil samples collected from a boring directly beneath the tank excavation area; and the other three detections (at concentrations an order of magnitude lower than the others) were in surface soil samples collected from exposed and paved areas. No PCBs were detected in Site groundwater.

Several metals were detected in Site soil and groundwater. The locations with most of the maximum detected metals concentrations varied among the soil depth intervals and locations. In groundwater, three metals (arsenic, iron, and manganese) were detected most frequently in site groundwater. Because iron is an essential nutrient and is not included in risk calculations, the metals evaluation in the RI focused on arsenic and manganese.

1.3.6 Contaminant Fate and Transport

Concentrations of several VOCs, SVOCs, pesticides, PCBs, and metals are present in Site soil and groundwater. VOCs were also detected in soil vapor immediately beneath the foundation and in shallow subsurface soil. A limited number of chemicals in each of these contaminant classes were detected in some Site samples from each media at concentrations exceeding risk-based screening levels and Base background concentrations. The presence of these substances at the Site appears to be a result of: past activities at the Site relating to its former use as a vehicle maintenance building; anthropogenic sources; natural sources; and natural background conditions. A summary of the likely sources, transport pathways, and environmental fate of the contaminants detected at the Site is presented below.

VOCs

The primary source of the VOC contaminants in Site soil and groundwater is the release of waste oils and solvents in the vicinity of the former waste oil UST. These releases resulted in the presence of LNAPL floating near the water table, trapped in soil pores, or sorbed to soil particles in a large area surrounding the tank until the waste-oil contaminated soils were excavated and removed from the Site.

Groundwater data indicate that both aerobic and anaerobic biodegradation of VOCs has occurred within the dissolved contaminant plume via natural biodegradation and chemical oxidation facilitated by the ISCO pilot test conducted at the Site in 2000 and 2001. The data also indicate that the ISCO reduced the concentrations of petroleum hydrocarbons (i.e. the benzene, toluene, ethylbenzene, xylene [BTEX] compounds) in Site groundwater; however it did not significantly reduce the concentrations of chlorinated VOCs.

The highest VOC concentrations in groundwater are generally located in the vicinity of the waste oil tank excavation and at downgradient locations to the west or southwest. The groundwater contaminant plumes are generally oriented in an east-west direction originating from the vicinity of the former tank (source area) and migrating along the dominant groundwater flow directions. Previous investigations concluded that the presence of DNAPL at the Site is unlikely, based on a variety of factors. However, somewhat higher concentrations of PCE (above the 1 percent pure-phase solubility of PCE) were detected in bedrock groundwater samples collected from two locations southwest and south-southwest of the former tank location. Because the extent of high PCE concentrations in the vicinity of these wells is limited, it appears that if present, the DNAPL mass is probably small and is present in small, hydraulically isolated fractures in a limited area.

The predominant VOCs in soil vapor are PCE and petroleum hydrocarbons (benzene and ethylbenzene) detected in sub slab material and/or at depth.

SVOCs

There are two primary sources of SVOCs presence in Site soil and groundwater. The predominant SVOCs present in Site soil are several PAHs that are typically products of fires, vehicle exhaust, and incomplete combustion of fossil fuels; and bis(2-ethylhexyl)phthalate, which is a widely used plasticizer and is found in numerous products. These compounds are likely present in Site soils as a result of their ubiquitous presence in the environment.

The primary source of SVOCs present in Site groundwater is likely the release of waste oil in the vicinity of the former waste oil tank. SVOCs are generally less soluble in groundwater than the VOCs and tend to sorb more strongly to soil, the extent and concentrations of these contaminants in groundwater is more limited than that of the VOCs that were released in the former tank area. Where detected, these SVOCs were co-located with the predominant VOCs.

Pesticides and PCBs

Pesticides were generally detected infrequently and at low concentrations in site soil and groundwater. The presence of pesticides at the Site is likely a background condition related to their general use throughout the Base. The only PCB detected was Aroclor-1260, which was detected in two subsurface soil samples collected from a boring directly beneath the tank excavation area and three surface soil samples collected from exposed areas between the building foundation and the pavement. These results suggest that the PCBs may have been present in the waste oil released in the area of the tank, but because PCBs are nearly insoluble in water and sorb strongly to soil, most of the PCBs mass likely remained bound in the soils that were excavated from the area surrounding the former tank.

Metals

Metals appear to be present in site soil and groundwater as a result of their natural occurrence in soil and groundwater. However, site conditions have resulted in increased dissolved concentrations of some metals, including arsenic and manganese, in groundwater. The major cause of the increased arsenic and manganese concentrations appears to be the biodegradation of VOCs within the contaminant plume, which has resulted in highly reducing conditions in some areas of the dissolved VOC contaminant plume. In a highly reducing environment, the arsenic and manganese bound to the soil and rock surfaces are reduced to more soluble forms and tend to remain in solution, causing an increase in the dissolved arsenic and manganese concentrations.

1.3.7 Baseline Risk Assessment

A baseline Human Health Risk Assessment (HHRA) was conducted to identify potential risks from contaminants in soil and groundwater at the Site. The HHRA included the following receptor groups: current and future trespasser, future recreational user, future resident, future industrial/commercial worker, and future construction worker. As discussed in Section 1.3.4, the ecological habitat in the immediate vicinity of the Site is limited by the extensive pavement and urbanization. The surface of the Site is largely paved and the Site is located in an urbanized area, the Site lacks any significant potential ecological habitat and there is no current complete exposure pathway for Site contaminants. For that

reason, any potential impacts to ecological receptors will be negligible, so an ecological risk assessment was not conducted.

Potential unacceptable risks were identified for future child and adult residents primarily from use of groundwater as drinking water, for future residents from vapor intrusion of volatile contaminants in groundwater and soil gas, and for future construction workers from inhalation of volatile contaminants in trench air. While potential risks to future child and lifelong recreational users do not exceed the USEPA cancer risk range, they exceed the Massachusetts risk threshold. Note: as discussed in Section 2, drinking the Site groundwater is not considered a reasonably foreseeable future use. Exposures to surface soil or 0 to 6 foot soil do not contribute significantly to total receptor hazards. Lead and naphthalene in exposed surface soil and future surface soil and lead in 0-6 foot soil were identified as contaminant of concern (COCs) for groundwater protection. The results of the HHRA are summarized below.

For the future resident exposure scenarios, use of groundwater as drinking water is the only pathway with hazard indices (HIs) for non-carcinogenic effects exceeding 1, and the only pathway with cancer risks exceeding $1x10^{-4}$. The calculated reasonable maximum exposure (RME) non-carcinogenic HIs and cancer risks for use of site groundwater as drinking water by future adult and child residents of the Site are: HI = 89 and cancer risk = $1x10^{-1}$ (adult); and HI = 288 and cancer risk = $1x10^{-1}$ (child). The calculated RME cancer risk for the lifelong resident is $3x10^{-1}$ (including exposure to all media). The contaminants contributing most significantly to the non-carcinogenic HIs and cancer risks in groundwater used as drinking water are PCE, trichloroethene (TCE), vinyl chloride, carcinogenic PAHs (cPAHs), arsenic, cadmium, and manganese.

For future construction workers, inhalation of VOCs in trench air is the only pathway with HIs greater than 1. The calculated RME HI for this pathway is 14. The contaminants contributing most significantly to the non-cancer HIs for the future construction worker exposure to trench air are TCE and naphthalene. Calculated cancer risks for this receptor are $4x10^{-5}$. RME cancer risks for the inhalation of VOCs pathway are $3x10^{-5}$ with PCE and naphthalene most significantly contributing to the cancer risk.

Vapor intrusion risks were evaluated using soil gas data (where available) and shallow groundwater data. Total non-cancer HIs were less than 1 for both future industrial workers and residents. Therefore, adverse non-carcinogenic effects are not anticipated at the Site. Total cancer risks are within the USEPA target cancer risk range ($1x10^{-6}$ to $1x10^{-4}$) but exceed the State target cancer level ($1x10^{-5}$) for industrial workers (cancer risk = $5x10^{-5}$) due to PCE (based on soil gas data). For residents, total cancer risks exceed the State target cancer level and the USEPA target risk range (cancer risk = $4x10^{-4}$). Major risk

contributors to the residential cancer risk were PCE (based on soil gas data) and naphthalene (based on shallow groundwater data).

In summary, groundwater at the Building 81 Site contains several organic contaminants and metals at concentrations that may pose unacceptable human health risks to people living or working at the Site. Potential unacceptable risks were identified for three receptors/exposure scenarios: (1) future residents who use groundwater as drinking water; (2) future residents in a building constructed on site who are exposed to contaminants that volatilize from groundwater into the indoor air; and (3) construction workers exposed to contaminants that volatilize from groundwater into the air in deep, narrow construction trenches. The groundwater contaminants contributing most significantly to the identified risks are PCE, TCE, vinyl chloride, cPAHs, naphthalene, arsenic, cadmium, and manganese.

2.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

This section develops RAOs and presents cleanup goals for contaminated groundwater at the Site. The regulatory requirements and guidance (e.g., ARARs) that may potentially govern remedial activities are presented in this section. In addition, this section presents COCs for remedial action and the conceptual pathways through which these chemicals may affect human health and the environment. The cleanup goals for contaminated media are developed in this section, and GRAs that may be suitable to achieve the cleanup goals are presented. Finally, this section presents estimates of the mass and volumes of contaminated groundwater.

As shown on Figure 2-1, the Site is located in a portion of the Base where Massachusetts Geographic Information System (MassGIS) has not mapped any medium or high-yield aquifers. MassDEP has assigned category GW-3 to groundwater at the Site. In addition, the Local Redevelopment Authority, South Shore Tri-Town Development Corporation (SSTTDC), as well as the Master Developer, LNR Property Corporation South Shore LLC (LNR), have indicated that production, supply, and irrigation water needs for the redevelopment can be provided by sources other than the groundwater under the Building 81 Site. Land use controls (LUCs) to restrict use of groundwater are included in the alternatives discussed in Section 4 of this FS.

The extent of groundwater contamination shown on Figure 2-1 is predominantly in an area zoned for recreation district (RecD) uses and also extends into the Village Center District (VCD), which is west of Shea Memorial Drive and is designated in the Reuse Plan as a mixed-use area that will contain residential development as well as office, commercial and retail uses. Based on the foregoing, the reasonably foreseeable future uses of the Building 81 Site include recreational, institutional, commercial, office, retail and residential uses.

2.1 MEDIA OF CONCERN

Based on the results of the risk assessment discussed in Section 1.3.7 and the reasonable foreseeable future groundwater uses discussed above, the media of concern at the Site were determined to be groundwater and off-gassing vapors from groundwater. The FS addresses the potential unacceptable risks to building occupants from vapor intrusion and to construction workers exposed to vapors in narrow deep trenches. No unacceptable risks were identified in the HHRA based on exposures to surface soil or 0 to 6 foot soil. The HHRA included a qualitative, not quantitative, evaluation of risks to soils at depths greater than 6 ft bgs or below the water table, since human exposure to such soils is considered unlikely. Contaminants in saturated soils at a depth of 6 to 20 ft will be indirectly addressed in the FS by the groundwater treatment alternatives.

2.2 CHEMICALS OF CONCERN FOR REMEDIATION

COCs were selected based primarily on the cancer and non-cancer risk estimates provided in the HHRA section of the RI Report (Tetra Tech, 2011) as modified by the reasonably foreseeable future uses of the Site as described above. The COCs carried forward in the FS for the development of remedial alternatives are discussed below. PRGs are developed for the selected COCs in Section 2.4 of the FS. As noted in Section 1.3.7 since the Site lacks any significant potential ecological habitat and there is no current complete exposure pathway for Site contaminants, an ecological risk assessment was not performed. There are no ecological COCs.

As discussed above, the groundwater at the Site will not be used for production, supply, or irrigation purposes. Therefore, the COCs that were identified in the HHRA due to a potential unacceptable risk to future residents who use groundwater for drinking water can be eliminated from further consideration in the FS. COCs that could contribute to risk through exposure by way of vapor intrusion were retained. The list of VOCs was further reduced after consideration of the low and infrequent concentrations detected in the shallow overburden groundwater. Thus, the list of COCs to be evaluated is the FS includes:

- cis-1,2-dichloroethene
- Benzene
- PCE
- Toluene
- TCE
- Vinyl Chloride

In addition, TCE and naphthalene are included as COCs because of the potential unacceptable risk to construction workers.

2.3 REMEDIAL ACTION OBJECTIVES

RAOs are medium-specific goals that define the objective of conducting remedial actions to protect human health and the environment. The RAOs specify the COCs, potential exposure routes and receptors, and acceptable concentrations (i.e., cleanup goals) for the Site.

The development of cleanup goals is based on the reasonably foreseeable future uses of the Site discussed above and takes into consideration chemical-specific ARARs and TBCs criteria. Section 2.3.2 identifies the ARARs and TBCs for groundwater remediation.

2.3.1 Statement of Remedial Action Objectives

To protect the public from potential current and future health risks, as well as to protect the environment, the following RAOs have been developed for groundwater at the Site.

Groundwater RAO No. 1: Prevent the migration of COC-impacted groundwater at concentrations that pose unacceptable risk.

Groundwater RAO No. 2: Prevent exposure of construction workers to COCs at concentrations that pose unacceptable risk.

Groundwater RAO No. 3: Prevent exposure of potential building occupants to VOCs resulting from vapor intrusion into any future buildings on the Site at concentrations that pose unacceptable risk.

Groundwater RAO No. 4: Prevent human exposure to COCs in groundwater at concentrations that pose unacceptable risk.

2.3.2 ARARs and TBC Criteria

ARARs consist of any standard, requirement, criterion, or limitation under federal environmental law and any promulgated standard, requirement, criterion, or limitation under a state environmental or facility-siting law that is more stringent than the associated federal standard, requirement, criterion, or limitation.

In addition to ARARs, TBCs, which are non-promulgated, non-enforceable guidelines or criteria that may be useful for developing a remedial action or are necessary for determining what is protective to human health and/or the environment may be identified.

According to 40 CFR 300.430(f)(1)(i)(A), overall protection of human health and the environment and compliance with ARARs are threshold requirements that each remedial alternative must meet to be eligible for selection.

2.3.2.1 Definitions

The NCP at 40 CFR 300.5 provides the following definitions for ARARs:

- Applicable Requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law

that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and Appropriate Requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law, although not "applicable" to a hazardous substance, pollutant, contaminant, or remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

Per 40 CFR 300.400(g)(3), other advisories, criteria, or guidance are to be considered for a particular release. The TBC category consists of advisories, criteria, or guidance developed by USEPA, other federal agencies, or states that may be useful in developing CERCLA remedies.

Under CERCLA Section 121(d)(4), an ARAR can be waived if one of the following conditions can be demonstrated:

- The remedial action selected is only part of a total remedial action that will attain the ARAR level or standard of control upon completion.
- Compliance with the requirement will result in greater risk to human health and the environment than other alternatives.
- Compliance with the requirement is technically impracticable from an engineering perspective.
- The remedial action selected will attain a standard of performance that is equivalent to that required by the ARAR through the use of another method or approach.
- With respect to a state requirement, the state has not consistently applied the ARAR in similar circumstances at other remedial actions within the state.
- Compliance with the ARAR will not provide a balance between protecting public health, welfare, and the environment at the facility with the availability of Superfund money for response at other facilities (fund-balancing). This condition only applies to Superfund-financed actions.

USEPA, in various guidance documents and the NCP, has divided ARARs into three categories to facilitate identification. Chemical-specific and location-specific ARARs are identified early in the process, generally during the RI, and action-specific ARARs are normally identified during the FS in the detailed analysis of alternatives. These three types of ARARs are defined as follows:

- <u>Chemical-Specific</u>: Health or risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples include maximum contaminant levels (MCLs) and Clean Water Act (CWA) National Recommended Water Quality Criteria (NRWQC).

- Location-Specific: Restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of these areas regulated under various federal laws include floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present.
- Action-Specific: Technology or activity-based requirements, limitations on actions, or conditions involving special substances. Examples of action-specific ARARs include Resource Conservation and Recovery Act (RCRA) regulations for generation, characterization, and management of hazardous wastes and CWA effluent limitations and pre-treatment standards for wastewater discharges.

The following section discusses chemical- and location-specific ARARs and TBCs. Action-specific ARARs and TBCs are presented in Section 2.5.2 along with the discussion of GRAs.

2.3.2.2 Chemical-Specific ARARs and TBCs

Federal and state chemical-specific ARARs and TBCs provide some medium-specific guidance on "acceptable" or "permissible" concentrations of contaminants. Table 2-1 presents federal and Massachusetts chemical-specific ARARs and TBCs for this FS.

2.3.2.3 Location-Specific ARARs and TBCs

Federal and state location-specific ARARs and TBCs place restrictions on concentrations of contaminants or the conduct of activities based on the site's particular characteristics or location. Table 2-2 presents federal and Massachusetts location-specific ARARs and TBCs for this FS.

2.4 PRELIMINARY REMEDIATION GOALS

PRGs were developed for the Site to establish target cleanup goals for remedial actions to reduce COC concentrations in Site media and mitigate the unacceptable risks to human health and the environment. Final cleanup goals for the selected Site remedial action will be documented in the ROD.

PRGs can be developed based on chemical-specific ARARs, when available, or risk-based factors. In addition, the protection of groundwater and the presence of COCs in background locations are also considered in developing the PRGs. The methods used to develop candidate PRGs are discussed below.

2.4.1 Human Health Risk-Based Preliminary Remediation Goals

Chemicals with unacceptable human health risks were identified as COCs for human receptors in Section 2.2. Human health risk-based PRGs were developed for those COCs.

Risk-based PRGs are proposed cleanup levels that are based on human health risks, and are intended to be protective of human health. PRGs were derived for the COCs identified in Site groundwater. The methodology used to derive PRGs for groundwater at the Site is described below.

Table 2-3 presents the PRGs for the following exposure scenarios, based on the RAOs:

- Recreational exposure to VOCs migrating from the shallow groundwater via vapor intrusion into buildings in the RecD zone.
- Residential exposure to VOCs migrating from the shallow groundwater via vapor intrusion into buildings in the VCD zone.
- Construction worker exposure via inhalation of VOCs in the shallow water table.

For each scenario, risk-based PRGs were calculated representing the 1×10^{-5} cancer risk level and HI of 1 for each COC based on the exposure routes in each scenario (see Appendix B). These PRGs apply to the specific areas as noted. The lower of the values was selected as the human health risk-based PRG for each scenario. These selected human health risk-based PRGs represent values protective of both cancer and non-cancer risks. For a given COC, the lowest of the carcinogenic and non-carcinogenic risk values was carried forward for comparison with other potential PRGs.

2.4.2 ARARs and TBCs

Because the Site groundwater is not part of a potentially productive aquifer, drinking the Site groundwater is not considered a reasonable foreseeable future use. Therefore, drinking water criteria, such as MCLs and Maximum Contaminant Level Goals (MCLGs), are not considered as potential PRGs. MassDEP GW-3 standards were selected as TBCs and used as maximum values for PRGs. Where a risk-based PRG is greater than the GW-3 standard, the GW-3 standard will be used. These values are shown in Table 2-3.

2.4.3 Background Concentrations

Background concentrations may be used as PRGs, since background values represent contaminant concentrations in the absence of Site activities when no excess risk is anticipated. Background

concentrations are used in selection of PRGs because it is not reasonable and may not be possible to remediate Site media to concentrations that are lower than background conditions. Further, it is Navy policy to only address those risks associated with chemical concentrations that are elevated as a result of a site-related release.

Although background groundwater concentrations were developed for NAS South Weymouth, because of the exposure routes (i.e., vapor intrusion) and types of COCs (e.g., VOCs), background concentrations were not considered for selection of PRGs.

2.4.4 Selection of Proposed PRGs

The human health risk-based PRGs were typically selected except where they were greater than the MassDEP GW-3 standards. In those cases, the MassDEP GW-3 standard was used. The selected PRGs are the COC concentrations that would provide the highest level of protection of human health and the environment, while still being reasonably achievable by current remediation techniques. Table 2-3 presents the potential and selected PRGs for each compound for groundwater for each exposure scenario**,** and the basis for selection. Table 2-4 presents the groundwater PRGs selected for the VCD and RecD zoning districts for each groundwater COC along with the basis for the selection.

2.5 GENERAL RESPONSE ACTIONS AND ACTION-SPECIFIC ARARS

GRAs describe categories of actions that could be implemented to satisfy or address a component of an RAO for the site. Remedial action alternatives will then be developed using GRAs individually or in combination to meet RAOs. The remedial action alternatives, composed of GRAs, will be capable of achieving the RAOs for groundwater above PRGs at the Site.

2.5.1 General Response Actions

The following GRAs will be considered for groundwater at the Building 81 Site:

- No Action
- Limited Action Removal
- In-Situ Treatment

2.5.2 Action-Specific ARARs

Action-specific ARARs and TBCs are technology- or activity-based regulatory requirements or guidance that would control or restrict remedial action. Action-specific ARARs and TBCs for each alternative are developed and presented in Section 4.

2.6 ESTIMATED VOLUMES OF CONTAMINATED GROUNDWATER

2.6.1 Volume of Contaminated Groundwater

The PCE plumes in the overburden (water table interval and deep overburden intervals) begin just west of the former waste oil UST, with the easternmost detections at monitoring well (MW)-02S (0.19 microgram per liter [µg/L]) in the water table interval and I-15 (1.5 µg/L) in the deep overburden. The plumes extend primarily toward the west-southwest, consistent with the overburden groundwater flow direction. The highest concentration in the water table interval (100 µg/L in 2006) is located between the former tank grave and the building footprint. Based on available data, the PCE plume in the water table interval has not migrated beneath Shea Memorial Drive. The highest concentration in the deep overburden (360 µg/L in 2006) is located downgradient of the former tank grave, near the northwest corner of the building footprint and significantly decreases on the west side of Shea Memorial Drive. PCE was detected at concentrations up to 2 µg/L, as far west as the Transportation Building (MW-48I). This is likely the leading edge of the plume in the deep overburden. Both plumes are bound to the north by Redfield Road and to the south between the building footprint and Building 140. A lobe of the PCE plume in the water table interval extends northwest toward MW-43S, on the north side of Redfield Road. In the deep overburden, a small lobe of the PCE plume extends northwest toward MW-38I. The outline of the PCE plume at various depths is depicted on Figures 1-5 through 1-7. The PCE concentration contours in the water table interval and deep overburden are depicted on Figures 1-13 and 1-14.

The PCE plume in shallow bedrock has a similar general east-west orientation as in the deep overburden, but the shallow bedrock plume is not elongated to the southwest. The PCE plume in shallow bedrock extends farther east than the overburden plumes, with the eastern-most detection at BR-08 (15 µg/L). The northern extent of the PCE plume is similar to the overburden plume, but the southern extent is greater. A low concentration of PCE (0.835 µg/L) was detected at MW-50B in the shallow bedrock. Similar to the PCE plumes in overburden groundwater, a lobe of the PCE plume extends northwest in shallow bedrock toward MW-38B. The highest PCE concentration in shallow bedrock was reported in the sample from BR-07 (11,000 µg/L). All of the other detected concentrations of PCE were below 650 µg/L. There appears to be a fracture zone or preferential pathway south-southwest of BR-07 toward BR-21.

The PCE plume in deep bedrock groundwater has the same general orientation as in the shallow bedrock, but the deep bedrock plume is much narrower in the middle and is more limited in extent. The maximum PCE concentration in deep bedrock groundwater, 1,600 µg/L (2,800 µg/L in 2006), is located at MW-03D. PCE was also detected in the collocated deep bedrock well at MW-3D2, screened in the deepest monitoring portion of bedrock (110 to 120 ft bgs), but the concentration was less than 1 µg/L. PCE concentrations were lower in the deep bedrock than the shallow bedrock. As noted in the shallow bedrock, flow in the bedrock appears to be very fracture dependent.

The volume of groundwater in the overburden plume, based on the 5 µg/L (the MCL) PCE isoconcentration line, is approximately 458,000 gallons. Within the plume is an area where PCE concentrations are greater than 100 µg/L, and the volume of contaminated groundwater within the 100 µg/L PCE isoconcentration lines is approximately 188,000 gallons. Porosity values, based on the RI data, were 0.20 for the overburden zone.

The volume of groundwater in the shallow and deep bedrock plumes, based on the 5 µg/L (the MCL) PCE isoconcentration line, is approximately 158,000 gallons. Within the plume is an area where PCE concentrations are greater than 10,000 µg/L, and the volume of contaminated groundwater within the 10,000 µg/L PCE isoconcentration lines is approximately 3,000 gallons. Porosity values, based on the RI data, were 0.02 for the shallow and deep bedrock zone.

2.6.2 Mass of Contaminants - Dissolved and Adsorbed Phases

The masses of contaminants in groundwater and adsorbed to saturated soil were estimated using RI data. Partition coefficients were obtained from literature, and the value for organic carbon in the soil was estimated using data collected during the RI. The mass of contaminants in the PCE plume is summarized in Table 2-4. The calculations are included in Appendix C.

3.0 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

This section identifies, screens, and evaluates the potential technologies and process options that may be applicable to the remedial alternatives for the Building 81 Site. The primary objective of this phase of the FS is to develop an appropriate range of remedial technologies and process options to be used for developing the remedial alternatives.

The basis for technology identification and screening began in Section 2.0 with a series of discussions that included the following:

- Identification of ARARs
- Development of RAOs and PRGs
- Identification of GRAs
- Development of estimated areas and volumes of contaminated groundwater

Technology screening evaluation is performed in this section with the completion of the following analytical steps:

- Identification and screening of remedial technologies and process options
- Evaluation and selection of representative process options

A variety of technologies and process options are identified under each GRA (see Section 2.5.1) and screened. The selection of technologies and process options for initial screening is based on the "Guidance for Conducting RI/FS's under CERCLA" (USEPA, 1988). The screening is first conducted at a preliminary level to focus on relevant technologies and process options. Then the screening is conducted at a more detailed level based on certain evaluation criteria. Finally, process options are selected to represent the technologies that have passed the detailed evaluation and screening.

The evaluation criteria for the detailed screening of the technologies and process options retained after the preliminary screening are effectiveness, implementability, and cost. The following are descriptions of these evaluation criteria:

<u>Effectiveness</u>

The effectiveness evaluation is focused on the following elements:

- Potential effectiveness of process options in handling the estimated areas or volumes of media of concern and in meeting the RAOs.

- Potential impacts to human health and the environment during the construction and implementation phases.
- Reliability and proven effectiveness of the process with respect to the COCs and the site-specific conditions.

Implementability

The implementability evaluation includes both the technical and institutional (administrative) feasibility of implementing each technology or process option. This initial technology screening eliminates technology types or process options that are clearly ineffective or unworkable at the Site. The institutional aspects considered include the following:

- Potential for obtaining regulatory approval
- Availability of necessary equipment and skilled workers to implement the technology
- Availability of treatment, storage, and disposal services
- Time required for implementation
- Ability to achieve the applicable remediation standards within a reasonable timeframe.

Cost

For this screening evaluation, a qualitative cost analysis is presented to indicate whether costs are prohibitive or if other process options within the same technology type were comparably effective and implementable but less costly. Preliminary cost estimates for the remedial technologies retained in the screening steps are presented in Section 4 as part of each of the remedial alternatives developed from the technologies retained in this section.

3.1 PRELIMINARY SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

This section identifies and screens remediation technologies and process options for groundwater based on implementation with respect to site-specific conditions and COCs. Table 3-1 summarizes the results of this preliminary screening process. It presents the GRAs, identifies the technologies and process options, and provides a brief description of each process option followed by comments about the results of the screening process.

Table 3-1 shows that containment, removal (e.g., groundwater extraction/interception and soil excavation), ex-situ treatment, and discharge/disposal GRAs are eliminated as a result of the screening process. Appendix H provides an evaluation and cost estimate for soil excavation in the source area to

support elimination of this technology as indicated in Table 3-1. The following are the groundwater technologies and process options remaining for detailed screening in Section 3.2.

General Response Action	Technology	Process Options
No Action	None	Not applicable
Limited Action	LUCs	Physical controls
		Institutional controls
	Monitoring	Sampling and analysis
	Natural Attenuation	Naturally occurring biodegradation and physical processes
In-Situ Treatment	Biological	Enhanced bioremediation
	Chemical	Permeable reactive barriers
		Chemical oxidation

3.2 DETAILED SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

3.2.1 No Action

No Action consists of maintaining the status quo at the Site. As required under CERCLA regulations, the No Action alternative is carried through the FS to provide a baseline for comparison with other alternatives and their effectiveness in mitigating risks posed by site contaminants.

Effectiveness

No Action would not be effective in meeting the RAOs. No Action would also not be effective in evaluating either potential contaminant reduction through natural attenuation or potential contaminant migration off site because no monitoring would be performed.

Implementability

There would be no implementability concerns because no action would be implemented.

Cost

Because hazardous substances, pollutants, or contaminants would be present on the Site in excess of levels that allow for unlimited use and unrestricted exposure, statutory five-year reviews would be conducted. Costs would be low.

Conclusion

No Action is retained because of NCP requirements, although it would not be effective.

3.2.2 Limited Action

3.2.2.1 Land Use Controls

LUCs would be designed to protect public health and the environment from residual contamination at environmental restoration sites. LUCs would consist of administrative or legal mechanisms (e.g., deed or zoning restrictions, permits, etc.) designated as institutional controls and/or physical controls (e.g., fencing, security guards, etc.) designated as engineering controls. Site-specific LUCs would typically be formulated through a LUC Remedial Design (RD) that is prepared in accordance with the Navy's LUCs Principles (Department of Defense [DoD], 2003) following approval of the ROD. LUCs would typically also include the performance of regular site inspections to verify continued implementation. Depending upon the site-specific conditions, LUCs can be used alone or in conjunction with other remedial actions.

Effectiveness

Site use restrictions would be effective for minimizing human exposure to site COCs through the use of access controls and/or implementation of deed restrictions. Permanent or interim deed or zoning restrictions could be effectively used to control site use permanently if no other remedial measures were undertaken or temporarily while remediation is ongoing. The effectiveness of these measures would be dependent on adequate enforcement of administrative controls. Signage would be used to indicate that LUCs may be implemented on the Site. Physical restrictions such as fencing, physical barriers, and site security would be applicable during implementation and construction activities. Short-term LUCs could be effectively implemented during performance of the remedial action until the cleanup goals are reached.

Implementability

Current site use is controlled by the Navy. There are no unacceptable risks to current site use scenarios, however, since the Site will be redeveloped in the future, limitations on use (e.g., well installation, building construction methods) of the Site would be readily implementable as part of the property transfer process and documentation. Short-term LUCs would be easily implemented until the remedial action is complete.

Cost

Site use restrictions are generally inexpensive, although long-term administration, enforcement, and maintenance are required if applied long-term.

Conclusion

LUCs are retained only for use in combination with other process options for the development of groundwater remedial alternatives.

3.2.2.2 Monitoring

Sampling and analysis of groundwater would be used to evaluate migration of COCs. Monitoring would also be used to evaluate potential natural attenuation or the progress of active groundwater remediation.

Effectiveness

Monitoring would not of itself reduce the toxicity, mobility, or volume of COCs in groundwater, but it would allow the evaluation of potential migration of the COCs and the expected reductions in their concentrations through natural attenuation or active remediation.

Implementability

A groundwater monitoring program could be readily implemented and such programs are routinely performed at other sites. Monitoring well installation activities would need to comply with state and local regulations.

Cost

In general, monitoring costs are low; however, such costs can become high if an extensive monitoring program is implemented over a long period of time.

Conclusion

Monitoring is retained only for use in combination with other process options for the development of groundwater remedial alternatives.

3.2.2.3 Natural Attenuation

Natural attenuation (NA) would consist of allowing naturally occurring processes such as biodegradation, dispersion, dilution, and adsorption to reduce concentrations of groundwater COCs over time. To evaluate natural attenuation, groundwater samples would be regularly collected and analyzed to establish trends in COC concentrations. Installation of new monitoring wells may be required. Samples from new and existing wells would be regularly collected and analyzed for natural attenuation indicator parameters such as oxidation-reduction potential (ORP), dissolved oxygen (DO), pH, alkalinity, temperature, conductivity, total organic carbon (TOC), ferrous and total iron, sulfur compounds (sulfide and sulfate), nitrogen compounds (nitrite and nitrate), orthophosphate, chloride, and metabolic gases (methane, ethane, ethene, and carbon dioxide).

Effectiveness

Naturally occurring processes could reduce concentrations of PCE and other contaminants in groundwater over the long term. Based on the results of samples collected during the RI (Tetra Tech, 2011), anaerobic biodegradation by reductive dechlorination has occurred in all groundwater zones for PCE and its breakdown products. The hydrocarbons remaining in the subsurface as a result of historical releases from the former waste oil tank appear to provide carbon and energy sources for microorganisms responsible for the reductive dechlorination of chlorinated compounds. Groundwater analytical data and field measurements indicate that the strongly reducing conditions needed to support anaerobic degradation of chlorinated solvents exist in several areas of the Site, but are not widespread within the contaminant plume in the water table and deep bedrock zones.

Groundwater monitoring would provide an effective means of evaluating the concentrations of COCs in groundwater and of assessing the rate of decrease of these concentrations. Monitoring of indicator parameters would help to evaluate the potential effectiveness of the reductive dechlorination process.

Because groundwater at the Site is not a drinking water source or potential water source, the relatively long time for remediation through natural attenuation processes would be acceptable.

Implementability

Natural attenuation would be very easy to implement because it requires monitoring as the only action. As noted earlier, the resources and materials required for monitoring are readily available.

Cost

In general, monitoring costs are low; however, such costs can become high if an extensive natural attenuation monitoring program is implemented over a long period of time.

Conclusion

Natural attenuation is retained for use in combination with other process options for the development of groundwater remedial alternatives.

3.2.3 In-Situ Treatment

The technologies considered under this GRA are enhanced bioremediation, chemical oxidation, and permeable reactive barriers (PRBs).

3.2.3.1 Enhanced Bioremediation

Enhanced bioremediation involves the use of microorganisms, primarily bacteria and fungi, to break down contaminants into nontoxic or less toxic forms. In-situ enhanced bioremediation incorporates biostimulation and/or bioaugmentation. Aerobic and anaerobic bioremediation processes are discussed below.

Biostimulation is the most common type of in-situ enhanced bioremediation and can be used to stimulate the growth of either anoxic/anaerobic or aerobic indigenous microorganisms depending on the type of contaminant to be biodegraded. Anoxic/anaerobic biostimulation uses an electron donor compound such as lactic acid or emulsified oil substrate (EOS), and aerobic biostimulation uses either oxygen or an oxygen-release compound (ORC) such as magnesium peroxide.

Bioaugmentation is less common and is typically used in addition to biostimulation. Bioaugmentation consists of adding a bacterial culture to increase the naturally-occurring microorganism population and to provide organisms specifically targeted to the degradation of the COCs.

The enhanced bioremediation reagent (electron donor compound, oxygen, ORC, and/or bacterial culture) can be injected into contaminated groundwater using multiple temporary direct-push technology (DPT) injection points and/or permanent injection wells. DPT injection would be simple to implement in the overburden and could be applied selectively in small locations or across large surface areas. Enhanced bioremediation can also be used as a barrier technology by positioning one or more lines of injection points (biotreatment barriers) in the projected path of a contaminant plume. Alternatively, biotreatment barriers can be constructed from mulch and other organic material and installed as a permeable reactive barrier (see Section 3.2.4.3 below).

<u>Effectiveness</u>

Enhanced anaerobic bioremediation would be an effective process option primarily for PCE and other chlorinated solvents. ORC application would not be effective for the treatment of the chlorinated VOCs in groundwater. While the amount of documentation for these technologies is increasing, their effectiveness, particularly in cases of very high contaminant concentrations, typically needs to be demonstrated through performance of a pilot study.

<u>Implementability</u>

Injection into overburden and bedrock via injection wells can be readily implemented and can provide accurate reagent delivery into target areas. A tight spacing of injection points may be required in order to achieve the required substrate contact in bedrock because of uncertainty in the extent of fractures, and

injection and distribution of reagent into bedrock may be difficult to accomplish. Many qualified contractors would be available for the implementation of this technology. Because of the relatively large surface area and depth of the plume, application of an electron-donor compound and bacterial culture would best be accomplished through injection wells. Permanent injection points into the bedrock would be required. Field pilot testing would be required to test the effectiveness and feasibility of injection.

Cost

The capital and operation and maintenance (O&M) costs for enhanced in-situ bioremediation by injection into the overburden and bedrock would be moderate.

Conclusion

Enhanced in-situ bioremediation via anaerobic bioremediation is retained in the development of groundwater remedial alternatives for treatment of the source areas. Injection of a substrate into overburden and bedrock is likely to be effective. Pilot testing would be required in order to demonstrate feasibility.

3.2.3.2 Chemical Oxidation

ISCO involves the injection of chemical agents into the contaminant plume. These chemical agents promote the generation of highly reactive hydroxyl radicals that react with the COCs and result in the oxidative cleavage of the carbon-to-carbon bond, yielding water, carbon dioxide, oxygen, and dilute hydrochloric acid as by-products.

Traditionally, the chemical agents used for this purpose have included powerful oxidants such as iron-catalyzed hydrogen peroxide (known as Fenton's Reagent), sodium persulfate, potassium permanganate, or ozone. More recently, milder oxidants such as catalytically complexed sodium percarbonate (marketed as Regenesis RegenOx™) have also been successfully used.

Similar to in-situ biological treatment additives, in-situ chemical oxidation reagents are generally injected into contaminant plumes using either multiple DPT or permanent injection locations. For low permeability media such as clay and bedrock, oxidizers such as potassium permanganate can be applied in solids blended with sand and emplaced into source zones via hydraulic fracturing due to its relatively long lifetime, ability to diffuse between fracture intervals and to more aggressively address source zone contamination. Oxidizers can also be applied to the overburden groundwater by soil mixing methods.

Effectiveness

ISCO with strong oxidants such as Fenton's Reagent is a well-established technology that could be effective for the destruction of chlorinated volatile organic compounds (CVOCs). An ISCO pilot test using Fenton's reagent was conducted at the Site in 2000 with a second injection test in 2001 (Tetra Tech, 2011). Overall reductions in the extent of the CVOCs and BTEX plumes were achieved in the pilot test; however, elevated PCE concentrations still remain in overburden and bedrock groundwater, particularly in areas near the former tank location. The pilot test report concluded that not all the goals of the test were met due to the inability of the oxidant to reach all the target zones and the likelihood of contaminants located in hydraulically isolated bedrock fractures. Pilot-scale treatability testing would be highly desirable to confirm effectiveness and to determine injection system design criteria.

The effectiveness of ISCO can also be impacted by heterogeneous subsurface conditions that could result in uneven distribution of the injected chemical agents and incomplete contact of these agents with the groundwater COCs. Due to the stratigraphic variations associated with the Site overburden and bedrock, a pilot study may be required within the overburden and bedrock groundwater zones to evaluate oxidant distribution and injection conditions.

Implementability

ISCO could be implemented at the Site. Qualified contractors specializing in the application of this technology are relatively available. Because of the heterogeneity of subsurface materials at the Site, application of an oxidant would best be accomplished through direct injection rather than by recirculation. Although injection into the overburden and shallow bedrock is expected to be more successful, the uncertainty of the distribution of the oxidizer limits the effectiveness. Oxidizers are typically short-lived and are likely to react with other constituents in the groundwater and soil matrix before reacting with contaminants.

The chemical reactions that result from the application of strong oxidizing agents may generate heat and high pressures that can alter subsurface characteristics and even result in hazardous conditions if not carefully administered. Air quality monitoring of the remediation area may be required while strong oxidizing agents are utilized.

Cost

Capital and O&M costs for ISCO with a strong oxidant using injection points would be moderate.

Conclusion

Chemical oxidation is retained in the development of alternatives for treatment of the source areas. Injection of a chemical agent into overburden and bedrock is likely to be effective.

3.2.3.3 Permeable Reactive Barriers

PRBs involve emplacement of reactive materials in the subsurface to intercept a contaminant plume, provide a flow path through the reactive media, and transform the contaminant(s) into environmentally acceptable forms to attain PRGs downgradient of the barrier.

PRBs have been used to treat a wide range of groundwater contaminants, including chlorinated and non-chlorinated VOCs. Iron metal [zero valent-iron (ZVI)] is the most common reactive media used in PRBs for the treatment of CVOCs such as PCE. ZVI works by releasing electrons to the chlorine molecules on the hydrocarbons (e.g., PCE) allowing them to cleave from the hydrocarbons. Successive cleavages dechlorinate the hydrocarbons ultimately resulting in the production of ethene. The reaction pathways may be very complex, but the net result is the dechlorination of the hydrocarbons.

Organic material, such as wood mulch, can be used to create a biological PRB, also referred to as a bio-barrier. The mulch acts as a source of carbon for aerobic microorganisms that use dissolved oxygen to metabolize the mulch, thus lowering the redox potential of the aquifer. This stimulates anaerobic degradation of the organic matter releasing hydrogen and acetate that are used by other anaerobic microorganisms to complete reductive dechlorination of the chlorinated hydrocarbons. Bio-barriers can also be constructed by injecting electron donor compounds such as emulsified oil into one or more lines of injection points in the projected path of a contaminant plume.

PRBs are generally built in two basic configurations: funnel-and-gate and continuous. The funnel-and-gate PRB uses impermeable walls (sheet pilings, slurry walls, etc.) as a ”funnel” to direct the contaminant plume into a “gate” containing the reactive media, whereas the continuous PRB completely intercepts the plume flow path with reactive media. Because PRBs are not designed to contain groundwater movement but to intercept groundwater contaminants, the permeability of the reactive media must be at least equal or greater than the permeability of the surrounding aquifer to avoid diversion of the groundwater flow path. This is particularly necessary with the funnel-and-gate design where the cross section of the permeable zones is restricted. Because the emplacement of reactive material generally requires excavation, both types of PRBs have typically been limited to relatively shallow depths of approximately 50 ft bgs. However, the use of alternate technologies, such as slurry injection and hydrofracturing, may help to overcome some of these emplacement limitations.

Placement of PRBs must consider both groundwater and contaminant velocity and the lifespan of the reactive material in the PRB. For this Site, PRBs located at the leading edge of the plume would be effective in treating the plume and preventing contaminants from further migration.

Effectiveness

The use of injection-based bio-barriers would be effective for the in-situ treatment of PCE and other organic compounds at the Building 81 Site. It is expected that the concentrations of PCE would be reduced to the PRGs.

Implementability

PRBs would be easy to install to a depth of up to 30 ft bgs because this could be accomplished with single pass trench excavators. The number of competent contractors available to implement these specialized techniques would be relatively limited. However, this method cannot readily be applied to bedrock. In addition, the presence of buried utilities in the vicinity of the Site may interfere with the installation of trenches in the overburden.

The injection-based approach would be readily implementable at the Site. Many qualified contractors would be available for the implementation of this technology. Permanent injection points into the bedrock would be required. Field pilot testing would be required to test the effectiveness of injection, particularly in the bedrock. The effectiveness of distribution of ZVI in bedrock is uncertain.

Once installed, the O&M requirements of PRBs would be minimal and would be essentially limited to the monitoring of groundwater quality to verify performance and routine inspections to verify continued integrity of the structure. Due to the shorter lifespans of mulch barriers, replenishment by injection of an electron donor substrate would be needed periodically. Injection-based bio-barriers would also need to be regenerated periodically. However, for ZVI PRBs, the need for replacement of the ZVI material in 15 to 20 years is likely because of the potential issues of reactivity loss and mineral fouling.

Cost

The capital cost of installation of trench PRBs, as required at the Building 81 Site, would be moderate to high. The cost for ZVI is significantly higher than the cost for mulch. The cost of injection-based bio-barriers is much less than trench PRBs. O&M costs would be very low.

Conclusion

Injection-based bio-barriers using an emulsified oil substrate are retained in combination with other process options for the development of groundwater remedial alternatives. ZVI PRBs are not retained because of the need for replacement in 15 to 20 years, the implementability issue in bedrock, and the related capital cost and site impacts during installation.

3.3 SELECTION OF REPRESENTATIVE TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER

The following technologies and process options, under the GRAs as noted, were retained for the development of groundwater remedial alternatives:

- No Action
- Bio-barriers (e.g., PRBs), LUCs, and monitored natural attenuation (MNA)
- In-Situ Treatment: Enhanced Bioremediation, Bio-barriers (e.g., PRBs), LUCs and MNA
- In-Situ Treatment: ISCO, Bio-barriers (e.g., PRBs), LUCs, and MNA

The next step was to select representative process options from each technology to assemble an adequate variety of alternatives and evaluate the alternatives in sufficient detail to aid in the final selection process. The alternatives are presented in Section 4.

4.0 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

This section presents an evaluation of each remedial alternative with respect to the criteria of the NCP (40 CFR Part 300). These criteria and their relative importance are described in the following subsections.

4.1 DEVELOPMENT OF REMEDIAL ALTERNATIVES FOR GROUNDWATER

As previously outlined in Sections 2.3 and 2.5 of this FS, RAOs and GRAs for the Site were developed to mitigate unacceptable risks to human health associated with concentrations of PCE, TCE, cis-1,2-Dichloroethene (cis-1,2-DCE), VC, toluene, benzene, and naphthalene in groundwater. This section presents the development and detailed analysis of the remedial alternatives for groundwater to achieve the Site RAOs. Each alternative was developed from the technologies that were retained from the screening process presented in Section 3. The alternatives cover a wide variety of treatment technologies in order to provide a range of remedial alternatives for consideration. From the technologies retained from the preliminary screening summarized in Table 3-1, the following potential remedial alternatives were developed to mitigate the concentrations of COCs exceeding PRGs in groundwater at the Site:

- Alternative G-1: No Action
- Alternative G-2: Bio-barriers, MNA, and LUCs
- Alternative G-3: In-situ Enhanced Bioremediation, Bio-barriers, MNA, and LUCs
- Alternative G-4: ISCO Bio-barriers, MNA, and LUCs

4.1.1 Evaluation Criteria

In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance

- Community Acceptance

The last two evaluation criteria, State Acceptance and Community Acceptance, are not formally addressed until the ROD is prepared. Each of the remaining seven criteria is discussed below.

4.1.1.1 Overall Protection of Human Health and the Environment

Alternatives must be assessed for adequate protection of human health and the environment, in both the short and long term, from unacceptable risks posed by hazardous substances or contaminants present at the Site by eliminating, reducing, or controlling exposure to levels exceeding PRGs. Overall protection draws on the assessments of the other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

4.1.1.2 Compliance with ARARs

Alternatives must be assessed to determine whether they attain ARARs under federal environmental laws and state environmental or facility siting laws. CERCLA Section 121(d) specifies in part that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (i.e., ARARs) to the hazardous substances or particular circumstances at a site or a waiver must be obtained [see also 40 CFR 300.430(f)(1)(ii)(B)]. ARARs include only federal and state environmental or facility siting laws/regulations and do not include occupational safety or worker protection requirements. In addition, per 40 CFR 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (TBC guidance category).

4.1.1.3 Long-Term Effectiveness and Permanence

Alternatives must be assessed for the long-term effectiveness and permanence they offer, along with the degree of certainty that the alternative would prove successful. Factors to be considered, as appropriate, include the following:

- Magnitude of Residual Risk - Risk posed by untreated waste or treatment residuals at the conclusion of remedial activities. The characteristics of residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate.

- Adequacy and Reliability of Controls - Controls such as containment systems and LUCs that are necessary to manage treatment residuals and untreated waste must be shown to be reliable. Examples include: the uncertainties associated with land disposal for providing long-term protection from residuals; assessment of the potential need to replace technical components of the alternative such as a cap, a slurry wall, or a treatment system; and potential exposure pathways and risks posed if the remedial action needs replacement.

4.1.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The degree to which the alternative employs recycling or treatment that reduces the toxicity, mobility, or volume of contaminants must be assessed, including how treatment is used to address the principal threats posed by the site. Factors to be considered, as appropriate, include the following:

- The treatment or recycling processes the alternative employs and the materials that these processes will treat.
- The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled.
- The degree of expected reduction in toxicity, mobility, or volume of contaminants due to treatment or recycling and the amount of reduction(s) that is occurring.
- The degree to which the treatment is irreversible.
- The type and quantity of residuals that will remain following treatment considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents.
- The degree to which treatment reduces the inherent hazards posed by the principal threats at the site.

4.1.1.5 Short-Term Effectiveness

The short-term effectiveness of the alternatives must be assessed considering the following:

- Short-term risks that might be posed to the community during implementation.
- Potential impacts on workers during the remedial action and the effectiveness and reliability of protective measures.
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation.
- Time until protection is achieved.

Although not a CERCLA criterion, the sustainability of each alternative is evaluated per Navy policy. Sustainability factors are similar to those evaluated as part of the Short-Term Effectiveness criterion, so they are discussed in this section. Sustainability evaluations provide insight into elements of a remedy that have the greatest impact on the environmental footprint. For example, the amount of greenhouse gas (GHG) emissions related to materials production generally exceeds that from installation, transportation, or operations. Other factors that are considered include emissions of criteria air pollutants, water usage, and energy consumption. Sensitivity analysis of such factors can help provide an optimal design that minimizes the overall environmental footprint of the remedial action. Sustainability evaluations were performed for each remedial alternative and are provided in Appendix F.

4.1.1.6 Implementability

The ease or difficulty of implementing the alternatives must be assessed by considering the following types of factors, as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, reliability of the technology, ease of undertaking additional remedial actions, and ability to monitor the effectiveness of the remedy.
- Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions).
- Availability of services and materials, including the availability of adequate off-site treatment capacity, storage capacity, and disposal capacity and services; availability of necessary equipment and specialists and provisions to ensure necessary additional resources; availability of services and materials; and availability of prospective technologies.

4.1.1.7 Cost

Capital costs, including both direct and indirect costs and annual O&M costs are provided. A net present value of the capital and O&M costs is also provided. Typically, the cost estimate accuracy range is plus 50 percent to minus 30 percent.

4.1.2 Relative Importance of Criteria

Among the nine criteria, the threshold criteria are considered to be:

- Overall Protection of Human Health and the Environment

- Compliance with ARARs (excluding those that may be waived)

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five criteria are considered to be the primary balancing criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

The balancing criteria are used to weigh the relative merits of the alternatives.

The remaining two of the nine criteria, State Acceptance and Community Acceptance, are considered to be modifying criteria that must be considered during remedy selection. The state's concerns that must be assessed include the state's position and key concerns related to the preferred alternative and other alternatives and State comments on ARARs or the proposed use of waivers. The assessment of community acceptance consists of responses of the community to the Proposed Plan and includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. These last two criteria will be evaluated after the FS has been reviewed by the Commonwealth of Massachusetts and the Proposed Plan has been discussed at a public meeting. Therefore, this document addresses only seven of the nine criteria.

4.1.3 Selection of Remedy

The selection of a remedy is a two-step process. The first step consists of identification of a preferred alternative and presentation of the alternative in a Proposed Plan for the community to review and comment. The preferred alternative must meet the following criteria:

- Protection of human health and the environment.
- Compliance with ARARs unless a waiver is justified.
- Cost effectiveness in protecting human health and environment and in complying with ARARs.
- Utilization of permanent solutions and alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

The second step consists of the review of the public comments and determination of whether or not the preferred alternative continues to be the most appropriate remedial action for the site, in consultation with the Commonwealth of Massachusetts.

4.2 ASSEMBLY AND DETAILED ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES

The detailed descriptions and evaluation of the four remedial alternatives developed for site groundwater are presented in Sections 4.2.1 through 4.2.4.

Alternative G-1 was developed and analyzed to serve as a baseline for comparison to other alternatives, as required by CERCLA and the NCP. Alternative G-2 was developed and analyzed to evaluate interception and treatment of the contaminant plume at its leading edge with MNA for the rest of the plume. Alternatives G-3 and G-4 were developed and analyzed to evaluate active remediation of the areas with the highest contaminant concentrations in overburden and bedrock in addition to plume interception and treatment at its leading edge and MNA for the rest of the plume as included in Alternative G-2. Treatment of the plume at its leading edge in Alternatives G-2 through G-4 would continue for a long time as contaminated groundwater slowly flows through the target treatment zones (TTZs). The treatment of groundwater with high COC concentrations in overburden and bedrock source areas in Alternatives G-3 and G-4 would be completed in approximately 1 to 5 years. A description and detailed analysis of these alternatives are presented in the following sections.

The area east of the Shea Memorial Drive was selected for passive treatment of the contaminant plume in overburden and bedrock using bio-barriers constructed by injection of an emulsified oil substrate via permanent injection wells. The area near the previously excavated area downgradient of the former tank location in overburden and the 1,000 µg/L PCE concentration contours in the shallow and deep bedrocks were selected as the areas for active treatment using enhanced bioremediation in Alternative G-3 and chemical oxidation in Alternative G-4 because these areas are most likely to include continuing sources of the PCE. The approach to groundwater remediation was to reduce the source mass in high concentration areas by active treatment and prevent plume migration by interception and passive treatment of the plume at its leading edge. Contamination in the rest of the plume would be expected to be reduced primarily through natural attenuation.

4.2.1 Alternative G-1: No Action

4.2.1.1 Description

The No Action alternative maintains the Site as is. This alternative does not address the groundwater contamination and is retained to provide a baseline for comparison to other alternatives. There would be no reduction in toxicity, mobility, or volume of the contaminants other than what would result from natural dispersion, dilution, and other attenuating factors.

4.2.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative G-1 would not provide protection of human health and the environment. There could be unacceptable risks to human health from exposure to contaminated groundwater. Groundwater contamination might migrate off-site because no monitoring would be performed, potential migration of contaminants would not be detected.

Compliance with ARARs and TBCs

Alternative G-1 would not comply with chemical-specific ARARs or TBCs listed in Table 4-1 because no action would be taken to reduce contaminant concentrations. There are no location- and action-specific ARARs or TBCs.

Long-Term Effectiveness and Permanence

Alternative G-1 would have little long-term effectiveness and permanence because: contaminated groundwater would remain on site; there would be no LUCs to restrict construction methods to mitigate vapor intrusion; and there would be no groundwater monitoring so potential off-site migration of COCs would not be detected. Although COC concentrations might eventually decrease through natural attenuation, no monitoring would verify this.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative G-1 would not reduce toxicity, mobility, or volume of groundwater COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Because no action would occur, implementation of Alternative G-1 would not have any short-term adverse impact from cleanup activities to the local community or the environment. Alternative G-1 might achieve the RAOs. Although the PRGs might eventually be achieved through natural attenuation, this

would not be verified through monitoring. There are no sustainability impacts to consider because no actions would be implemented.

Implementability

Because no action would occur, Alternative G-1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. Implementability of additional administrative measures is not applicable because no such measures would be taken.

Cost

The only cost associated with the No Action alternative is the required 5-year reviews.

Capital Cost:	$	11,000
30-Year NPW of Annual Costs:	$	109,000
30-Year NPW:	$	120,000

A detailed breakdown of estimated costs for this alternative is provided in Appendix G.

4.2.2 Alternative G-2: Bio-barriers, MNA, and LUCs

4.2.2.1 Description

Alternative G-2 would consist of three major components: (1) bio-barriers in the overburden and bedrock east of Shea Memorial Drive; (2) MNA; and (3) LUCs.

Component 1: Bio-barriers in the Overburden and Bedrock East of Shea Memorial Drive

Two bio-barriers, one in the overburden and one in the bedrock, would be installed east of the Shea Memorial Drive to intercept and treat the contaminant plume in overburden and bedrock at its leading edge as shown on Figure 4-1. The elevated PCE concentrations encompass the other COCs, so for simplicity, PCE concentration contours are shown on Figure 4-1. The bio-barriers would be installed by injecting a commercially available EOS product, such as AquaBu*pH*™, into rows of injection points placed across the plume perpendicular to the direction of groundwater flow to stimulate the reductive dechlorination of CVOCs in groundwater by naturally occurring microorganisms. The emulsified oil product would be distributed throughout the bio-barriers to provide a long-lasting electron donor (ED) to support anaerobic biodegradation processes as the contaminated groundwater slowly flows through them. These oils would be fermented to molecular hydrogen (H_2) and acetate by common subsurface microorganisms, which could then be used as a carbon and energy source for anaerobic biodegradation

of the target pollutants. Soluble substrates and nutrients (e.g., lactate, yeast extract, vitamins) could be added as needed to the mixture prior to injection to stimulate rapid growth of the desired bacteria.

For the overburden barrier, a total of 24 injection wells in three rows would be needed for a 120-foot long barrier to treat the overburden contaminant plume to levels less than the PRGs, using row spacing and well spacing of 15 ft as illustrated in Figure 4-1. The injection wells would be installed to the bottom of the deep overburden at approximately 18 ft bgs. The emulsified oil would be injected over an 11-foot interval in the saturated zone in each well. The total volume of the emulsion to be injected would be approximately 42,000 gallons, including approximately 9,400 pounds of EOS product. A high-pressure pump capable of a pumping rate of 1 to 5 gallons per minute (gpm) would be necessary to ensure the proper application of the emulsified oil product and to minimize application time.

For the bedrock barrier, a total of 25 injection wells in three rows would be needed for a 100-foot long barrier to treat the contaminant plume in shallow and deep bedrock zones to concentrations less than the PRGs, assuming a well spacing of 15 ft as shown on Figure 4-1. Four of the bedrock injection wells would be installed to the estimated depth of the contaminant plume in deep bedrock at approximately 60 ft bgs in the northern 60-foot section of the bedrock bio-barrier. The other 21 bedrock injection wells would be installed to the estimated depth of the contaminant plume in shallow bedrock at approximately 40 ft bgs. The emulsified oil would be injected using packers over discrete 10-ft intervals along the entire screened section in the bedrock zone in each well. The injection interval is assumed to be 18-40 ft bgs for injection wells in shallow bedrock and 18-60 ft bgs for injection wells in deep bedrock. The total volume of emulsion to be injected would be approximately 500 gallons, including approximately 1,200 pounds of emulsified oil. A high-pressure pump capable of a pumping rate of 1 to 2 gpm would be necessary to ensure the proper application of the emulsified oil product and to minimize application time.

A pilot study would be performed to confirm well spacing and application rates in both the overburden and bedrock systems. Alternatively, a phased design could be used for the installation of wells and injection of reagent.

It is assumed that the bio-barriers would need to be replenished every 5 years to maintain the ED supply until the entire plume has passed through the barriers and has been cleaned up to achieve the PRGs.

Monitoring (baseline and quarterly for 1 year) would be performed to evaluate the effectiveness and progress of the treatment using wells on both sides of the bio-barriers as part of the monitoring program for MNA as described in Component 2 below.

The reducing conditions resulting from injection of ED compounds could potentially cause temporary mobilization of metals such as iron and manganese. However, the metal concentrations would be naturally attenuated over time via adsorption or (co)precipitation downgradient of the bio-barriers as the geochemical conditions in the aquifer that favor the binding of metals to aquifer solids are re-established. A contingency measure would be implemented if monitoring indicates that concentrations of these metals exceed target levels that would cause unacceptable risks (to be determined during the preparation of the long-term monitoring plan). The contingency measure would change the reducing conditions downgradient from the bio-barriers to oxidizing conditions. See the uncertainty discussion below.

Component 2: MNA

MNA would be implemented for the rest of the plume, including the high concentration areas near the former tank location, in accordance with the Office of Solid Waste and Emergency Response (OSWER) Directive *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites* (USEPA, 1999) and other MNA guidance documents. The COCs that have not naturally attenuated by the time the contaminated groundwater reaches the bio-barriers would be treated as the groundwater passes through them. Contaminant downgradient of the bio-barriers would also degrade through natural attenuation processes.

Natural attenuation would rely on naturally occurring processes within the aquifer to reduce the mass, toxicity, volume, or concentration of the COCs in groundwater. The concentrations of CVOCs, which are the predominant COCs in groundwater at the Site, would be reduced through a variety of biological (e.g., reductive dechlorination, aerobic oxidation, anaerobic oxidation, aerobic co-metabolism), physical (e.g., advection, dilution, dispersion, diffusion, etc.), and chemical (e.g., abiotic degradation) processes. The most important mechanism for the natural biodegradation of CVOCs is anaerobic reductive dechlorination. Optimal conditions for reductive dechlorination are created when sufficient carbon sources are present for microorganisms to use up the available oxygen. Once the oxygen is depleted, the microorganisms must use other electron acceptors (e.g., Mn^{4+}, SO_4^{2-}, NO_3^-, and Fe^{3+}) to metabolize the carbon. If enough carbon, suitable organisms, and the proper geochemical conditions are present, the aquifer would become depleted of these electron acceptors and conditions would become suitable for methanogenic bacteria to use carbon dioxide (CO_2) as the electron acceptor (producing methane in the process). These conditions are also optimal for the CVOCs to serve as electron acceptors, resulting in degradation of the CVOCs via reductive dechlorination.

Less-oxidized CVOCs, such as VC do not readily serve as electron acceptors and may only degrade slowly under anaerobic conditions via reductive dechlorination. If conditions are sufficient to promote reductive dechlorination of the more highly substituted CVOCs, and anaerobic conditions persist along the entire length of the plume, VC may accumulate. VC can also be removed from the plume via aerobic

degradation. Under aerobic conditions, VC can be used as a primary substrate and can serve as an electron donor. Thus, optimal CVOC degradation can occur at sites where conditions change from strongly reducing to aerobic along the axis of the plume.

Natural attenuation of CVOCs has been found to be occurring to varying degrees across the Site, based on an evaluation of groundwater sampling results from the RI (Tetra Tech, 2011). Based on preliminary modeling using BIOCHLOR, it is estimated that PRGs would be achieved in less than 10 years in the overburden, approximately 60 years in the shallow bedrock, and approximately 250 years in the deep bedrock. Due to the simplifying assumptions of the BIOCHLOR model and limitations of the available data, the cleanup time estimates presented are only used for a semi-quantitative comparison between different alternatives. If DNAPL is present the remediation time would be longer. Calculations supporting BIOCHLOR modeling are included in Appendix E.

Monitoring would be conducted to assess the effectiveness of natural attenuation over time until the PRGs have been achieved. Groundwater samples would be collected and analyzed for the COCs, and various natural attenuation indicator parameters, such as ORP, DO, pH, alkalinity, TOC, ferrous and total iron, sulfur compounds (sulfate and sulfide), nitrogen compounds (nitrate and nitrite), chloride, and metabolic gases (methane, ethane, ethene, and CO_2). Wells monitored for these parameters would be selected from upgradient and side-gradient areas within the source area, within the plumes, and up- and down-gradient of the bio-barriers. Groundwater samples from wells located downgradient of the bio-barriers will also be collected and analyzed for iron and manganese. A long-term monitoring plan would be prepared to identify the wells to be sampled and the analyses to be performed. For the purpose of this FS, a total of 12 wells are assumed to be included in the MNA long-term monitoring program, based on the extent of the plumes and the thickness of the aquifer. The exact number and location of monitoring wells would be determined during the RD phase.

Conceptually, the monitoring program would be conducted quarterly for the first year to establish baseline conditions and to evaluate the effectiveness of natural attenuation as well as the treatment of the bio-barriers. Then the monitoring frequency could be reduced to semi-annual for the next two years and annual thereafter, as appropriate based on the observed COC trends. The effectiveness of MNA would be evaluated using a weight-of-evidence approach, consistent with recent MNA guidance documents.

Component 3: LUCs

The remedial action at the Building 81 Site will require a long remediation timeframe, thus the implementation of LUCs would control exposure to COCs in groundwater during this period.

Because the Building 81 Site is not located within a potentially productive aquifer and SSTTDC and LNR have indicated that production, supply, and irrigation water needs for site redevelopment can be provided by sources other than the groundwater under the Building 81 Site, future use of the Site groundwater for production, supply, or irrigation purposes are not exposure scenarios evaluated in the FS. Therefore, a permanent LUC that prevents the use of groundwater at the Building 81 site for production, supply, or irrigation purposes would be used to prevent exposure of residents to VOCs in groundwater at concentrations that pose unacceptable risk (SSTTDC/LNR, 2011). The approximate boundary of the permanent LUC area is shown on Figure 4-2.

PRGs for the vapor intrusion and construction worker pathways would be utilized to establish an "LUC Compliance Boundary" which is currently anticipated to be located near the eastern edge of Shea Memorial Drive. The approximate boundary of this interim LUC area is shown on Figure 4-1. Areas upgradient of the LUC Compliance Boundary may utilize the interim LUCs listed below which SSTTDC and LNR have indicated would be consistent with the proposed future uses of the Base (SSTTDC/LNR, 2011).

1. A LUC restricting the type and nature of construction permitted in the source area of the plume where the highest VOCs concentrations have been detected and where active remediation might be conducted (as a contingency), until PRGs are achieved. Construction in the vicinity of the bio-barriers would also be restricted to prevent disturbance of and damage to the injection wells and allow future injections.
2. A LUC requiring prior USEPA and MassDEP approval of construction dewatering plans before excavation activities could be conducted, until PRGs are achieved.
3. A LUC specifying health and safety procedures to be used by construction workers to prevent unacceptable exposure risks based upon risk-based values, until PRGs are achieved.
4. A LUC specifying passive building design methods, such as a sub-slab vapor mitigation system, to prevent exposure of building occupants to vapor intrusion from VOCs in groundwater at levels that pose an unacceptable risk, until PRGs are achieved.

Because COCs have not been detected in groundwater west of Shea Memorial Drive at concentrations in excess of MCLs or PRGs, it is not anticipated that interim LUCs would be imposed downgradient of the LUC Compliance Boundary (west of Shea Memorial Drive or otherwise in the VCD or Mixed-Use Village District [MUVD]) except for the permanent LUC prohibiting the installation of production, supply, or irrigation wells (as discussed above) (SSTTDC/LNR, 2011). In all cases, the interim LUCs listed above would be narrowly tailored to prevent specific, identified risks and exposure scenarios identified in the HHRA and applicable to this FS, and would be limited in both location and scope so as not to unreasonably burden or prohibit reasonably foreseeable uses anticipated by the Reuse Plan.

To implement the LUCs, the Navy would develop a LUC RD during the RD phase that would describe the specific controls for the Site and details of the LUCs listed above, as well as the implementation protocols and upkeep requirements. The LUC RD would use PRGs as a starting point to define the boundaries of the interim LUC areas as well as conditions, terms, and limitations of the controls (see Figure 4-1 for the approximate boundaries of LUC areas). The LUC RD would also outline the required inspection, reporting, and enforcement protocols.

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

Because this remedy would result in hazardous substances, pollutants, or contaminants remaining on the Site in excess of levels that allow for unlimited use and unrestricted exposure, in accordance with CERCLA Section 121(c) and 40 CFR 300.430(f)(5)(iii)(C) of the NCP, statutory five-year reviews would be conducted after initiation of the remedial action to ensure that the remedy continues to be protective of human health and the environment. Each five-year review would consist of a review of relevant documents, interviews, a site inspection, and preparation of a summary report.

Alternative G-2 Uncertainties and Contingency Measures

There are several uncertainties that may affect the design and implementation of this alternative. There are uncertainties associated with injection well spacing and the effectiveness in distributing the ED; these uncertainties may affect the number of wells. This issue is more important for the bedrock bio-barriers because the overall extent of bedrock fractures is not known: the results of the earlier ISCO study suggest a high variability. Pilot tests prior to the design should address these uncertainties. Another uncertainty is the rate of biodegradation due to natural attenuation. This is primarily a consideration for the groundwater plume between the source area and bio-barrier and affects the overall time that the bio-barriers must be maintained and replenished. Finally, the bio-barrier is expected to treat the plume such that PRGs are met on the downgradient side. However, if the treatment is not complete, VC concentrations may be greater than the PRG. In addition, the reducing conditions created by the bio-barrier may cause elevated concentrations of reduced metals, such as iron and manganese.

Contingency remedies may need to be implemented if any of these uncertainties result in unacceptable risks or impacts. If natural attenuation is not effective, then source area treatment (as described in Alternatives G-3 or G-4, or another technology) may be required to reduce the mass of contaminants that must be addressed by natural processes and by the bio-barrier. In the event that VC concentrations or metals concentrations downgradient of the bio-barriers exceed PRGs or other action levels established in

the RD, it may be necessary to implement a contingency technology to create oxidizing conditions downgradient of the bio-barrier.

There are several technologies that could be considered to promote oxidizing conditions. A blower could inject air through a series of air sparging wells. This would require constructing a small building for the blower and installing air distribution piping. Pure oxygen could also be sparged into the wells using compressed oxygen tanks and specialized diffusers in diffusion wells: pure oxygen can diffuse further from the wells than compressed air. Small vaults would be installed near each well to house the compressed oxygen cylinders. A third method would use an ORC that would be injected into wells at multiple locations. The ORC would gradually release oxygen into the surrounding groundwater, and the subsequent reinjections would be required. The specific technology would be selected after evaluating the conditions at the site.

4.2.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative G-2 would be protective of human health and the environment.

By intercepting the contaminant plume at its leading edge, the bio-barriers would control the plume migration and treat groundwater to levels less than the PRGs. Naturally occurring processes such as biodegradation, dispersion, and dilution would reduce concentrations of groundwater COCs in the rest of the plume over the long term. Monitoring would be protective of the environment by evaluating the progress of natural attenuation and detecting potential migration of contaminated groundwater so that appropriate contingency measures can be taken, if required.

LUCs would ensure protection of human health and the environment until the remediation goals are met. Restricting the use of groundwater would be protective of human health by avoiding unacceptable risks of exposure to COCs in groundwater. Exposure to VOCs through vapor intrusion would be controlled by the LUC requiring special building design and construction methods.

Compliance with ARARs and TBCs

Alternative G-2 would eventually comply with chemical-specific ARARs and TBCs through a combination of passive treatment by the bio-barriers and MNA. This would be verified through monitoring. Alternative G-2 would also comply with location- and action-specific ARARs and TBCs. The chemical-, location-, and action-specific ARARs and TBCs for Alternative G-2 are listed in Tables 4-2, 4-3, and 4-4, respectively.

Long-Term Effectiveness and Permanence

Alternative G-2 would provide long-term effectiveness and permanence through passive treatment by bio-barriers, MNA, and LUCs. The bio-barriers east of the Shea Memorial Drive would treat the plume in overburden and bedrock and prevent contaminants from further migration. Groundwater flowing through the bio-barriers would be treated to levels less than the PRGs. While bio-barriers are a relatively well-established technology, prior to design of the bio-barriers, a pilot-scale treatability study would need to be performed to verify the well spacing and injection rates. Natural attenuation would reduce concentrations of groundwater COCs in the rest of the plume over time. Monitoring the progress of natural attenuation and passive treatment by bio-barriers would be an effective means to evaluate the remedial progress and verify that no migration of COCs is occurring.

Groundwater use restrictions (e.g., permanent LUC) would prevent the use of groundwater for production, supply, or irrigation purposes. Requirements for specific construction methods (e.g., interim LUCs) would effectively prevent exposure to VOCs through vapor intrusion.

The administrative controls proposed in this alternative are considered reliable.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative G-2 would reduce the toxicity, mobility, and volume of groundwater COCs over time through passive treatment by the bio-barriers. The bio-barriers would permanently remove approximately 6 pounds of contaminants from the groundwater flowing through them. No treatment residues would be generated by this alternative other than the temporary formation of biodegradation by-products, such as VC, which may accumulate until conditions are suitable for aerobic and/or anaerobic biodegradation.

Short-Term Effectiveness

Alternative G-2 would result in few short-term effects. Exposure of workers to contamination during installation of injection wells, injection of emulsified oil substrate, and groundwater sampling would be minimized by compliance with the requirements of the Occupational Safety and Health Act (OSHA), including wearing of appropriate personal protection equipment (PPE) and adherence to site-specific health and safety procedures. Implementation of this alternative would have an impact at the area east of Shea Memorial Drive but would not have adverse impact to the surrounding community or the environment.

Groundwater RAO Nos. 2 through 4 would be achieved immediately upon implementation of LUCs and monitoring. The installation of injection wells for the bio-barriers and injection of emulsified oil would be completed in approximately 2 months. Groundwater RAO No. 1 would be achieved after the biodegradation of CVOCs in the bio-barriers begins. Replenishment of organic substrate in the bio-

barriers would be completed in approximately 1 week every 5 years after installation. Based on preliminary modeling using BIOCHLOR, it is estimated that for Alternative G-2 PRGs would be achieved in less than 10 years in the overburden, approximately 60 years in the shallow bedrock, and approximately 250 years in the deep bedrock. Due to the simplifying assumptions of the BIOCHLOR model and limitations of the available data, the cleanup time estimates presented in the FS can and should only be used for a semi-quantitative comparison between different alternatives. If DNAPL is present the remediation time would be longer. The BIOCHLOR modeling is provided in Appendix E.

The environmental footprint of each of the impact categories evaluated using SiteWise™ is based on the normalization of the remedial alternatives considered in the FS. The results of the environmental footprint evaluation are provided in Appendix F. These evaluations are required by Navy policy and are not part of the CERCLA evaluation criteria. For Alternative G-2, GHG emissions have a high relative impact, emitting 182 tons of carbon dioxide equivalents (CO_2e). For the criteria air pollutants, the relative impact of nitrogen oxides (NO_X), sulfur oxides (SO_X), and particulate matter less than 10 micrometers in diameter (PM_{10}) emissions is high, emitting 0.22, 0.2, and 0.015 tons of NO_X, SO_X and PM_{10}, respectively. The relative use water for Alternative G-2 is high, utilizing approximately 305,000 gallons of water. The relative use of energy is low to moderate at an approximated 1,400 Million British Thermal Units (MMBTU).

Implementability

The bio-barriers at the leading edge of the contaminant plume could be readily installed. There are many qualified contractors that can install injection wells and inject the emulsified oil. However, there is uncertainty in the effectiveness of the bedrock treatment because of the difficulties with injection and distribution of the emulsified oil product. Sampling and maintenance of monitoring wells, implementation of LUCs, and the performance of five-year reviews could readily be accomplished. The resources, equipment, and materials required for these activities are readily available.

The administrative aspects of Alternative G-2 for the property under the control of the Navy would be relatively simple to implement. However, if a change in ownership of the Site occurs prior to completion of remediation, appropriate provisions would be incorporated into property transfer documents to ensure continued implementation of remediation, aquifer use restrictions and monitoring.

Cost

The estimated costs for Alternative G-2 are as follows:

Capital Cost:	$	1,002,000
30-Year net present worth (NPW) of Annual Costs:	$	2,543,000
30-Year NPW:	$	3,545,000

A detailed breakdown of estimated costs for this alternative is provided in Appendix G.

4.2.3 Alternative G-3: Enhanced In-Situ Bioremediation, Bio-barriers, MNA, and LUCs

4.2.3.1 Description

Alternative G-3 would consist of four major components: (1) enhanced in-situ bioremediation in the overburden and bedrock source zones near to the former tank location; (2) bio-barriers in the overburden and bedrock east of Shea Memorial Drive; (3) MNA; and (4) LUCs.

Component 1: Enhanced In-situ Bioremediation in the Overburden and Bedrock Source Zones near the Former Tank Location

Active treatment by enhanced in-situ bioremediation would be applied to areas with the highest groundwater concentrations in overburden and bedrock to reduce the source mass of the contaminant plumes. The area of the 1,000 µg/L PCE concentration contour in the shallow and deep bedrock and the small area adjacent to well I-12 with approximately 280 µg/L of PCE in overburden were selected as the TTZs for enhanced bioremediation (see Figure 4-3). These areas are most likely to include potential sources of PCE that could continuously release PCE to groundwater via dissolution from residual NAPL or diffusion from soil or rock matrix.

Similar to the bio-barriers (see Component 2), a commercially available EOS product would be injected via injection wells into the TTZs in overburden and bedrock to stimulate the reductive dechlorination of CVOCs in groundwater. The injection locations would be on a grid with a spacing of approximately 10 ft between points in each TTZ to account for the uncertainty of the lateral interconnection, particularly in bedrock fractures (Figure 4-3).

A total of four injection wells would be needed in the overburden TTZ. The injection wells would be installed to the bottom of the deep overburden at approximately 18 ft bgs. The emulsified oil would be injected over an 11-foot interval in the saturated zone in each well. The total volume of emulsion and chase water to be injected would be approximately 4,000 gallons, including approximately 900 pounds of EOS product.

A total of 12 and 8 injection wells would be needed in the shallow bedrock TTZ and the deep bedrock TTZ, respectively as shown in Figure 4-3. The injection wells would be installed to approximately 40 ft bgs and 60 ft bgs for the shallow and deep bedrock TTZs, respectively. The emulsified oil would be injected using packers over discrete 10-foot intervals along the entire screened section in the bedrock zone in each well. The total volume of emulsion and chase water to be injected would be approximately 200 gallons, including approximately 550 pounds of EOS product.

A high-pressure pump capable of a pumping rate of 1 to 2 gpm would be necessary to ensure the proper application of the emulsified oil product and to minimize application time.

A pilot study would be performed to confirm well spacing and application rate in both the overburden and bedrock.

As a conservative assumption, a second injection of half the initial amount of the selected emulsified oil product would be applied at 50% of the injection points after 5 years. This injection would replenish the emulsified oil consumed by contaminant degradation and other electron acceptors in the aquifer based on the results of groundwater monitoring. The amount of ED required for this alternative would be determined during the remedial design phase with additional information provided by pilot studies and groundwater baseline monitoring.

Monitoring (baseline and quarterly for 1 year) would be performed to evaluate the effectiveness and progress of the treatment as part of the monitoring program for MNA as described in Component 3 below.

The reducing conditions resulting from injection of electron donor compounds could potentially cause mobilization of metals such as iron and manganese. However, the metal concentrations would be naturally attenuated over time as the geochemical conditions that favor the binding of metals to aquifer solids are re-established. The mechanisms of natural attenuation for metal contaminants are discussed in detail in Component 2 of Alternative G-2.

<u>Component 2: Bio-barriers in the Overburden and Bedrock East of Shea Memorial Drive</u>

This component would be identical to Component 1 of Alternative G-2. If reducing conditions cause unacceptable mobilization of iron, manganese, or arsenic, a contingency measure, as described in the uncertainty discussion below would be implemented.

Component 3: MNA

This component would be nearly identical to Component 2 of Alternative G-2, except that MNA would be implemented in the area between the source zone TTZs and bio-barriers after active treatment with enhanced bioremediation for further reduction of any residual CVOCs in the TTZs over time.

Component 4: LUCs

This component would be identical to Component 3 of Alternative G-2.

Because this remedy would result in hazardous substances, pollutants, or contaminants remaining on the Site in excess of levels that allow for unlimited use and unrestricted exposure, in accordance with CERCLA Section 121(c) and 40 CFR 300.430(f)(5)(iii)(C) of the NCP, statutory five-year reviews would be conducted after initiation of the remedial action to ensure that the remedy continues to be protective of human health and the environment. Each five-year review would consist of a review of relevant documents, interviews, a site inspection, and preparation of a summary report.

Alternative G-3 Uncertainties and Contingency Measures

There are several uncertainties that may affect the design and implementation of this alternative. There are uncertainties associated with injection well spacing and the effectiveness in distributing the ED; these uncertainties may affect the number of wells. This issue is more important for the bedrock bio-barriers because the overall extent of bedrock fractures is not known: the results of the earlier ISCO study suggest a high variability. Pilot tests prior to the design should address these uncertainties. Another uncertainty is the rate of biodegradation due to natural attenuation. This is primarily a consideration for the groundwater plume between the source area and bio-barrier and affects the overall time that the bio-barriers must be maintained and replenished. Finally, the bio-barrier is expected to treat the plume such that PRGs are met on the downgradient side. However, if the treatment is not complete, VC concentrations may be greater than PRGs. In addition, the reducing conditions created by the bio-barrier may cause elevated concentrations of reduced metals, such as iron and manganese.

Contingency remedies may need to be implemented if any of these uncertainties result in unacceptable risks or impacts. If natural attenuation if not effective then follow-up source area treatment may be required to further reduce the mass of contaminants that must be addressed by natural processes and by the bio-barrier. Alternatively, another technology may be evaluated for the source area. In the event that vinyl chloride concentrations or metals concentrations downgradient of the bio-barriers exceed the PRG or other action levels established in the RD, it may be necessary to implement a contingency technology to create oxidizing conditions downgradient of the bio-barrier.

There are several technologies that would be considered to promote oxidizing conditions. Examples are described in the Section 4.2.2.1 uncertainty discussion for Alternative G-2. The specific technology would be selected after evaluating the conditions at the site.

4.2.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative G-3 would be protective of human health and the environment.

By actively removing the sources of contamination, enhanced bioremediation in the TTZs would significantly reduce the source mass and the expansion of the plumes in overburden and bedrock. This would significantly reduce the risk from exposure to contaminated groundwater, and provide protection to future human receptors that may be exposed during intrusive activities. The enhanced bioremediation is expected to reduce or eliminate most of the contamination in the high concentration areas, thereby improving downgradient groundwater quality over time. In addition, by intercepting the contaminant plume at its leading edge, the bio-barriers in overburden and bedrock would control the plume migration and treat groundwater to levels less than the PRGs. Naturally occurring processes such as biodegradation, dispersion, and dilution would reduce concentrations of groundwater COCs in the rest of the plume over the long term. MNA would be protective of the environment by evaluating the progress of natural attenuation and detecting potential migration of contaminated groundwater so that appropriate contingency measures can be taken, if required.

LUCs would ensure protection of human health and the environment until the remediation goals are met. Restricting the use of groundwater would be protective of human health by avoiding unacceptable risks of exposure to contaminated groundwater. Exposure to VOCs through vapor intrusion would be controlled by the LUC requiring special building design and construction methods.

Compliance with ARARs and TBCs

Alternative G-3 would eventually comply with chemical-specific ARARs and TBCs through a combination of source zone treatment with enhanced bioremediation, passive treatment by bio-barriers and MNA. Alternative G-3 would also comply with location- and action-specific ARARs and TBCs. The chemical-, location-, and action-specific ARARs and TBCs for alternative G-3 are listed in Tables 4-5, 4-6, and 4-7, respectively.

Long-Term Effectiveness and Permanence

Alternative G-3 would provide long-term effectiveness and permanence.

In-situ treatment by enhanced bioremediation would effectively and permanently remove most of the contamination in the high concentration areas. This would reduce plume expansion and possibly reduce the duration that the bio-barriers must be maintained. In addition, the bio-barriers east of the Shea Memorial Drive would treat the plume in overburden and bedrock and prevent contaminants from further migration. Groundwater flowing through the bio-barriers would be treated to levels below the PRGs. Prior to design of the source zone treatment, a pilot-scale treatability study would need to be performed to verify well spacing and injection rates.

Monitoring the progress of active treatment of the source zone using enhanced bioremediation, passive treatment of the contaminant plume using bio-barriers at its leading edge, and natural attenuation in the rest of the plume would be an effective means to evaluate the progress of remediation and verify that no migration of COCs is occurring.

Groundwater use restrictions (e.g., permanent LUC) would prevent the use of groundwater for production, supply, or irrigation purposes. Requirements for specific construction methods (e.g., interim LUCs) would effectively prevent exposure to VOCs through vapor intrusion.

The administrative controls proposed in this alternative are considered reliable.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative G-3 would reduce the toxicity, mobility, and volume of groundwater COCs through a combination of in-situ active treatment and in-situ passive treatment. In-situ enhanced bioremediation would permanently remove an estimated 1.3 pounds of contaminants from groundwater from the TTZs. Passive treatment with the overburden and bedrock bio-barriers would permanently remove approximately 5 pounds of contaminants from the rest of the plume as groundwater flows through them. No treatment residues would be generated by this alternative other than the temporary formation of biodegradation by-products, such as VC, which may accumulate until conditions are suitable for aerobic and/or anaerobic biodegradation.

Short-Term Effectiveness

Alternative G-3 would result in few short-term effects. Exposure of workers to contamination during installation of injection wells, injection of emulsified oil substrate, and groundwater sampling would be minimized by compliance with OSHA requirements including wearing of appropriate PPE and adherence to site-specific health and safety procedures. Implementation of the components would have an impact in the high contamination area as well as the area east of Shea Memorial Drive but would not have adverse impact to the surrounding community or the environment.

Groundwater RAO Nos. 2 through 4 would be achieved immediately upon implementation of LUCs and monitoring. The installation of injection wells for the bio-barriers and injection of emulsified oil would be completed in approximately 2 months. The installation of injection wells for source zone enhanced bioremediation and injection of emulsified oil would be completed in approximately 1 month. Groundwater RAO No. 1 would be achieved after the biodegradation of CVOCs in the bio-barriers begins. Replenishment of organic substrate in the bio-barriers would be completed in approximately 1 week every 5 years after installation. Five years after the initial application, the second injection for the source zone enhanced bioremediation would be completed in approximately 1 week. Based on preliminary modeling using BIOCHLOR, it is estimated that Alternative G-3 would require less than 10 years in the overburden, approximately 30 years in the shallow bedrock, and less than 5 years in the deep bedrock to attain the groundwater PRGs through a combination of active treatment in source zone using enhanced bioremediation, passive treatment using bio-barriers, and natural attenuation. The BIOCHLOR simulations for this alternative include the assumption that the source concentrations are reduced by 90 percent using in-situ enhanced bioremediation alone. This results in the PRGs being met in the overburden and deep bedrock upon completion of the source treatment, so the time for the reduction of the remaining compounds to the PRGs is greatly reduced when compared to other simulations. The BIOCHLOR modeling is provided in Appendix E.

The environmental footprint of each of the impact categories evaluated using SiteWise^{TM} is based on the normalization of the remedial alternatives considered in the FS. The results of the environmental footprint evaluation are provided in Appendix F. These evaluations are required by Navy policy and are not part of the CERCLA evaluation criteria. For Alternative G-3, GHG emissions have a low to moderate relative impact, emitting approximately 190 tons of carbon dioxide equivalents (CO_2e). For the criteria air pollutants, the relative impact of NO_X emissions is high, and SO_X and PM_{10} emissions is low, emitting 0.22, 0.21, and 0.017 tons of NO_X, SO_X, and PM_{10}, respectively. The relative use of energy and water for Alternative G-3 is high, utilizing 6,500 MMBTU and 359,000 gallons of water, respectively.

Implementability

The injection wells for source zone enhanced bioremediation and the bio-barriers at the leading edge of the contaminant plume could be readily installed. There are many qualified contractors that can install injection wells and inject the emulsified oil. However, there is uncertainty in the effectiveness of the bedrock treatment because of the difficulties with injection and distribution of the emulsified oil product. Sampling and maintenance of monitoring wells, implementation of LUCs, and performance of five-year reviews could readily be accomplished. The resources, equipment, and materials required for these activities are readily available.

The administrative aspects of Alternative G-3 for the property under the control of the Navy would be relatively simple to implement. However, if a change in ownership of the Site occurs prior to completion of remediation, appropriate provisions would be incorporated into property transfer documents to ensure continued implementation of remediation, aquifer use restrictions and monitoring.

Cost

The estimated costs for Alternative G-3 are as follows:

Capital Cost:	$	1,200,000
30-Year NPW of Annual Costs:	$	2,591,000
30-Year NPW:	$	3,791,000

A detailed breakdown of the estimated costs for this alternative is provided in Appendix G.

4.2.4 Alternative G-4: In-Situ Chemical Oxidation, Bio-barriers, MNA, and LUCs

4.2.4.1 Description

Alternative G-4 would consist of four major components: (1) ISCO in the overburden and bedrock source zones near the former tank location; (2) bio-barriers in the overburden and bedrock east of Shea Memorial Drive; (3) MNA; and (4) LUCs.

Component 1: Chemical Oxidation in the Overburden and Bedrock Source Zones near the Former Tank Location

An ISCO pilot test was conducted at the site from 2000 to 2001 (Geo-Cleanse, 2002). Fenton's reagent was used to assess its applicability for treating CVOCs and BTEX contamination in overburden and bedrock aquifers. Overall reductions in the extent of the CVOCs and BTEX plumes were achieved in the pilot test; however, elevated CVOC concentrations remain in groundwater, particularly in areas near the former tank location.

In this alternative, active treatment by ISCO would be applied to areas with the highest groundwater concentrations in overburden and bedrock to reduce the source mass of the contaminant plumes. The area of the 1,000 µg/L PCE concentration contour in the shallow and deep bedrock and the small area adjacent to well I-12 with approximately 280 µg/L of PCE in overburden were selected as the TTZs for chemical oxidation (see Figure 4-4). These areas are most likely to include potential sources of PCE that could continuously release PCE to groundwater via dissolution from residual NAPL or diffusion from soil or rock matrix.

A sodium permanganate solution would be injected via injection wells into the deep overburden TTZ to destroy the CVOCs in groundwater. The injection locations would be on a hexagonal grid with a spacing of approximately 10 ft between points to account for the uncertainty of the lateral interconnection (Figure 4-4). A total of four injection wells would be needed in the overburden TTZ. The injection wells would be installed to the bottom of the deep overburden at approximately 18 ft bgs. The sodium permanganate solution would be injected over an 11-foot interval in the saturated zone in each well. The total volume of the sodium permanganate solution (5.3 percent) to be injected would be approximately 700 gallons. A high-pressure pump would be used to inject the sodium permanganate solution at approximately 0.75 gpm.

A potassium permanganate and sand blend would be delivered to the shallow and deep bedrock TTZs by hydrofracture emplacement. This solid oxidant/sand blend includes approximately 50 percent by mass of potassium permanganate. This approach was selected for the bedrock TTZs due to its relatively long lifetime, ability to diffuse between fracture intervals and to more aggressively address source area CVOC contamination. Three fractures would be required per boring in the bedrock TTZs. Approximately 9,000 pounds of potassium permanganate and sand blend would be emplaced at three boring locations in the shallow bedrock TTZ to target an interval approximately from 18 to 40 ft bgs (Figure 4-4). For the deep bedrock TTZ, approximately 6,000 pounds of blend would be emplaced at two boring locations to target an interval approximately from 40 to 60 ft bgs (Figure 4-4).

A pilot study or phased approach is proposed for this alternative to further evaluate hydrofracturing. A phased approach may be considered for application of the reagent.

For the purposes of this FS, it is assumed that a 99 percent reduction in aqueous phase CVOC concentrations in the TTZs would be achieved from the first injection. A second injection event in the deep overburden TTZ, at approximately 50 percent of the level of effort of the primary injection event, is assumed to be required 6 months to 1 year after the first injection. This injection would account for potential rebound of CVOC concentrations based on the results of groundwater monitoring. For the bedrock TTZs, it is assumed that the solid potassium permanganate in the blend emplaced in the fractures would act as a long-term source of oxidant for CVOCs in groundwater and no second injection would be required.

Monitoring (baseline and quarterly for 1 year) would be performed to evaluate the effectiveness and progress of the treatment as part of the monitoring program for MNA as described in Component 3 below.

Component 2: Bio-barriers in the Overburden and Bedrock East of Shea Memorial Drive

This component would be identical to Component 1 of Alternative G-2. If reducing conditions cause unacceptable mobilization of iron, manganese, or arsenic, a contingency measure, as described in the Uncertainty discussion below would be implemented.

Component 3: MNA

This component would be nearly identical to Component 2 of Alternative G-2, except that MNA would be implemented in the area between the source zone TTZs and bio-barriers after active treatment with chemical oxidation for further reduction of any residual CVOCs in the TTZs over time. The indigenous microbial population responsible for reductive dechlorination would typically recover after being temporarily diminished by the ISCO treatment. Before the geochemical conditions return to anaerobic that favor reductive dechlorination, abiotic degradation or aerobic co-metabolic oxidation may occur to decrease the residual CVOC concentrations. In addition, the residual CVOCs in the TTZs would also be degraded via natural attenuation or enhanced bioremediation after migrating to downgradient locations where reductive dechlorination is actively occurring.

Component 4: LUCs

This component would be identical to Component 3 of Alternative G-2.

Because this remedy would result in hazardous substances, pollutants, or contaminants remaining on site in excess of levels that allow for unlimited use and unrestricted exposure, in accordance with CERCLA Section 121(c) and 40 CFR 300.430(f)(5)(iii)(C) of the NCP, statutory five-year reviews would be conducted after initiation of the remedial action to ensure that the remedy continues to be protective of human health and the environment. Each five-year review would consist of a review of relevant documents, interviews, a site inspection, and preparation of a summary report.

Alternative G-4 Uncertainties and Contingency Measures

The uncertainties for Alternative G-4 are the same as those for Alternative G-3. Also the same contingency measures would be considered if necessary. The specific technology would be selected after evaluating the conditions at the site.

4.2.4.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative G-4 would be protective of human health and the environment.

By actively removing the sources of contamination, ISCO in the TTZs would significantly reduce the source mass and the expansion of the plumes in overburden and bedrock. This would significantly reduce the risk from exposure to contaminated groundwater, and provide protection to future human receptors that may be exposed during intrusive activities. The ISCO is expected to reduce or eliminate most of the contamination in the high concentration areas, thereby improving downgradient groundwater quality over time. In addition, by intercepting the contaminant plume at its leading edge, the bio-barriers in overburden and bedrock would control the plume migration and treat groundwater to levels below the PRGs. Naturally occurring processes such as biodegradation, dispersion, and dilution would reduce concentrations of groundwater COCs in the rest of the plume over the long term. MNA would be protective of the environment by evaluating the progress of natural attenuation and detecting potential migration of contaminated groundwater so that appropriate contingency measures can be taken, if required.

LUCs would ensure protection of human health and the environment until the remediation goals are met. Restricting the use of groundwater would be protective of human health by avoiding unacceptable risks of exposure to contaminated groundwater. Exposure to VOCs through vapor intrusion would be controlled by the LUC requiring special building design and construction methods.

Compliance with ARARs and TBCs

Alternative G-4 would eventually comply with chemical-specific ARARs and TBCs through a combination of source zone treatment with ISCO, passive treatment by bio-barriers, and MNA. Alternative G-4 would also comply with location- and action-specific ARARs and TBCs. The chemical-, location-, and action-specific ARARs and TBCs for alternative G-4 are listed in Tables 4-8, 4-9, and 4-10, respectively.

Long-Term Effectiveness and Permanence

Alternative G-4 would provide long-term effectiveness and permanence.

In-situ treatment by chemical oxidation would effectively and permanently remove most of the contamination in the high concentration areas. This would reduce plume expansion and possibly reduce the duration that the bio-barriers must be maintained. In addition, the bio-barriers east of the Shea Memorial Drive would treat the plume in overburden and bedrock and prevent contaminants from further migration. Groundwater flowing through the bio-barriers would be treated to levels less than the PRGs. Based on the results of the previous ISCO pilot study, a pilot-scale treatability study would not be performed.

Monitoring the progress of active treatment of the source zone using ISCO, passive treatment of the contaminant plume using bio-barriers at its leading edge, and natural attenuation in the rest of the plume

would be an effective means to evaluate the progress of remediation and verify that no migration of COCs is occurring.

Groundwater use restrictions (e.g., permanent LUC) would prevent the use of groundwater for production, supply, or irrigation purposes. Requirements for specific construction methods (e.g., interim LUCs) would effectively prevent exposure to VOCs through vapor intrusion.

The administrative controls proposed in this alternative are considered reliable.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative G-4 would reduce the toxicity, mobility, and volume of groundwater COCs through a combination of in-situ active treatment and in-situ passive treatment. ISCO would permanently remove an estimated 1.3 pounds of contaminants from groundwater from the TTZs. Passive treatment with the overburden and bedrock bio-barriers would permanently remove approximately 5 pounds of contaminants from the rest of the plume as groundwater flows through them. No treatment residues would be generated by this alternative other than the temporary formation of biodegradation by-products, such as vinyl chloride, which may accumulate until conditions are suitable for aerobic and/or anaerobic biodegradation. Products of incomplete oxidation would be treated through the bio-barrier and/or natural attenuation.

Short-Term Effectiveness

Alternative G-4 would result in few short-term effects. Exposure of workers to contamination during installation of injection wells and soil borings, injection of sodium permanganate solution, injection of potassium permanganate and sand blend via hydraulic fracturing, and groundwater sampling would be minimized by compliance with OSHA requirements including wearing of appropriate PPE and adherence to site-specific health and safety procedures. Implementation of the components would have an impact in the high contamination area as well as the area east of Shea Memorial Drive. There would be slight risk to the surrounding community from transport of oxidizers.

Groundwater RAO Nos. 2 through 4 would be achieved immediately upon implementation of LUCs and monitoring. The installation of injection wells for the bio-barriers and injection of emulsified oil would be completed in approximately 2 months. The installation of injection wells for the deep overburden source zone ISCO treatment and injection of sodium permanganate solution would be completed in approximately 1 week. The hydrofracture emplacement of potassium permanganate blend for the bedrock source zone ISCO treatment would be completed in approximately 3 weeks. Groundwater RAO No. 1 would be achieved after the biodegradation of CVOCs in the bio-barriers begins. Replenishment of organic substrate in the bio-barriers would be completed in approximately 1 week every 5 years after

installation. The second ISCO injection in the deep overburden TTZ would be completed in approximately 1 week 6 months to 1 year after the first injection. Based on preliminary modeling using BIOCHLOR, it is estimated that Alternative G-4 would require less than 10 years in the overburden, approximately 40 years in the shallow bedrock, and approximately 200 years in the deep bedrock to attain the groundwater PRGs through a combination of active treatment in source zone using ISCO, passive treatment using bio-barriers, and natural attenuation. The BIOCHLOR modeling is provided in Appendix E.

The environmental footprint of each of the impact categories evaluated using SiteWise™ is based on the normalization of the remedial alternatives considered in the FS. The results of the environmental footprint evaluation are provided in Appendix F. These evaluations are required by Navy policy and are not part of the CERCLA evaluation criteria. For Alternative G-4, GHG emissions have a low to moderate impact, emitting approximately 186 tons of carbon dioxide equivalents (CO_2e). For the criteria air pollutants, the relative impact of NO_X emissions is high, and SO_X and PM_{10} emissions is low, emitting 0.24, 0.19, and 0.014 tons of NO_X, SO_X and PM_{10}, respectively. The relative use of energy and water for Alternative G-4 is high, utilizing 6,500 MMBTU and 350,000 gallons of water, respectively.

Implementability

The injection wells and borings for source zone ISCO treatment and the bio-barriers at the leading edge of the contaminant plume could be readily installed. There are many qualified contractors that can install injection wells and inject oxidizer solution and emulsified oil. However, there is uncertainty in the effectiveness of the bedrock treatment because of the difficulties with injection and distribution of the emulsified oil product and permanganate solutions. Hydrofracture emplacement of potassium permanganate and sand blend is a relatively new approach for delivering chemical oxidants to the subsurface. There are several qualified contractors that can conduct the hydraulic fracturing and inject the blend. Sampling and maintenance of monitoring wells, implementation of LUCs, and performance of five-year reviews could readily be accomplished. The resources, equipment, and materials required for these activities are readily available.

The administrative aspects of Alternative G-4 for the property under the control of the Navy would be relatively simple to implement. However, if a change in ownership of the Site occurs prior to completion of remediation, appropriate provisions would be incorporated into property transfer documents to ensure continued implementation of remediation, aquifer use restrictions and monitoring.

Cost

The estimated costs for Alternative G-4 are as follows:

Capital Cost:	$	1,677,000
30-Year NPW of Annual Costs:	$	2,656,000
30-Year NPW:	$	4,333,000

A detailed breakdown of the estimated costs for this alternative is provided in Appendix G.

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section compares the analyses for each of the groundwater remedial alternatives presented in Section 4.0 of this FS. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives.

5.1 COMPARISON OF GROUNDWATER REMEDIAL ALTERNATIVES BY CRITERIA

The following remedial alternatives for the Building 81 Site are compared in this section:

- Alternative G-1: No Action
- Alternative G-2: Bio-barriers, MNA, and LUCs
- Alternative G-3: In-Situ Enhanced Bioremediation, Bio-barriers, MNA, and LUCs
- Alternative G-4: ISCO, Bio-barriers, MNA, and LUCs

5.1.1 Overall Protection of Human Health and the Environment

Alternatives G-2 through G-4 would all provide protection to human health and the environment. Alternative G-4 would provide the greatest protection because it treats the source areas with high-CVOC concentrations in the shortest timeframe using ISCO and controls the plume migration by treating it at its leading edge using bio-barriers. Alternative G-3 would provide the second best protection because modeling estimated it would take a slightly longer timeframe than Alternative G-4 to clean up the source areas using enhanced bioremediation. However, the significant uncertainties in calculating remedial timeframes make G-3 and G-4 comparable. In Alternative G-2, COCs would persist for the longest time because no active treatment would be performed for the high CVOC concentration areas to reduce the source mass and the entire plume would rely on natural processes to attenuate over time, although its leading edge would be treated by bio-barriers to prevent further migration.

The natural attenuation components of Alternatives G-2, G-3, and G-4 would further reduce the residual COC concentrations across the Site. This would reduce the potential future risk from exposure to COCs in groundwater. Monitoring under each of these alternatives would be effective in detecting the potential migration of the plume and in monitoring the progress of the remediation.

LUCs would provide protection of human health with a permanent restriction on the use of groundwater for production, supply, or irrigation purposes and with interim LUCs to prevent exposure through vapor intrusion by controlling building design and construction methods until PRGs are met.

Alternative G-1 would provide no protection of human health and the environment. The absence of LUCs would allow for exposure to contaminated groundwater; because no monitoring would be performed, potential migration of COCs would not be detected.

5.1.2 Compliance with ARARs and TBCs

Alternatives G-2 through G-4 would comply with location- and action-specific ARARs and TBCs.

Alternatives G-2 through G-4 would eventually comply with chemical-specific ARARs and TBCs as they attain PRGs through a combination of in-situ treatment and MNA.

Alternative G-1 would not meet chemical-specific ARARs; location-specific and action-specific ARARs or TBCs would not apply.

5.1.3 Long-Term Effectiveness and Permanence

Alternatives G-2 through G-4 would provide long-term effectiveness and permanence through a combination of treatment, MNA, and LUCs. Alternatives G-3 and G-4 provide a higher level of permanence compared to Alternative G-2 because the source area treatment component would permanently remove most of the contamination in the high concentration areas. For Alternatives G-2 through G-4, interim LUCs could be maintained until the PRGs are met.

Alternative G-1 would have no long-term effectiveness and permanence because there would be no LUCs to restrict site use and building construction methods, and the potential would also exist for an unacceptable risk for human receptors through groundwater use and vapor intrusion. Since there would be no groundwater monitoring, migration of COCs would not be detected.

5.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives G-3 and G-4 would achieve the greatest reductions in COC toxicity and volume through a combination of active treatment in source areas and passive treatment at the plume's leading edge. Alternative G-2 would achieve a lower level reduction in COC toxicity and volume through passive treatment by the bio-barriers.

Alternatives G-2 through G-4 would permanently remove COCs from groundwater flowing through the bio-barriers. In addition, Alternatives G-3 and G-4 would permanently remove an estimated 1.3 pounds of COCs from the source area TTZs through active treatment.

Alternatives G-2 through G-4 would not generate treatment residues, although manganese and iron concentrations may increase in the vicinity of the bio-barriers and the TTZs for enhanced bioremediation in the source area (Alternative G-3) until oxidizing conditions are restored. A contingency action to create oxidizing conditions may be implemented, if needed.

Alternative G-1 would not achieve any reduction of toxicity, mobility, or volume of COCs through treatment because there is no treatment.

5.1.5 Short-Term Effectiveness

Short-term effects of Alternatives G-2 through G-4 would result in a possibility of exposing site workers to contaminated groundwater during the maintenance and sampling of 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 installation of the injection wells and injection of emulsified oil substrate for the bio-barriers and groundwater sampling. Alternative G-3 would have higher potential for short-term exposures compared to Alternative G-2, with the installation of additional injection wells and injection of emulsified oil substrate for source area treatment. Alternative G-4 would have the highest potential for short-term exposures because workers would also be required to transport and handle a strong oxidizer for the ISCO application in the source areas. However, these risks of exposure would be effectively controlled by wearing appropriate PPE and compliance with proper site-specific health and safety procedures. Implementation of Alternatives G-2 through G-3 would not adversely impact the surrounding community or environment.

Alternatives G-2 through G-4 would achieve groundwater RAO Nos. 2 through 4 immediately upon implementation of LUCs and monitoring. Construction activities associated with Alternatives G-2, G-3, and G-4 would be completed in 2 months, 3 months, and 3 months, respectively. Groundwater RAO No. 1 would be achieved after the biodegradation of CVOCs in the bio-barriers begins. For Alternatives G-2 through G-4, replenishment of organic substrate in the bio-barriers by emulsified oil injection would be completed in approximately 1 week every 5 years after the installation of the bio-barriers. For Alternative G-3, the second injection for the source zone enhanced bioremediation would be completed in approximately 1 week, 5 years after the initial application. For Alternative G-4, the second ISCO injection in the deep overburden TTZ would be completed in approximately 1 week, 6 months to 1 year after the first injection. Based on preliminary modeling using BIOCHLOR, it is estimated that it would require less than 10 years for Alternatives G-2, G-3, and G-4, respectively, to attain the groundwater PRGs in the overburden. For the shallow bedrock, it is estimated that it would require 60 years, 30 years, and 40 years for Alternatives G-2, G-3, and G-4, respectively. For the deep bedrock, it is estimated that it would require 250 years, less than 5 years, and 200 years for Alternatives G-2, G-3, and G-4, respectively.

Alternative G-3 provides the shortest overall cleanup timeframe since the PRGs would be met in the overburden and deep bedrock upon completion of the source treatment in the TTZ. The BIOCHLOR modeling is provided in Appendix E.

Implementation of Alternative G-1 would not result in risks to site workers or adversely impact the surrounding community or environment because no remedial activities would be performed. Alternative G-1 would not achieve the RAOs.

Because no actions would be implemented in Alternative G-1, there would be no impacts on sustainability factors.

Alternatives G-2 and G-4 had the lowest CO_2e emissions (182 tons and 186 tons, respectively), and Alternative G-3 (190 tons), the highest. Alternatives G-2 and G-3 had the lowest NO_x emissions (0.22 ton) and Alternative G-4 had the highest (0.24). Alternative G-4 had the lowest SO_x emissions (0.19 ton) followed by Alternative G-2 (0.20 ton), and G-3 (0.21 ton). Alternative G-4 had the lowest PM_{10} emissions (0.014 ton), followed by Alternative G-2 (0.015 ton) and Alternative G-3 (0.017 ton). Alternative G-2 had the lowest energy use (1,400 MMBTUs), followed by Alternatives G-4 and G-3 (approximately 6,500 MMBTUs each). Finally, Alternative G-2 had the lowest water use (305,000 gallons), followed by Alternative G-4 (350,000 gallons) and Alternative G-3 (359,000 gallons).

5.1.6 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 only the bio-barriers would need to be installed in addition to groundwater monitoring. Alternatives G-3 and G-4 would both be more difficult to implement than Alternative G-2 because installation of active treatment with enhanced bioremediation or ISCO would be required for the high concentration source areas. Technical implementation of the various components of Alternatives G-2 through G-4 would be feasible, although handling of the oxidizing agent in Alternative G-4 would add to the difficulty of implementation. For Alternatives G-2 through G-4, contractors and equipment are readily available. However, there is uncertainty associated with the distribution of chemicals injected into the bedrock under Alternatives G-2 through G-4 because of the heterogeneity in fractures.

Interim LUCs would be required until groundwater PRGs are attained for Alternatives G-2 through G-4. 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-2, G-3, and G-4 would temporarily impact site use during installation of the injection wells and injection of substrates into the subsurface and limit the types of uses of the Site over and near the bio-barriers and source area TTZs because of the overburden and bedrock injection wells.

5.1.7 Cost

The capital and O&M costs and NPW of the alternatives are as follows.

Alternative	Capital	NPW of Annual Costs	NPW
G-1	$11,000	$109,000	$120,000
G-2	$1,002,000	$2,543,000	$3,545,000
G-3	$1,200,000	$2,591,000	$3,791,000
G-4	$1,677,000	$2,656,000	$4,333,000

Detailed cost estimates are provided in Appendix G.

5.2 SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Table 5-1 summarizes the comparative analysis of the groundwater remedial alternatives.

TABLES

TABLE 2-1
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs and TBCs
BUILDING 81 SITE 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. Alternatives must meet the risk-based cleanup goals developed through the use of this guidance.
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. Alternatives must meet the risk-based cleanup goals developed through the use of this guidance.
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. Alternatives must meet the risk-based cleanup goals developed through the use of this guidance.
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. Alternatives must meet the risk-based cleanup goals developed through the use of this guidance.

TABLE 2-1
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs and TBCs
BUILDING 81 SITE 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.
State				
Massachusetts Contingency Plan – GW-3 Standards	310 CMR 40.0974(2)	TBC	Least protective state cleanup standards.	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.

TABLE 2-2
FEDERAL AND STATE LOCATION-SPECIFIC ARARs
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
There are no federal location-specific ARARs.				
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 Building 81 Site. Appropriate measures will be taken during remedial actions to ensure that the species is not harmed by the alternative.

TABLE 2-3
COMPILATION OF GROUNDWATER PRGs
BUILDING 81 FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Where used	**Full site (RecD, VCD)**	**Source, east of Shea (RecD)**			**Downgradient, west of Shea (VCD)**			**Full site (RecD, VCD)**		
Scenario	**All**	**Vapor intrusion (Commercial)**			**Vapor intrusion (Residential)**			**Construction worker (10-day exposure) (trench air)**		
Chemical of Concern	**MassDEP GW-3 Values**	**ILCR of 10^{-5}**	**HI=1**	**Selection**	**ILCR of 10^{-5}**	**HI=1**	**Selection**	**ILCR of 10^{-5}**	**HI=1**	**Selection**
PCE	30,000	1,700	630	630	250	110	110	33,000	500	500
TCE	5,000	170	49	49	18	8.5	8.5	1,900	23	23
cis-1,2-DCE	50,000	NA	NA	NA	NA	NA	NA	NA	29,000	29,000
Vinyl Chloride	50,000	18	570	18	2.6	99	2.6	1,200	770	770
Benzene	10,000	140	1,200	140	21	210	21	780	260	260
Toluene	40,000	NA	180,000	40,000*	NA	32,000	32,000	NA	43,000	40,000*
Naphthalene	20,000	680	2,500	680	100	440	100	260	38	38

All concentrations are ug/L.
* - GW-3 value is used where risk-based value is greater than the GW-3 value (310 CMR 40.0974(2)).
DCE - Dichloroethene.
HI - Hazard Index.
ILCR - Incremental Lifetime Cancer Risk.
NA - Not applicable.
PCE - Tetrachloroethene.
RecD - Recreation District.
TCE - Trichloroethene.
VCD - Village Center District.

TABLE 2-4
SELECTION OF GROUNDWATER PRGs
BUILDING 81 FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Chemical of Concern	VCD Zoning District				RecD Zoning District			
	Residential VI PRG [1]	Construction Worker PRG [1]	Selected PRG [2]	Selection Basis	Commercial VI PRG [1]	Construction Worker PRG [1]	Selected PRG [2]	Selection Basis
PCE	110	500	110	Residential VI	630	500	500	Construction Worker
TCE	8.5	23	8.5	Residential VI	49	23	23	Construction Worker
cis-1,2-DCE	NA	29,000	29,000	Construction Worker	NA	29,000	29,000	Construction Worker
Vinyl Chloride	2.6	770	2.6	Residential VI	18	770	18	Commercial VI
Benzene	21	260	21	Residential VI	140	260	140	Commercial VI
Toluene	32,000	40,000 [3]	32,000	Residential VI	40,000 [3]	40,000 [3]	40,000 [3]	GW-3 value
Napththalene	100	38	38	Construction Worker	680	38	38	Construction Worker

All concentrations are ug/L.
Notes:
[1] Vapor intrusion and construction worker PRG values are from Table 2-3.
[2] Selected PRG is the lowest of the vapor intrusion and construction worker PRGs.
[3] GW-3 value is used where risk-based value is greater than the GW-3 standard.
DCE - Dichloroethene.
OS-W - Open Space-Weymouth District
PCE - Tetrachloroethene.
RecD - Recreation District
TCE - Trichloroethene
VI - Vapor Intrusion
VCD - Village Center District

TABLE 2-5
ESTIMATED MASS OF COCs IN GROUNDWATER
BUILDING 81 FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

COC	Dissolved Phase (pounds)	Sorbed Phase (pounds)	Total (pounds)
Within 1,000 µg/L PCE isoconcentration lines (Bedrock)			
PCE	0.2	1.08	1.28
TCE	0.0036	0.0086	0.012
cis-1,2-DCE	-	-	-
Vinyl chloride	-	-	-
Benzene	-	-	-
Between 100 µg/L and 1,000 µg/L PCE isoconcentration lines (Bedrock)			
PCE	0.1	0.58	0.68
TCE	0.0068	0.015	0.022
cis-1,2-DCE	0.001	0.00096	0.002
Vinyl chloride	0.00048	0.000028	0.0005
Benzene	0.000066	0.00013	0.0002
Within 100 µg/L PCE isoconcentration lines (Overburden)			
PCE	0.57	1.65	2.2
TCE	0.028	0.033	0.06
cis-1,2-DCE	0.0092	0.0044	0.014
Vinyl chloride	0.0093	0.00031	0.0096
Benzene	0.0089	0.0093	0.018
Between 5 µg/L and 100 µg/L PCE isoconcentration lines (Bedrock)[1]			
PCE	0.04	0.5	0.5
TCE	0.00063	0.0020	0.0026
cis-1,2-DCE	-	-	-
Vinyl chloride	0.000067	0.000012	0.00008
Benzene	-	-	-
Between 5 µg/L and 100 µg/L PCE isoconcentration lines (Overburden)			
PCE	0.19	1.4	1.56
TCE	-	-	-
cis-1,2-DCE	-	-	-
Vinyl chloride	-	-	-
Benzene	-	-	-
Total			
PCE	1.09	5.2	6.3
TCE	0.04	0.058	0.097
cis-1,2-DCE	0.01	0.0053	0.016
Vinyl chloride	0.01	0.00035	0.01
Benzene	0.01	0.0094	0.018

Notes:
[1] Deep bedrock TCE calculations based on the 10 µg/L contour
[2] Toluene not included in mass estimates; no exceedances of the MCL in groundwater
DCE - Dichloroethene

TABLE 3-1
PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

General Response Action	Technology	Process Options	Description	Screening Comment
No Action	None	Not Applicable	No activities conducted at site to remedy or monitor contamination.	Retain. No action is retained as a baseline for comparison with other technologies.
Limited Action	Monitoring	Sampling and Analysis	Periodic sampling and analysis of groundwater to track changes in the extent of contamination.	Retain. This technology could assess natural attenuation and/or migration of contaminants and evaluate progress of active remediation.
	Land Use Controls (LUCs)	Active Controls: Physical Barriers/ Security Guards	Fencing, markers, and warning signs to restrict site access.	Retain in part. Restricted access would not reduce risk of exposure to groundwater. Physical barriers would affect site reuse. Warning signs may be used in conjunction with land use controls.
		Passive Controls: Deed and Land Use Restrictions	Administrative action using LUCs to restrict future site use and to prohibit use of groundwater for potable and irrigation uses.	Retain. Groundwater is currently not used as a drinking water source and is not classified as a potential source. This process option will limit all future uses of groundwater and thus limit human exposure to groundwater.
	Natural Attenuation	Naturally Occurring Biodegradation and Physical Processes	Monitoring groundwater to assess the reduction in concentrations of COCs through natural processes, such as biological activity, dilution, dispersion, and sorption.	Retain. This technology may decrease concentrations of PCE and other VOCs over time.
	Phytoremediation	Use of Plants	A set of processes that uses plants to remove, transfer, stabilize and destroy organic/inorganic contamination in groundwater, surface water, and leachate. Applicable to shallow contamination.	Eliminate. Limited effectiveness on the treatment of deep groundwater. Site development would limit the placement and long-term maintenance of trees.

TABLE 3-1
PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

General Response Action	Technology	Process Options	Description	Screening Comment
Containment	Vertical Barriers	Slurry Wall	Low-permeability wall formed in a perimeter trench to restrict horizontal migration of groundwater.	Eliminate. This technology would not restore groundwater quality. Groundwater treatment would still be needed. Difficult to apply to fractured bedrock.
		Sheet Piling	Metal sheet piling driven into the ground to restrict horizontal migration of groundwater.	Eliminate. This technology would not restore groundwater quality. Groundwater treatment would still be needed. Difficult to apply to bedrock.
		Grout Curtain	Pressure injection of grout to form a low-permeability perimeter wall to restrict horizontal migration of groundwater.	Eliminate. This technology would not restore groundwater quality. Groundwater treatment would still be needed.
		Hydraulic Barrier	Use of extraction wells and/or collection trenches to restrict horizontal migration of groundwater.	Eliminate. Although a hydraulic barrier may eventually restore groundwater quality, an extraction and treatment system would require long-term operation and maintenance costs. The extraction and treatment system would also interfere with development and re-use of the site. Disposal options for the treated groundwater are limited.
	Horizontal Barriers	Physical Barrier	Injection of bottom-sealing slurry beneath source to minimize vertical migration of groundwater.	Eliminate. Not applicable. Contaminants extend through surficial groundwater to fractured bedrock below.

TABLE 3-1
PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

General Response Action	Technology	Process Options	Description	Screening Comment
Removal	Groundwater Extraction	Extraction Wells	Series of conventional pumping wells used to remove contaminated groundwater.	Eliminate. Although extraction may eventually restore groundwater quality, an extraction and treatment system would require long-term operation and maintenance costs. The extraction and treatment system would also interfere with development and re-use of the site. Because of the potential for residual NAPL, an asymptotic level greater than the PRGs may be met even after a long period of operation. Disposal options for the treated groundwater are limited.
		Collection Trench	A permeable trench used to intercept and collect groundwater.	Eliminate. Although extraction using a collection trench may eventually restore groundwater quality, an extraction and treatment system would require long-term operation and maintenance costs. The extraction and treatment system would also interfere with development and re-use of the site. Because of the potential for residual NAPL, an asymptotic level greater than the PRGs may be met even after a long period of operation. Disposal options for the treated groundwater are limited. The presence of buried utilities in the vicinity of the Site would limit the efficient installation of a trench. Because of the depth of the contamination in the bedrock, a trench may not be effective in treating the bedrock.

TABLE 3-1
PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

General Response Action	Technology	Process Options	Description	Screening Comment
Removal (continued)	Excavation	Excavation	Saturated soil/groundwater is dewatered and excavated for off-site disposal.	Eliminate. Limited excavation of saturated soil in the source area would reduce the contaminant mass in the overburden but would not be cost effective and would not reduce the contaminant mass in the bedrock. See further evaluation in Appendix H.
In-Situ Treatment	Biological	Anaerobic/ Aerobic	Enhanced bioremediation via degradation of organics in an anaerobic (oxygen-deficient) or aerobic (oxygen-rich) environment by injection of electron-donor compounds or oxygen source. Microorganism cultures may need to be added.	Retain. Anaerobic reductive dechlorination is effective at removing PCE and other chlorinated VOCs. Subsurface heterogeneity would affect the distribution of the chemical. A pilot study is typically needed. Difficult to apply to bedrock.
	Physical/ Biological	Air Sparging (AS) or AS/Soil Vapor Extraction (SVE)	Volatilization and enhancement of biodegradation of organic compounds by supply of air with or without capture and treatment of volatilized compounds.	Eliminate. The heterogeneous subsurface would make effective implementation of this method difficult. Not effective in bedrock.
		Dynamic Underground Stripping	Steam injection at the periphery of the contaminated area resulting in the vaporization of volatile compounds bound to soil and the movement of contaminants to a centrally located extraction well.	Eliminate. The heterogeneous subsurface would make effective implementation of this method difficult. Not effective in bedrock.

TABLE 3-1
PRELIMINARY SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

General Response Action	Technology	Process Options	Description	Screening Comment
In-Situ Treatment (continued)	Chemical	Chemical Oxidation	Chemical destruction of organic COCs through oxidation with hydrogen peroxide and ferrous iron (Fenton's Reagent), catalyzed percarbonate (RegenOx™), or potassium permanganate.	Retain. This technology could remove the chlorinated VOCs, although the subsurface heterogeneity would affect the distribution of the chemical. A pilot study is typically needed. Difficult to apply to bedrock. Fenton's reagent was used in a pilot study at the site in 2000 and 2001.
		Permeable Reactive Barriers (PRBs) or Bio-Barriers	Use of a permeable barrier with zero-valent iron (ZVI), mulch, or injection of organic substrates via rows of injection wells, which allows the passage of groundwater and reacts with the contaminants.	Retain. Injection-based bio-barriers could be effective in containing the plume for passive treatment. Subsurface heterogeneity would affect the distribution of the injected substrate. Difficult to apply to bedrock.
	Thermal	Electrical Resistance Heating	Volatilization of organic COCs through groundwater and soil heating with electrical electrodes in combination with vacuum extraction of volatilized material.	Eliminate. This technology could remove the chlorinated VOC, but may not be effective for deep bedrock, and the cost is high.
Ex-Situ Treatment	Biological/ Physical/Chemical	Various	Aerobic/anaerobic biological degradation; separation of solids or contaminants from water; chemical agents.	Eliminate. Ex-situ treatment is not applicable since groundwater will not be extracted.
Discharge/ Disposal	Surface or Subsurface Discharge	Various	Discharge/disposal of treated groundwater.	Eliminate. Not applicable since groundwater will not be extracted.

AS = Air sparging.
COC = Chemical of concern.
PCE = Tetrachloroethene.
GAC = Granular Activated Carbon
LUC = Land use control.
VOC = Volatile organic compound.
PRB = Permeable reactive barrier.
SVE = Soil vapor extraction.
ZVI = Zero-valent iron.

TABLE 4-1
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-1 – NO ACTION
BUILDING 81 - 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.	This alternative will not meet the risk-based cleanup goals developed through the use of this guidance since potential carcinogenic risks caused by exposure to contaminants will not be addressed.
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.	This alternative will not meet the risk-based cleanup goals developed through the use of this guidance since potential non-carcinogenic hazards caused by exposure to contaminants will not be addressed.
Guidelines for Carcinogen Risk Assessment	EPA/630/p-03/001F March 2005	TBC	Guidelines for assessing cancer risk.	This alternative will not meet the risk-based cleanup goals developed through the use of this guidance since potential carcinogenic risks caused by exposure to contaminants will not be addressed.
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.	This alternative will not meet the risk-based cleanup goals developed through the use of this guidance since potential carcinogenic risks to children caused by exposure to contaminants will not be addressed.

TABLE 4-1
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-1 – NO ACTION
BUILDING 81 - 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.	While the future use includes structures on the Site, this alternative will not include an assessment of potential vapor intrusion risks in accordance with the guidance.
State				
There are no State chemical-specific ARARs.				

TABLE 4-2
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-2 - BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 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	TBC	Guidance used to compute 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 since treating groundwater that poses potential carcinogenic risks through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.
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.	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential non-carcinogenic risks through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.

TABLE 4-2
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-2 - BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 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	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.
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	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks to children through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.
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.

TABLE 4-2
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-2 - BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 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	Least protective state cleanup standards.	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.

TABLE 4-3
FEDERAL AND STATE LOCATION-SPECIFIC ARARs – ALTERNATIVE G-2 - BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
There are no federal location-specific ARARs.				
State				
Massachusetts Endangered Species Act	MGL Ch. 131A; 321 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 Building 81 Site. The existing area is highly developed and little suitable habitat is present. Appropriate measures will be taken during remedial actions to ensure that the species is not harmed by the alternative.

TABLE 4-4
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-2 - BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - 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 do not indicate that any wastes will be hazardous. Any water generated by this action that requires off-site disposal will be tested.
Underground Injection Control	40 CFR 144, 146, 147.1100	Relevant and Appropriate	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 substances into the groundwater. In-situ treatment using injection-based bio-barriers will be conducted in compliance with these standards.
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.

TABLE 4-4
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-2 - BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (Continued)				
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites	OSWER Directive 9200.4-17P (April 21, 1999)	TBC	EPA guidance regarding the use of monitored natural attenuation for the cleanup of contaminated soil and groundwater. In particular, a reasonable time frame for achieving cleanup standard through monitored attenuation would be comparable to that which could be achieved through active restoration.	The monitored natural attenuation component of this alternative will only meet these standards if natural attenuation will attain all groundwater cleanup standards within a reasonable time frame. It is estimated that all overburden cleanup standards will be achieved in 30 years.
State				
Hazardous Waste Rules for Identification and Listing of Hazardous Wastes	310 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, 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 do not indicate that any wastes will be hazardous.

TABLE 4-4
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-2 - BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
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. 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.
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.	Any hazardous wastes generated as part of the remedial action will be handled in compliance with the requirements of these regulations.

TABLE 4-4
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-2 - BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (Continued)				
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.
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 injection wells for groundwater treatment.
Erosion and Sediment Control Guidance	-	TBC	This guidance includes standards for preventing erosion and sedimentation.	Remedial actions, such as installation and maintenance of wells, will be managed to control erosion and sedimentation.

TABLE 4-5
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - 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.	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.
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.	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential non-carcinogenic risks through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.

TABLE 4-5
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - 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	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.
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	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks to children through bioremediation and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.

TABLE 4-5
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - 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.
State				
Massachusetts Contingency Plan – GW-3 Standards	310 CMR 40.0974(2)	TBC	Least protective state cleanup standards.	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.

TABLE 4-6
FEDERAL AND STATE LOCATION-SPECIFIC ARARs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
There are no federal location-specific ARARs.				
State				
Massachusetts Endangered Species Act	MGL Ch. 131A; 321 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 Building 81 Site. The existing area is highly developed and little suitable habitat is present. Appropriate measures will be taken during remedial actions to ensure that the species is not harmed by the alternative.

TABLE 4-7
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - 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 do not indicate that any wastes will be hazardous. Any water generated by this action that requires off-site disposal will be tested.
Underground Injection Control	40 CFR 144, 146, 147.1100	Relevant and Appropriate	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 substances into the groundwater. In-situ treatment using enhanced bioremediation and injection-based bio-barriers will be conducted in compliance with these standards.
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.

TABLE 4-7
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (Continued)				
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites	OSWER Directive 9200.4-17P (April 21, 1999)	TBC	EPA guidance regarding the use of monitored natural attenuation for the cleanup of contaminated soil and groundwater. In particular, a reasonable time frame for achieving cleanup standard through monitored attenuation would be comparable to that which could be achieved through active restoration.	The monitored natural attenuation component of this alternative will only meet these standards if natural attenuation will attain all groundwater cleanup standards within a reasonable time frame. It is estimated that overburden cleanup standards will be achieved in 15 years.
State				
Hazardous Waste Rules for Identification and Listing of Hazardous Wastes	310 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, 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 do not indicate that any wastes will be hazardous.

TABLE 4-7
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
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. 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.
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.	Any hazardous wastes generated as part of the remedial action will be handled in compliance with the requirements of these regulations.

TABLE 4-7
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-3 - IN-SITU ENHANCED BIOREMEDIATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (Continued)				
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.
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 injection wells for groundwater treatment.
Erosion and Sediment Control Guidance	-	TBC	This guidance includes standards for preventing erosion and sedimentation.	Remedial actions, such as installation and maintenance of wells, will be managed to control erosion and sedimentation.

TABLE 4-8
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-4 - IN-SITU CHEMICAL OXIDATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - 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.	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks through in-situ chemical oxidation, bioremediation, and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.
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.	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential non-carcinogenic risks through in-situ chemical oxidation, bioremediation, and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.

TABLE 4-8
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-4 - IN-SITU CHEMICAL OXIDATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - 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	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks through in-situ chemical oxidation, bioremediation, and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.
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	This alternative will meet the risk-based cleanup goals developed through the use of this guidance since treating groundwater that poses potential carcinogenic risks to children through in-situ chemical oxidation, bioremediation, and natural attenuation will address long-term risk, while LUCs will prevent short-term exposure until risk-based cleanup goals are achieved.

TABLE 4-8
FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-4 - IN-SITU CHEMICAL OXIDATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - 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.
State				
Massachusetts Contingency Plan – GW-3 Standards	310 CMR 40.0974(2)	TBC	Least protective state cleanup standards.	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.

TABLE 4-9
FEDERAL AND STATE LOCATION-SPECIFIC ARARs – ALTERNATIVE G-4 - IN-SITU CHEMICAL OXIDATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
There are no federal location-specific ARARs.				
State				
Massachusetts Endangered Species Act	MGL Ch. 131A; 321 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 Building 81 Site. The existing area is highly developed and little suitable habitat is present. Appropriate measures will be taken during remedial actions to ensure that the species is not harmed by the alternative.

TABLE 4-10
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-4 - IN-SITU CHEMICAL OXIDATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 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 do not indicate that any wastes will be hazardous. Any water generated by this action that requires off-site disposal will be tested.
Underground Injection Control	40 CFR 144, 146, 147.1100	Relevant and Appropriate	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 substances into the groundwater. In-situ treatment using injection-based bio-barriers and chemical oxidation will be conducted in compliance with these standards.
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.

TABLE 4-10
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-4 - IN-SITU CHEMICAL OXIDATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
Federal (Continued)				
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites	OSWER Directive 9200.4-17P (April 21, 1999)	TBC	EPA guidance regarding the use of monitored natural attenuation for the cleanup of contaminated soil and groundwater. In particular, a reasonable time frame for achieving cleanup standard through monitored attenuation would be comparable to that which could be achieved through active restoration.	The monitored natural attenuation component of this alternative will only meet these standards if natural attenuation will attain all groundwater cleanup standards within a reasonable time frame. It is estimated that overburden cleanup standards will be achieved in 24 years.
State				
Hazardous Waste Rules for Identification and Listing of Hazardous Wastes	310 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, 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 do not indicate that any wastes will be hazardous.

TABLE 4-10
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-4 - IN-SITU CHEMICAL OXIDATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
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 and oxidation chemicals. 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.
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.	Any hazardous wastes generated as part of the remedial action will be handled in compliance with the requirements of these regulations.

TABLE 4-10
FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs – ALTERNATIVE G-4 - IN-SITU CHEMICAL OXIDATION (SOURCE), BIO-BARRIERS, MNA, AND LUCs
BUILDING 81 FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken
State (Continued)				
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 and oxidizers for in-situ chemical oxidation. 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.
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 injection wells for groundwater treatment.
Erosion and Sediment Control Guidance	-	TBC	This guidance includes standards for preventing erosion and sedimentation.	Remedial actions, such as installation and maintenance of wells, will be managed to control erosion and sedimentation.

TABLE 5-1
SUMMARY OF COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Evaluation Criterion	Alternative G-1: No Action	Alternative G-2: Bio-barriers, MNA, and LUCs	Alternative G-3: In-situ Enhanced Bioremediation, Bio-barriers, MNA, and LUCs	Alternative G-4: In-situ Chemical Oxidation, MNA, and LUCs
Overall Protection of Human Health and Environment	Would not offer protectiveness of human health and the environment because no action would occur. Migration of chemicals of concern (COCs) would continue and remain undetected.	Would be protective of human health and the environment. Would be less protective than Alternatives G-3 and G-4. Bio-barriers east of Shea Memorial Drive would control the plume migration and treat groundwater to levels less than the PRGs. Natural attenuation would reduce concentrations of groundwater COCs in the rest of the plume over time. Monitoring would evaluate the progress of natural attenuation and detect potential migration of groundwater contamination so that appropriate contingency measures can be taken, if required. Interim LUCs would prevent exposure until remediation is complete.	Would be protective of human health and the environment. Would be slightly less protective than Alternative G-4 but more protective than Alternative G-2. Enhanced bioremediation in the high concentration areas would significantly reduce the source mass and the plume expansion in overburden and bedrock. The timeframe to clean up the high concentration areas is longer than for Alternative G-4 since a second injection is needed after 5 years. Bio-barriers east of Shea Memorial Drive would control the plume migration and treat groundwater to levels less than the PRGs. Natural attenuation would reduce concentration of groundwater COCs in the rest of the plume over time. Monitoring would evaluate the progress of natural attenuation and detect potential migration of groundwater contamination so that appropriate contingency measures can be taken, if required. Interim LUCs would prevent exposure until remediation is complete.	Would be protective of human health and the environment. Would be the most protective alternative. ISCO in the high concentration areas would significantly reduce source mass and the plume expansion in overburden and bedrock. ISCO injections would be completed in 2 years. Bio-barriers east of Shea Memorial Drive would control the plume migration and treat groundwater to levels less than the PRGs. Natural attenuation would reduce concentration of groundwater COCs in the rest of the plume over time. Monitoring would evaluate the progress of natural attenuation and detect potential migration of groundwater contamination so that appropriate contingency measures can be taken, if required. Interim LUCs would prevent exposure until remediation is complete.
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBCs):				
Chemical-Specific	Would not comply	Would eventually comply	Would eventually comply	Would eventually comply
Location-Specific	Would not comply	Would comply	Would comply	Would comply
Action-Specific	Not applicable	Would comply	Would comply	Would comply
Long-Term Effectiveness and Permanence	Would not provide long-term effectiveness or permanence because no action would occur. Contaminant reduction or migration would remain undetected because no monitoring would occur.	Would be slightly less permanent and effective compared to Alternatives G-3 and G-4 because there would be no high concentration area treatment. Bio-barriers would treat the PCE plume to levels less than the PRGs at its leading edge and prevent its further migration. Natural attenuation would reduce COC concentrations in the rest of the plume over time. Monitoring would evaluate the remediation progress and verify that no COC migration is occurring. Interim LUCs would prevent exposure until PRGs are met.	Would be as permanent and effective as Alternative G-4 and more permanent and effective than Alternative G-2. In-situ treatment by enhanced bioremediation would effectively and permanently remove most of the contamination in the high concentration areas. This would reduce contaminant migration and possibly reduce the duration that the bio-barriers must be maintained. Bio-barriers would treat the plume to levels less than the PRGs at its leading edge and prevent its further migration. Natural attenuation would reduce COC concentrations in the rest of the plume over time. Monitoring would evaluate the remediation progress and verify that no COC migration is occurring. Interim LUCs would prevent exposure until PRGs are met.	Would be as permanent and effective as Alternative G-3 and more permanent and effective than Alternative G-2. In-situ treatment by chemical oxidation would effectively and permanently remove most of the contamination in the high concentration areas. This would reduce contaminant migration and possibly reduce the duration that the bio-barriers must be maintained. Bio-barriers would treat the plume to levels less than the PRGs at its leading edge and prevent its further migration. Natural attenuation would reduce COC concentrations in the rest of the plume over time. Monitoring would evaluate the remediation progress and verify that no COC migration is occurring. Interim LUCs would prevent exposure until PRGs are met.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Would not reduce contaminant toxicity, mobility or volume through treatment because no treatment would occur.	Would permanently reduce contaminant toxicity and volume over time through passive treatment by the bio-barriers. The bio-barriers would permanently remove COCs from groundwater flowing through them.	Would permanently reduce contaminant toxicity and volume through a combination of in-situ active treatment and in-situ passive treatment. Enhanced bioremediation would permanently remove an estimated 1.3 pounds of COCs from groundwater from the high concentration areas. The bio-barriers would permanently remove COCs from groundwater flowing through them.	Would permanently reduce contaminant toxicity and volume through a combination of in-situ active treatment and in-situ passive treatment. ISCO would permanently remove an estimated 1.3 pounds of COCs from groundwater from the high concentration areas. The bio-barriers would permanently remove COCs from groundwater flowing through them.

TABLE 5-1
SUMMARY OF COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

Evaluation Criterion	Alternative G-1: No Action	Alternative G-2: Bio-barriers, MNA, and LUCs	Alternative G-3: In-situ Enhanced Bioremediation, Bio-barriers, MNA, and LUCs	Alternative G-4: In-situ Chemical Oxidation, MNA, and LUCs
Short-Term Effectiveness	Would not result in any short-term risk to site workers or adversely impact the surrounding community or environment because no action would occur. The Remedial Action Objectives (RAOs) would never be achieved with the implementation of this alternative.	Would result in a possibility of exposing site workers to contaminated groundwater during installation of injection wells, emulsified oil substrate injection, and monitoring activities. This risk would be reduced through compliance with appropriate site-specific health and safety procedures. There would be no adverse impact on the surrounding community or the environment. Groundwater RAO Nos. 2 through 4 would be achieved immediately upon implementation of LUCs and monitoring. The installation of injection wells for the bio-barriers and injection of emulsified oil substrate would be completed in approximately 2 months. Groundwater RAO No. 1 would be achieved after the biodegradation of CVOCs in the bio-barriers begins. Replenishment of organic substrate in the bio-barriers would be completed in approximately 1 week every 5 years after installation. Alternative G-2 would require less than 10 years in the overburden, approximately 60 years in the shallow bedrock, and 250 years in the deep bedrock to attain the groundwater PRGs through a combination of passive treatment using bio-barriers and natural attenuation. For sustainability, lowest impact based on emissions, lowest impact based on energy and water.	Would result in a possibility of exposing site workers to contaminated groundwater during installation of injection wells, emulsified oil substrate injection, and monitoring activities. This risk would be reduced through compliance with appropriate site-specific health and safety procedures. There would be no adverse impact on the surrounding community or the environment. Reducing conditions in the aquifer may mobilize metals into groundwater. Groundwater RAO Nos. 2 through 4 would be achieved immediately upon implementation of LUCs and monitoring. The installation of injection wells for the bio-barriers and injection of emulsified oil substrate would be completed in approximately 2 months. The installation of injection wells for source zone enhanced bioremediation and injection of emulsified oil would be completed in approximately 1 month. Groundwater RAO No. 1 would be achieved after the biodegradation of CVOCs in the bio-barriers begins. Replenishment of organic substrate in the bio-barriers would be completed in approximately 1 week every 5 years after installation. The second injection for the source zone enhanced bioremediation would be completed in approximately 1 week, 5 years after the initial application. Alternative G-3 would require less than 10 years in the overburden, approximately 30 years in the shallow bedrock, and less than 5 years in the deep bedrock to attain the groundwater PRGs through a combination of passive treatment using bio-barriers and natural attenuation. This alternative provides the shortest overall cleanup timeframe since the PRGs would be met in the overburden and deep bedrock upon completion of the source treatment. For sustainability, highest impact based on emissions, highest impact based on energy (equal to Alternative G-4), and highest impact based on water.	Would result in a possibility of exposing site workers to contaminated groundwater during installation of injection wells, injection of emulsified oil substrate and ISCO reagents, and monitoring activities. This risk would be reduced through compliance with appropriate site-specific health and safety procedures. There would be slight risk to the surrounding community from transport of oxidizers. Reducing conditions in the aquifer may mobilize metals into groundwater. Incomplete oxidation may result in treatment residuals; ISCO would temporarily diminish the indigenous microbial population. Groundwater RAO Nos. 2 through 4 would be achieved immediately upon implementation of LUCs and monitoring. The installation of injection wells for the bio-barriers and injection of emulsified oil substrate would be completed in approximately 2 months. The installation of injection wells for the deep overburden source zone ISCO and injection of sodium permanganate solution would be completed in approximately 1 week. The hydrofracture emplacement of potassium permanganate blend for the bedrock source zone ISCO treatment would be completed in approximately 3 weeks. Groundwater RAO No. 1 would be achieved after the biodegradation of CVOCs in the bio-barriers begins. Replenishment of organic substrate in the bio-barriers would be completed in approximately 1 week every 5 years after installation. The second ISCO injection in the deep overburden TTZ would be completed in approximately 1 week, 6 months to 1 year after the first injection. Alternative G-4 would require less than 10 years in the overburden, approximately 40 years in the shallow bedrock, and 200 years in the deep bedrock to attain the groundwater PRGs through a combination of passive treatment using bio-barriers and natural attenuation. For sustainability, low impact based on emissions (nearly equal to Alternative G-2), highest impact based on energy(equal to Alternative G-3), and the second highest impact based on water.
Implementability	Technical and administrative implementation would be extremely simple because there would be no action to implement.	Installation of bio-barriers is readily implementable. Effectiveness of injection of reagent into bedrock is uncertain. Easy to implement monitoring and LUCs. Less difficult than Alternatives G-3 and G-4. Administrative implementation of the LUCs would be simple.	Enhanced bioremediation in the high concentration areas and installation of bio-barriers are readily implementable. Effectiveness of injection of reagent into bedrock is uncertain. Easy to implement monitoring and LUCs. Less difficult than Alternative G-4. Administrative implementation of the LUCs would be simple.	ISCO in the high concentration areas and installation of bio-barriers are readily implementable. Effectiveness of injection of reagent into bedrock is uncertain. Easy to implement monitoring and LUCs. Most difficult alternative. Administrative implementation of the LUCs would be simple.
Costs:				
Capital	$11,000	$1,002,000	$1,200,000	$1,677,000
NPW of Annual Costs	$109,000	$2,543,000	$2,591,000	$2,656,000
NPW	$120,000	$3,545,000	$3,791,000	$4,333,000

TABLE 5-1
SUMMARY OF COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES
BUILDING 81 - FEASIBILITY STUDY
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

ARAR = Applicable or Relevant and Appropriate Requirement.
COC = Chemicals of concern.
PRB = Permeable Reactive Barrier.
RAO = Remedial Action Objective.
PCE = Tetrachloroethene.
LUC = Land use control.
NPW = Net present worth.
TBC = To be considered.

FIGURES

ACAD: I:\02073\FS.DF.B81\B81_LOCUS.DWG 02/18/08 DWM

BASE MAP FROM USGS QUADRANGLE SHEET: WEYMOUTH, MASSACHUSETTS, 1984

QUADRANGLE LOCATION

GRAPHIC SCALE
0 0.5 MILE 1 MILE

TETRA TECH

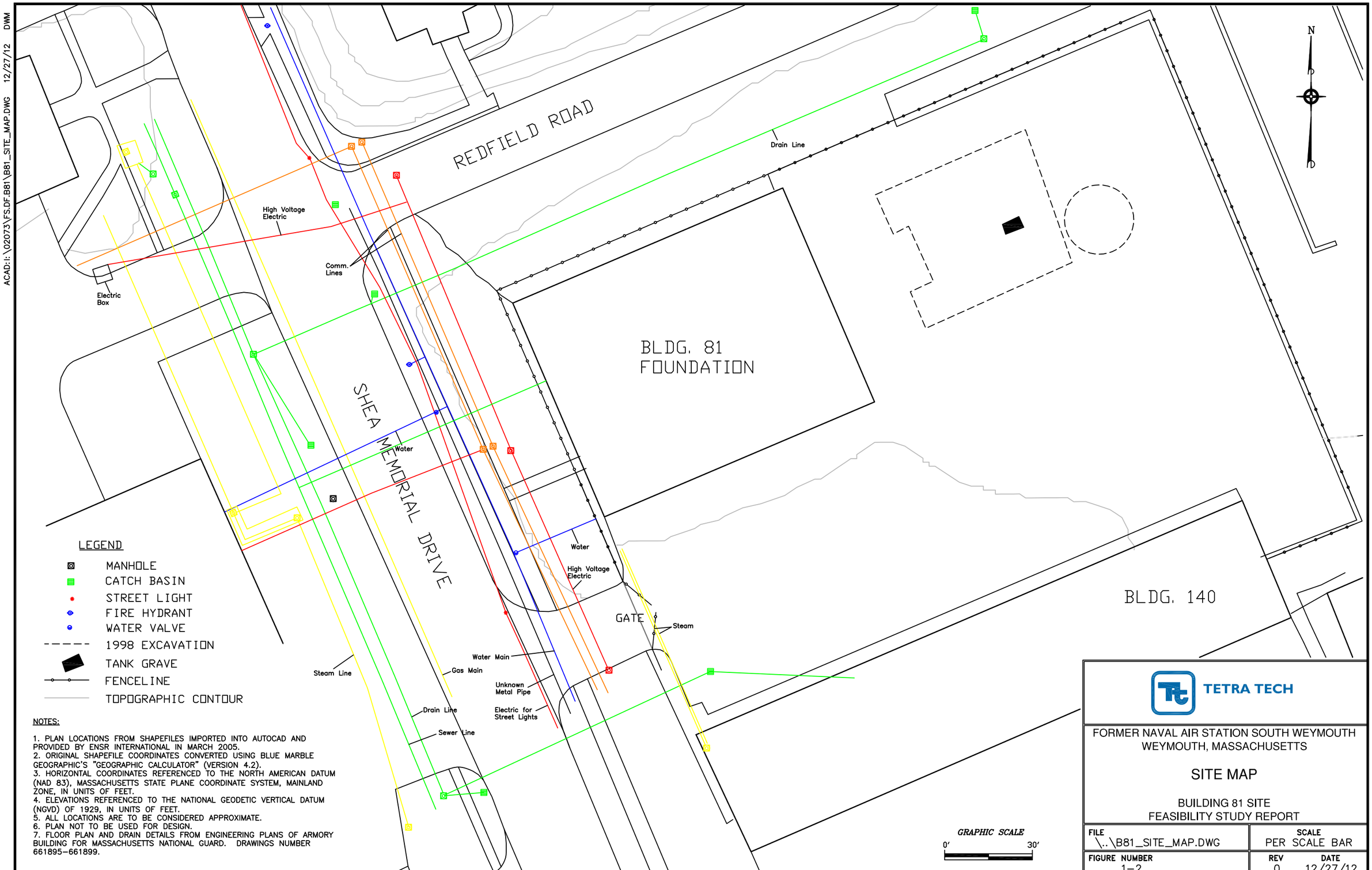
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

LOCATION OF NAS SOUTH WEYMOUTH

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

SCALE	PER SCALE BAR
FILE	I:\..\B81_LOCUS.DWG
REV	0
DATE	12/27/12
FIGURE NUMBER	1-1

ACAD:I:\02073\FS.DF.B81\B81_SITE_MAP.DWG 12/27/12 DWM



NOTES:

1. PLAN LOCATIONS FROM SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83), MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929, IN UNITS OF FEET.
5. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
6. PLAN NOT TO BE USED FOR DESIGN.
7. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWINGS NUMBER 661895–661899.

TETRA TECH

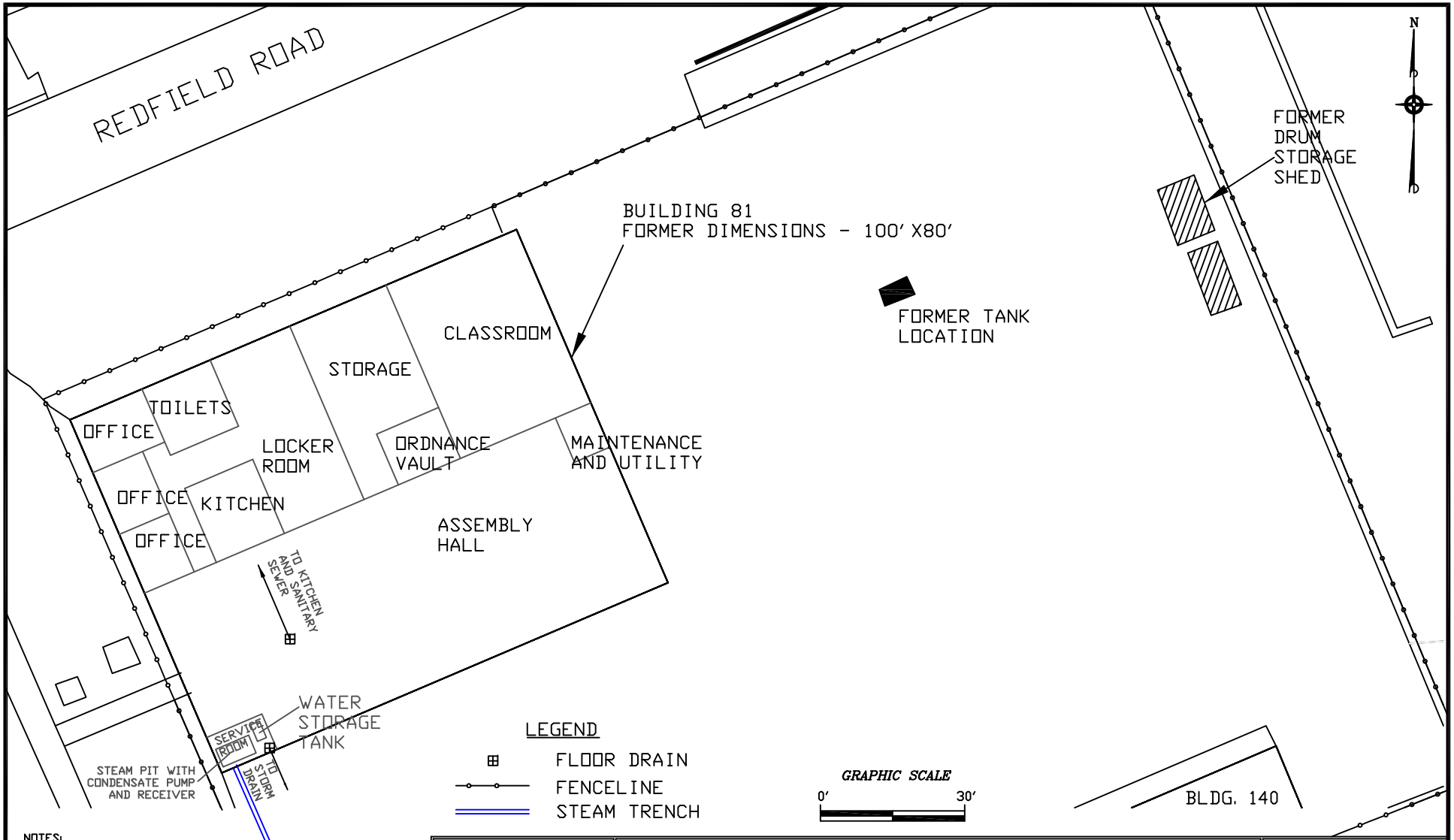
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

SITE MAP

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
\..\B81_SITE_MAP.DWG	PER SCALE BAR
FIGURE NUMBER 1–2	REV 0 / DATE 12/27/12

ACAD:I:\02073\FS.DF.B81\B81_FORM_SITE_FEAT.DWG 12/27/12 DWM



NOTES:

1. PLAN LOCATIONS FROM SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S 'GEOGRAPHIC CALCULATOR' (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83), MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929, IN UNITS OF FEET.
5. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
6. PLAN NOT TO BE USED FOR DESIGN.

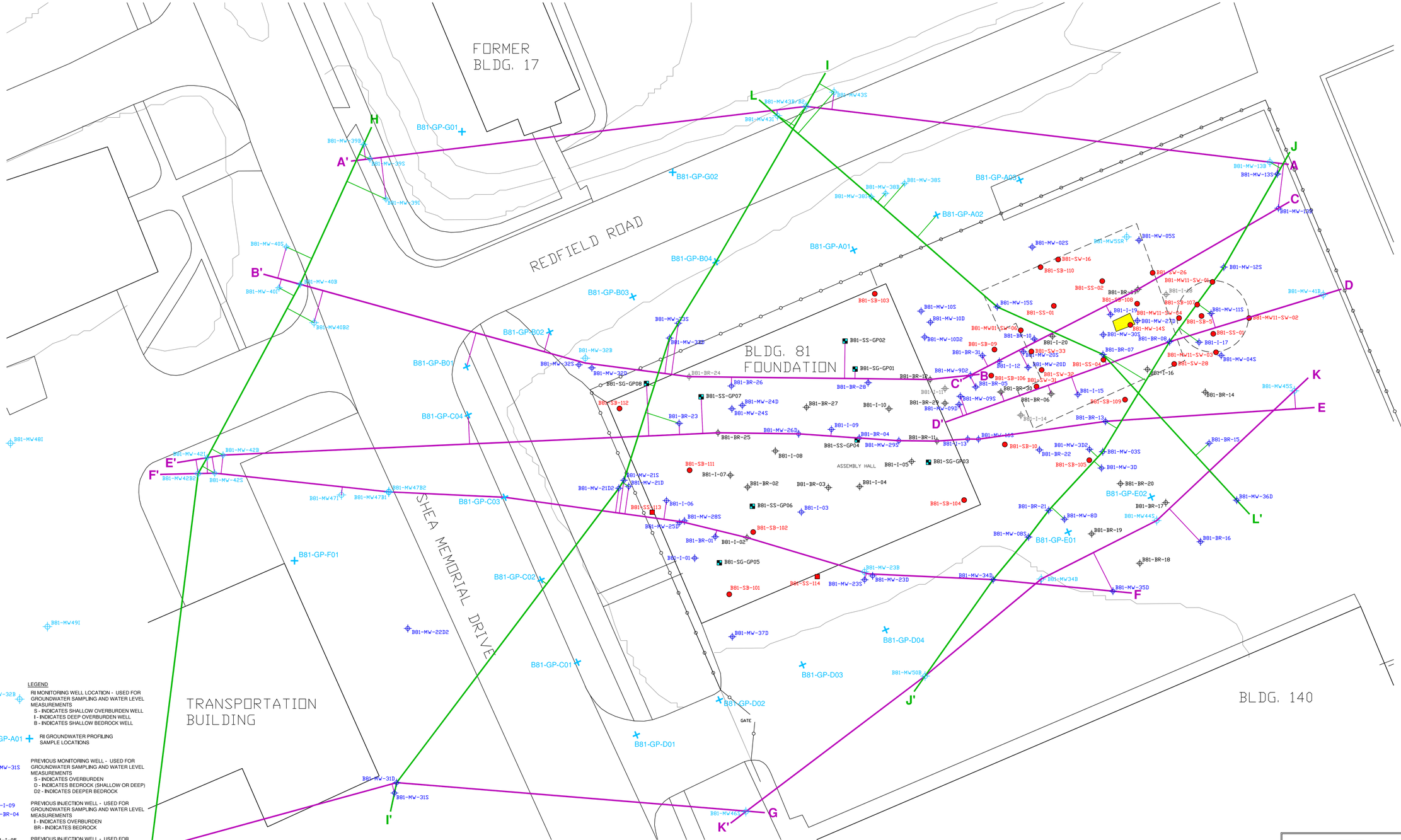
TETRA TECH

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

FORMER SITE FEATURES

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

SCALE	
PER SCALE BAR	
FILE	
\..\B81_FORM_SITE_FEAT.DWG	
REV	DATE
0	12/27/12
FIGURE NUMBER	
1-3	



LEGEND

B81-MW-32B — RI MONITORING WELL LOCATION - USED FOR GROUNDWATER SAMPLING AND WATER LEVEL MEASUREMENTS
S - INDICATES SHALLOW OVERBURDEN WELL
I - INDICATES DEEP OVERBURDEN WELL
B - INDICATES SHALLOW BEDROCK WELL

B81-GP-A01 — RI GROUNDWATER PROFILING SAMPLE LOCATIONS

B81-MW-31S — PREVIOUS MONITORING WELL - USED FOR GROUNDWATER SAMPLING AND WATER LEVEL MEASUREMENTS
S - INDICATES OVERBURDEN
D - INDICATES BEDROCK (SHALLOW OR DEEP)
D2 - INDICATES DEEPER BEDROCK

B81-I-09, B81-BR-04 — PREVIOUS INJECTION WELL - USED FOR GROUNDWATER SAMPLING AND WATER LEVEL MEASUREMENTS
I - INDICATES OVERBURDEN
BR - INDICATES BEDROCK

B81-I-05, B81-BR-11 — PREVIOUS INJECTION WELL - USED FOR WATER LEVEL MEASUREMENTS ONLY
I - INDICATES OVERBURDEN
BR - INDICATES BEDROCK

9AB-MW-01 — OFF-SITE MONITORING WELL - USED FOR WATER LEVEL MEASUREMENTS ONLY

B81-I-14 — WELL DAMAGED - NOT USED IN RI

B81-SB-104 — RI SOIL CHARACTERIZATION BORING LOCATION

B81-SS-111 — RI SURFACE SOIL SAMPLE LOCATION (MANUAL COLLECTION)

B81-SG-GP01 — SOIL GAS SAMPLE LOCATION

H — H' NORTH-SOUTH GEOLOGICAL CROSS-SECTION

A — A' EAST-WEST GEOLOGICAL CROSS-SECTION

APPROXIMATE LOCATION OF 1998 EXCAVATION

APPROXIMATE LOCATION OF FORMER WASTE OIL TANK GRAVE

FENCELINE

TOPOGRAPHIC CONTOUR

NOTES:

1. PLAN LOCATIONS FROM SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83), MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEYS BY OEST.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.

GRAPHIC SCALE

15′ 0′ 15′ 30′

TETRA TECH

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

GEOLOGIC CROSS-SECTION LOCATION MAP

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
\..\B81_X-SECTION_LINES.DWG	PER SCALE BAR
FIGURE NUMBER	REV / DATE
1-4	0 / 1/8/13

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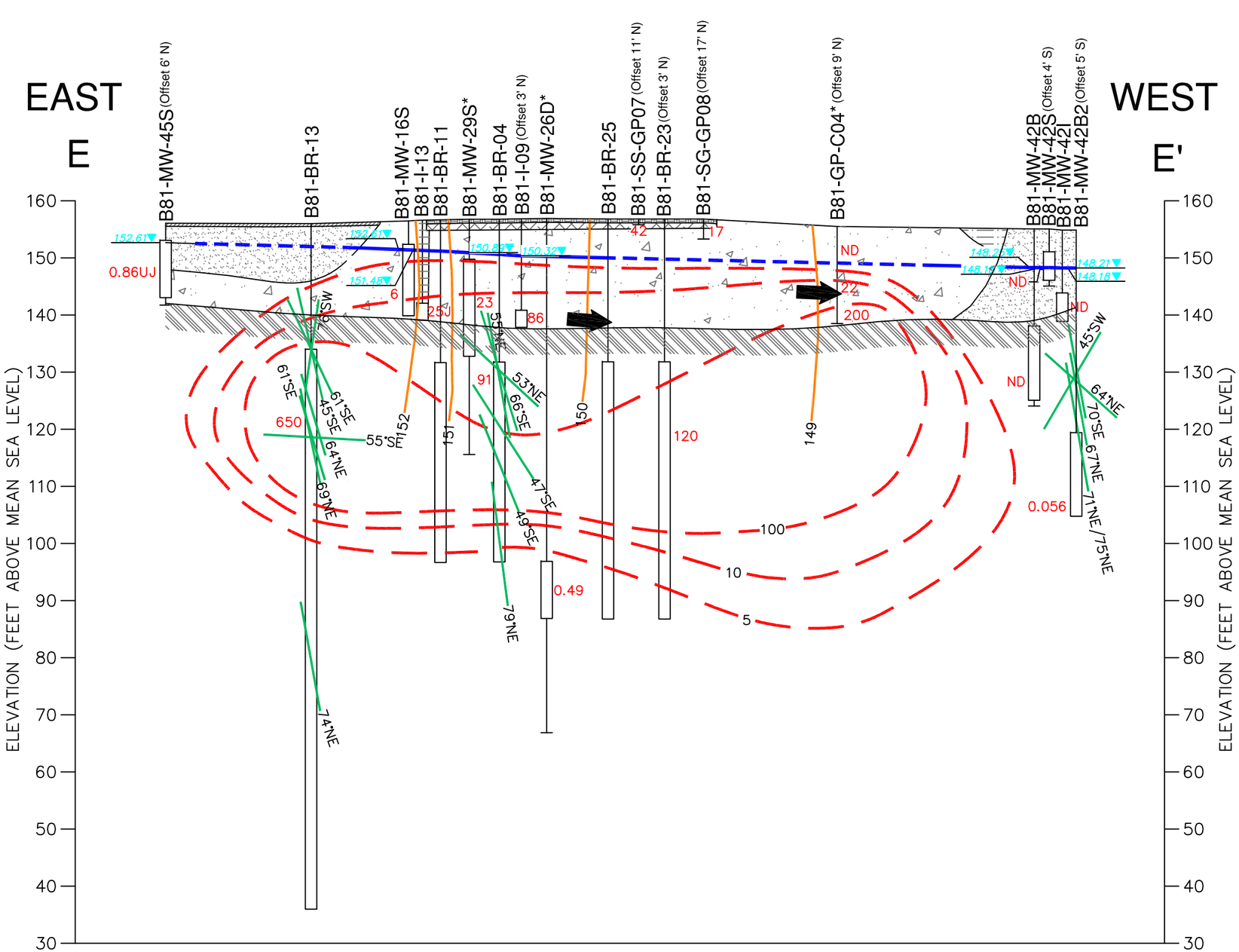
ACAD:I:\02073\FS.DF.B81\B81_X-SECTION_E.DWG 12/27/12 DWM



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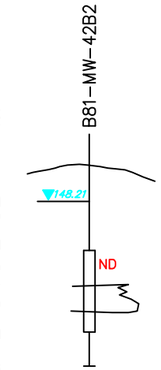

- MONITORING WELL OR BORING NUMBER
- GROUND SURFACE
- GROUNDWATER ELEVATION (FEET MSL)
- TOP OF SCREEN
- TETRACHLOROETHENE CONCENTRATION (µg/L)
- LITHOLOGIC CONTACT (INFERRED BETWEEN BORINGS)
- BOTTOM OF SCREEN
- TOTAL DEPTH OF BORING
- CONCRETE SLAB
- ASPHALT
- FILL (SAND & GRAVEL)
- SAND
- SILTY SAND
- SILT, SAND & GRAVEL
- COMPETENT BEDROCK
- 45°SW — BEDROCK FRACTURE WITH DEGREE AND DIRECTION OF TRUE DIP DERIVED FROM BOREHOLE GEOPHYSICS REPORT BY HAGER GEOSCIENCE (2005) & NE GEOPHYSICAL SERVICES (2010)
- GROUNDWATER ELEVATION (FEBRUARY 2010) (DASHED WHERE INFERRED)
- 5 — APPROXIMATE TETRACHLOROETHENE ISOCONTOUR (µg/L)
- * — NO SOIL BORING DATA
- 151 — INFERRED GROUNDWATER FLOW CONTOUR
- INFERRED GROUNDWATER FLOW DIRECTION

NOTES:
1. VERTICAL EXAGGERATION = 2.5
2. EXAGGERATED DIP OF BEDROCK FRACTURE SHOWN

0 20 40
SCALE: 1" = 20'
VERTICAL SCALE IN FEET

0 50 100
SCALE: 1" = 50'
HORIZONTAL SCALE IN FEET

TETRA TECH

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

GEOLOGIC CROSS SECTION E-E'

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_X-SECTION_E.DWG	PER SCALE BAR
FIGURE NUMBER	REV / DATE
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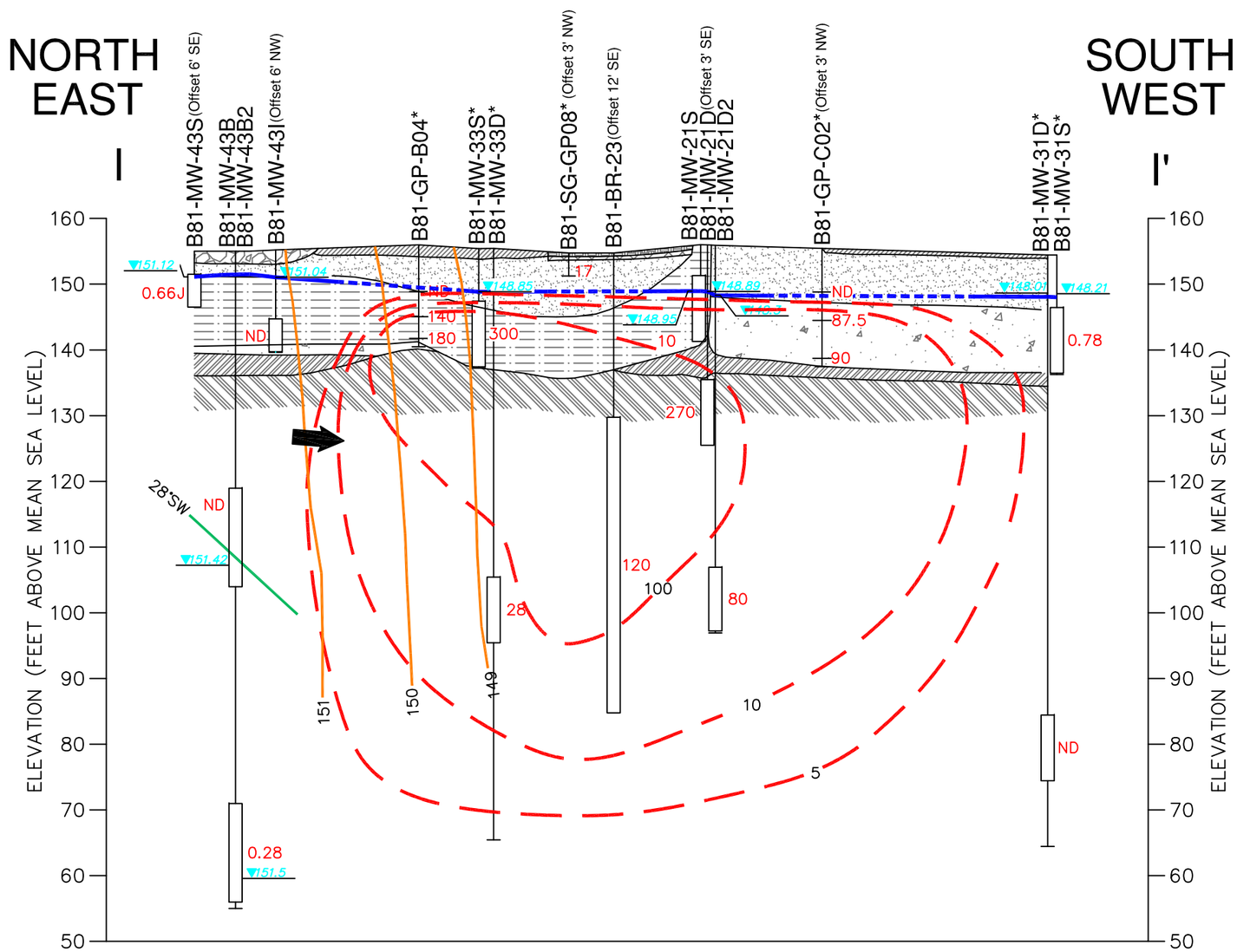

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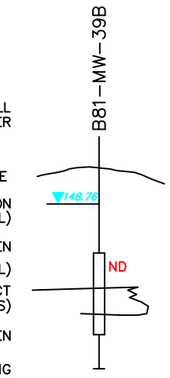

- MONITORING WELL OR BORING NUMBER
- GROUND SURFACE
- GROUNDWATER ELEVATION (FEET MSL)
- TOP OF SCREEN
- TETRACHLOROETHENE CONCENTRATION (µg/L)
- LITHOLOGIC CONTACT (INFERRED BETWEEN BORINGS)
- BOTTOM OF SCREEN
- TOTAL DEPTH OF BORING
- CONCRETE SLAB
- ASPHALT
- FILL (SAND & GRAVEL)
- SAND AND GRAVEL
- SAND
- SILTY SAND WITH GRAVEL
- SILTY SAND
- WEATHERED BEDROCK
- COMPETENT BEDROCK
- 28°SW — BEDROCK FRACTURE WITH DEGREE AND DIRECTION OF TRUE DIP DERIVED FROM BOREHOLE GEOPHYSICS REPORT BY NE GEOPHYSICAL SERVICES (2010)
- GROUNDWATER ELEVATION (FEBRUARY 2010) (DASHED WHERE INFERRED)
- 5 — APPROXIMATE TETRACHLOROETHENE ISOCONTOUR (µg/L)
- * — NO SOIL BORING DATA
- 151 — INFERRED GROUNDWATER FLOW CONTOUR
- INFERRED GROUNDWATER FLOW DIRECTION

0 20 40
SCALE: 1" = 20'
VERTICAL SCALE IN FEET

0 50 100
SCALE: 1" = 50'
HORIZONTAL SCALE IN FEET

NOTES:
1. VERTICAL EXAGGERATION = 2.5
2. EXAGGERATED DIP OF BEDROCK FRACTURE SHOWN

TETRA TECH

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

GEOLOGIC CROSS SECTION I-I'

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_X-SECTION_I.DWG	PER SCALE BAR
FIGURE NUMBER	REV / DATE
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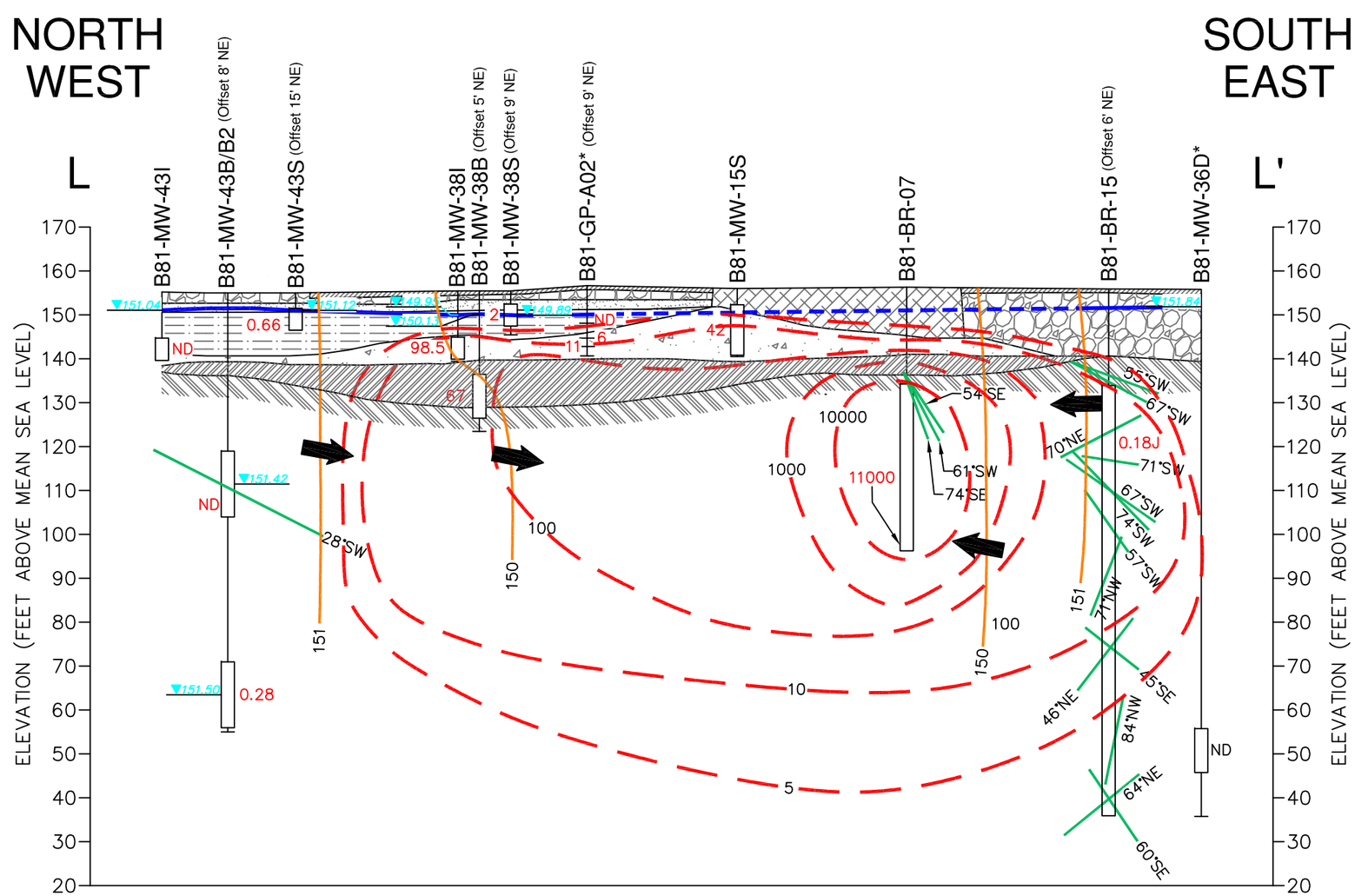

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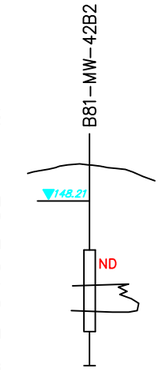


- MONITORING WELL OR BORING NUMBER
- GROUND SURFACE
- GROUNDWATER ELEVATION (FEET MSL)
- TOP OF SCREEN
- TETRACHLOROETHENE CONCENTRATION (µg/L)
- LITHOLOGIC CONTACT (INFERRED BETWEEN BORINGS)
- BOTTOM OF SCREEN
- TOTAL DEPTH OF BORING

- ASPHALT
- COMPETENT BEDROCK
- SAND
- SILTY SAND
- FILL (SAND & GRAVEL)
- SILT, SAND, & GRAVEL
- WEATHERED BEDROCK
- SAND AND GRAVEL

- 45°SW — BEDROCK FRACTURE WITH DEGREE AND DIRECTION OF TRUE DIP DERIVED FROM BOREHOLE GEOPHYSICS REPORT BY HAGER GEOSCIENCE (2005) & NE GEOPHYSICAL SERVICES (2010)
- GROUNDWATER ELEVATION (FEBRUARY 2010) (DASHED WHERE INFERRED)
- 5 — APPROXIMATE TETRACHLOROETHENE ISOCONTOUR (µg/L)
- * — NO SOIL BORING DATA
- 151 — INFERRED GROUNDWATER FLOW CONTOUR
- INFERRED GROUNDWATER FLOW DIRECTION

NOTES:
1. VERTICAL EXAGGERATION = 1
2. EXAGGERATED DIP OF BEDROCK FRACTURE SHOWN

0 30 60
SCALE: 1" = 30'
VERTICAL SCALE IN FEET

0 30 60
SCALE: 1" = 30'
HORIZONTAL SCALE IN FEET

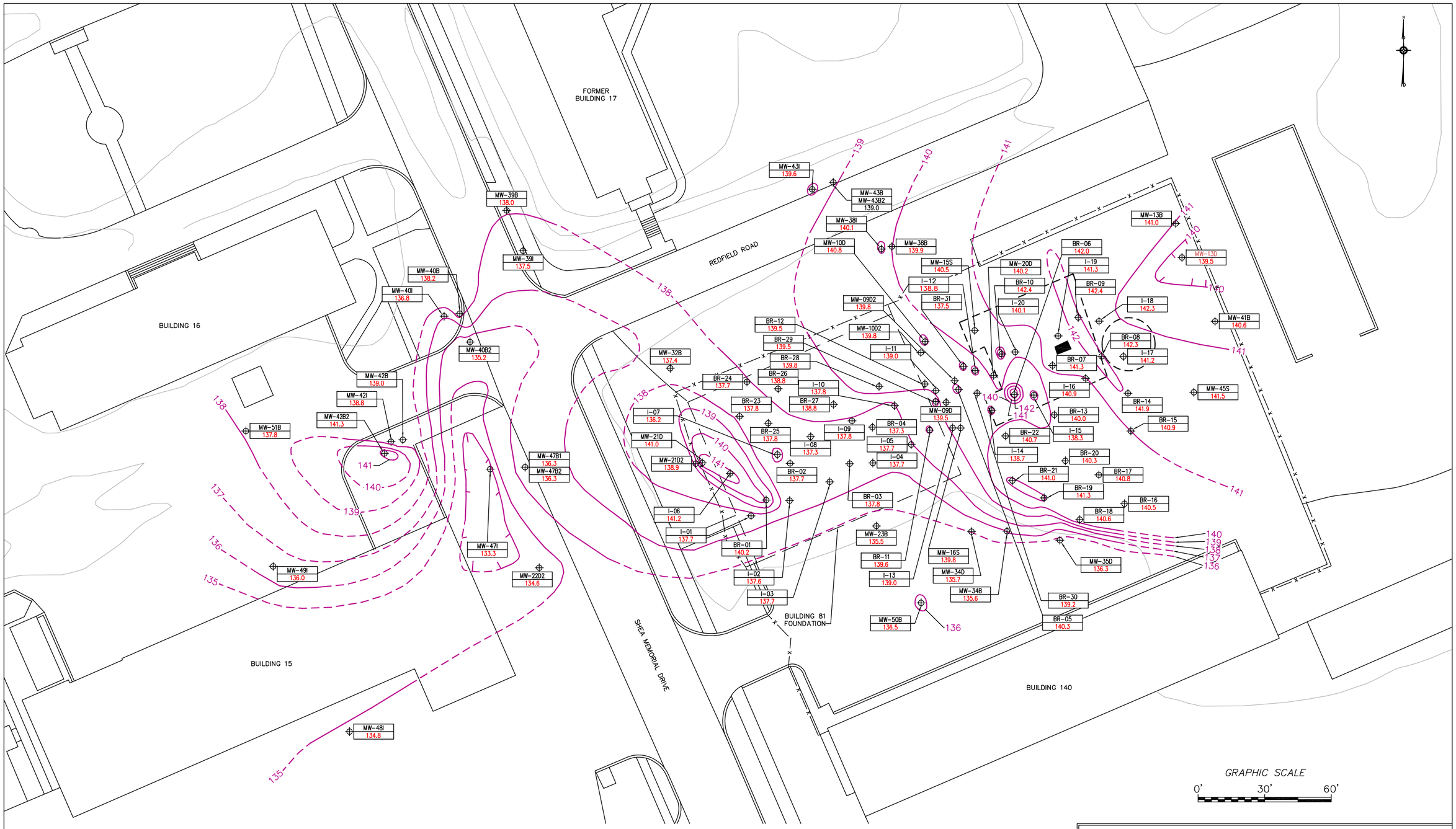
TETRA TECH

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

GEOLOGIC CROSS SECTION L-L'

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_X-SECTION_L.DWG	PER SCALE BAR
FIGURE NUMBER 1-7	REV 0 / DATE 12/27/12



LEGEND:

- MW-01 / 146.9 — MONITORING WELL ID / BEDROCK SURFACE ELEVATION (FEET)
- 150 — BEDROCK ELEVATION CONTOUR (FEET) (DASHED WHERE INFERRED)
- APPROXIMATE LOCATION OF TANK GRAVE
- APPROXIMATE LOCATION 1998 EXCAVATION
- FENCELINE
- TOPOGRAPHIC CONTOUR
- HACHURED LINES SUGGEST A DEPRESSION (TICKS POINT DOWNSLOPE)

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83) MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND IN 2010 BY FEDERICI ASSOCIATES.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.
8. MAP DEPICTS ONLY THOSE WELLS FOR WHICH BEDROCK INFORMATION HAS BEEN DESCRIBED.
9. CONTOUR LINES DRAWN MANUALLY USING A TRIANGULATION METHODOLOGY COUPLED WITH PROFESSIONAL JUDGMENT, WHEN NECESSARY.

TETRA TECH

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

BEDROCK SURFACE CONTOUR MAP

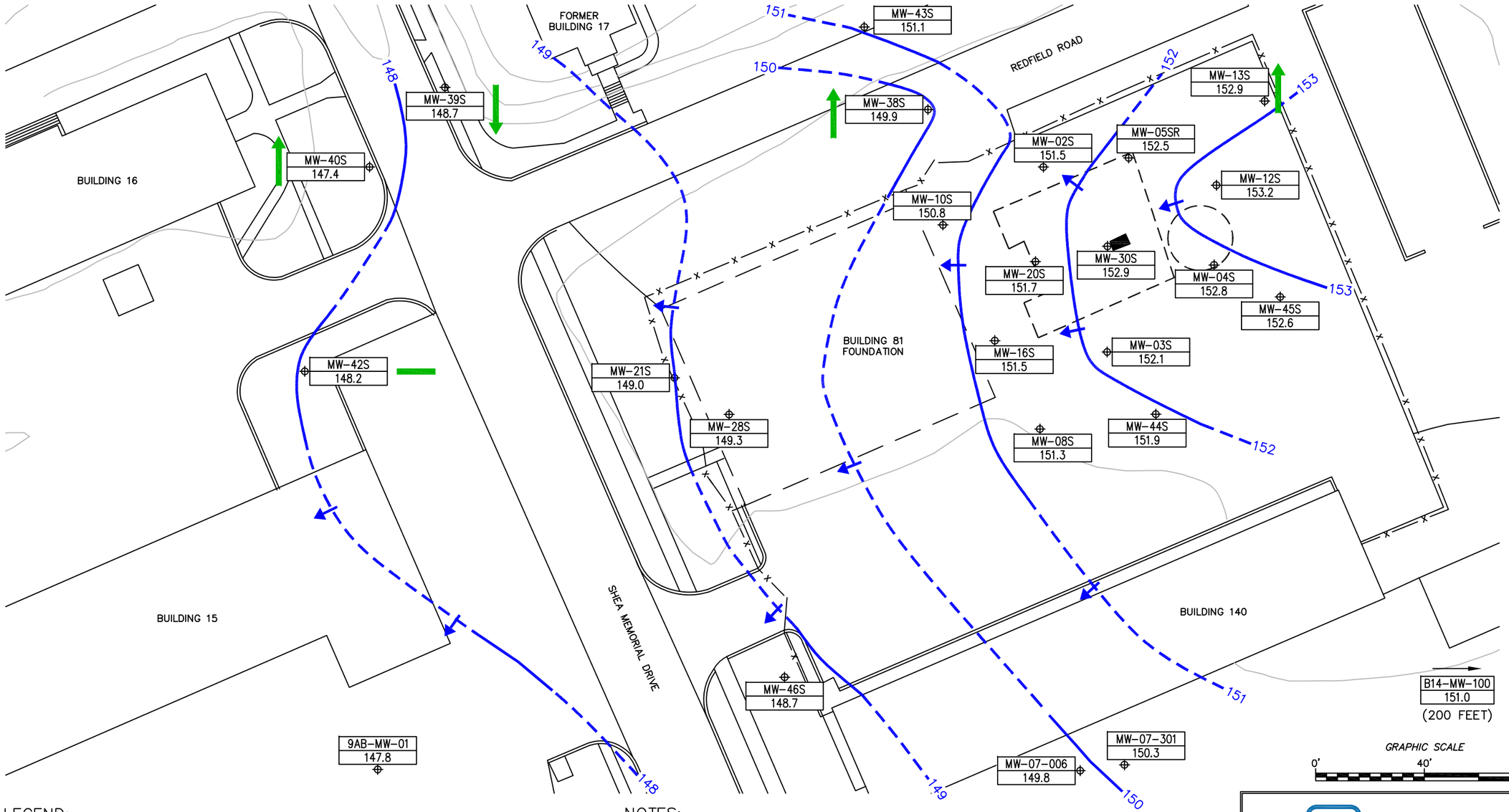
BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
\..\B81_BED_SURF_CONTOUR.DWG	PER SCALE BAR

FIGURE NUMBER	REV	DATE
1-8	0	12/27/12

I:\02073\FS.DF.B81\B81_BED_SURF_CONTOUR.dwg BOS DWM 12/27/12

I:\02073\FS.DF.B81\B81_GW_CONTOUR_020910_SO.dwg BOS DWM 12/27/12



LEGEND:

- MW-01 / 147.7 — MONITORING WELL ID / MEASURED GROUNDWATER ELEVATION (FEET)
- 150 — GROUNDWATER ELEVATION CONTOUR (FEET) (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- APPROXIMATE LOCATION OF TANK GRAVE
- APPROXIMATE LOCATION 1998 EXCAVATION
- FENCELINE
- TOPOGRAPHIC CONTOUR
- DIRECTION OF VERTICAL GRADIENT BETWEEN SHALLOW AND DEEP OVERBURDEN FLAT LINE REPRESENTS NO VERTICAL GRADIENT (CALCULATED IN TABLE 3-3)

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. RBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND 2010 SURVEY BY FEDERICI ASSOCIATES.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.
8. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
9. GROUNDWATER ELEVATION MEASURED FEBRUARY 9, 2010 BY TETRA TECH NUS, INC.
10. SHALLOW OVERBURDEN WELLS BASED ON TOP OF SCREEN ≤ 7 FEET BELOW GROUND SURFACE (FT BGS).

TETRA TECH

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

SHALLOW OVERBURDEN GROUNDWATER CONTOUR MAP - FEBRUARY 9, 2010

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_GW_CONTOUR_020910_SO.DWG	PER SCALE BAR

FIGURE NUMBER	REV	DATE
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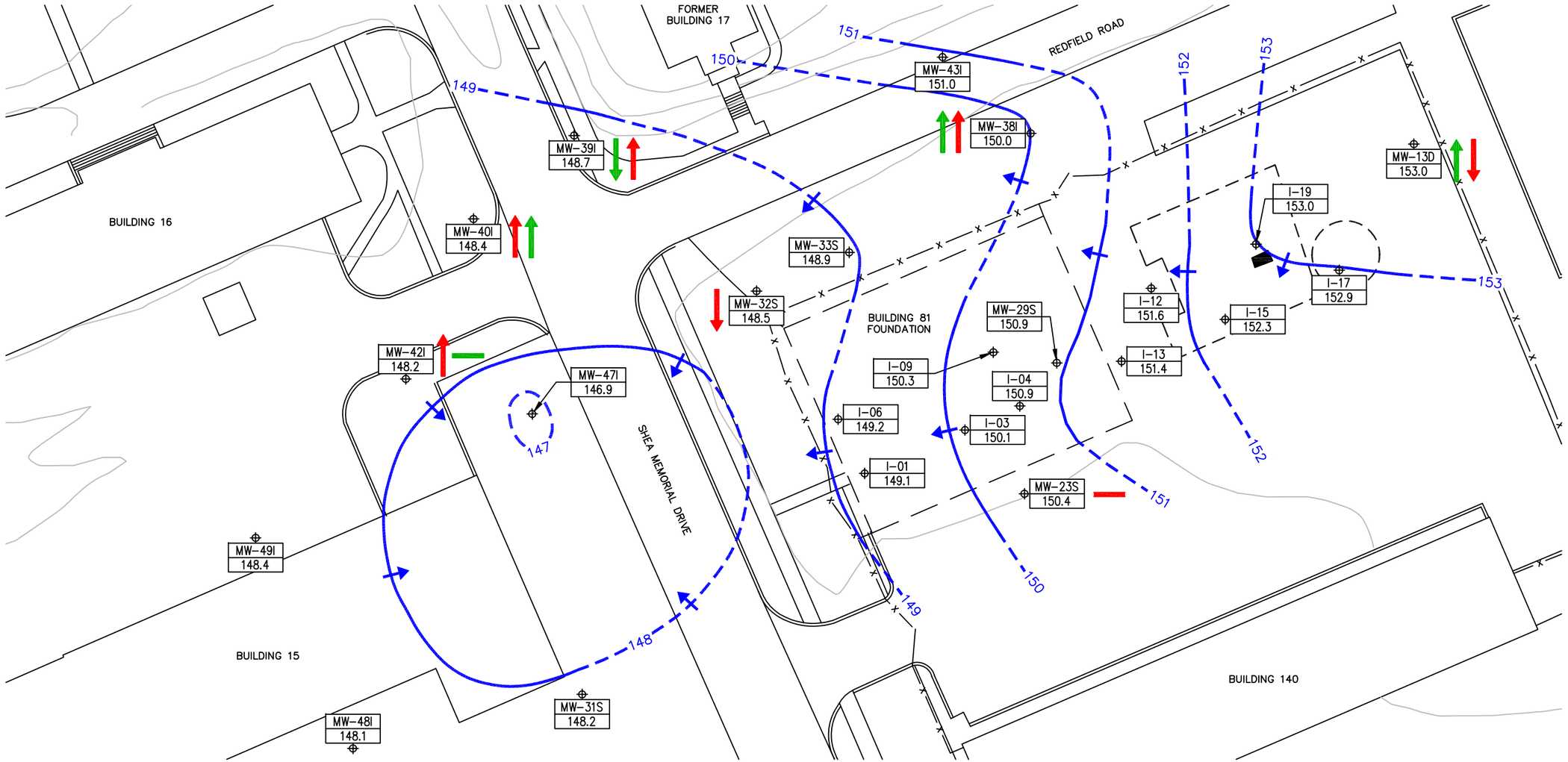
I:\02073\FS.DF.B81\B81_GW_CONTOUR_020910_DO.dwg BOS DWM 12/27/12



GRAPHIC SCALE

0' 40' 80'

LEGEND:

- MW-48I / 148.1 — MONITORING WELL ID / MEASURED GROUNDWATER ELEVATION (FEET)
- 150 — GROUNDWATER ELEVATION CONTOUR (FEET) (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- APPROXIMATE LOCATION OF TANK GRAVE
- APPROXIMATE LOCATION 1998 EXCAVATION
- FENCELINE
- TOPOGRAPHIC CONTOUR
- DIRECTION OF VERTICAL GRADIENT BETWEEN SHALLOW AND DEEP OVERBURDEN FLAT LINE REPRESENTS NO VERTICAL GRADIENT (CALCULATED IN TABLE 3-3)
- DIRECTION OF VERTICAL GRADIENT BETWEEN DEEP OVERBURDEN AND SHALLOW BEDROCK FLAT LINE REPRESENTS NO VERTICAL GRADIENT (CALCULATED IN TABLE 3-3)

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83) MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND 2010 SURVEY BY FEDERICI ASSOCIATES.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.
8. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
9. GROUNDWATER ELEVATION MEASURED FEBRUARY 9, 2010 BY TETRA TECH NUS, INC..
10. DEEP OVERBURDEN WELLS BASED ON TOP SCREEN > 7 FEET BELOW GROUND SURFACE (FT BGS) AND < 20 FT BGS (OR ABOVE BEDROCK SURFACE).

TETRA TECH

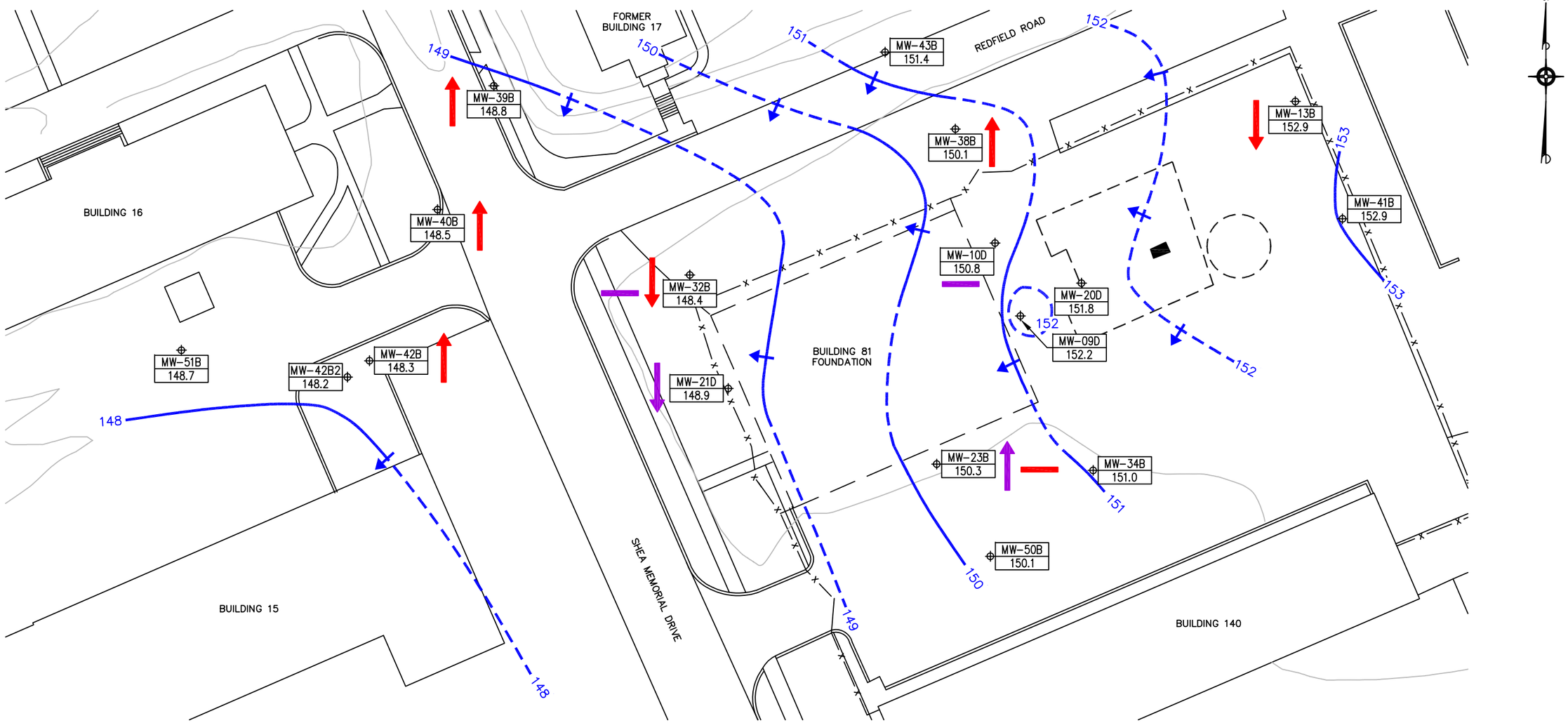
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

DEEP OVERBURDEN GROUNDWATER CONTOUR MAP - FEBRUARY 9, 2010

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_GW_CONTOUR_020910_DO.DWG	PER SCALE BAR
FIGURE NUMBER	REV / DATE
1-10	0 / 12/27/12

I:\02073\FS.DF.B81\B81_GW_CONTOUR_020910_SB.dwg BOS DWM 12/27/12



LEGEND:

- MW-07-006 / 149.2 — MONITORING WELL ID / MEASURED GROUNDWATER ELEVATION (FEET)
- 150 — GROUNDWATER ELEVATION CONTOUR (FEET) (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- APPROXIMATE LOCATION OF TANK GRAVE
- APPROXIMATE LOCATION 1998 EXCAVATION
- FENCELINE
- TOPOGRAPHIC CONTOUR
- DIRECTION OF VERTICAL GRADIENT BETWEEN DEEP OVERBURDEN AND SHALLOW BEDROCK FLAT LINE REPRESENTS NO VERTICAL GRADIENT (CALCULATED IN TABLE 3-3)
- DIRECTION OF VERTICAL GRADIENT BETWEEN SHALLOW BEDROCK AND DEEP BEDROCK FLAT LINE REPRESENTS NO VERTICAL GRADIENT (CALCULATED IN TABLE 3-3)

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83) MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND 2010 SURVEY BY FEDERICI ASSOCIATES.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.
8. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
9. GROUNDWATER ELEVATION MEASURED FEBRUARY 9, 2010 BY TETRA TECH NUS, INC.
10. SHALLOW BEDROCK WELLS BASED ON TOP OF SCREEN ≥ 17 FEET BELOW GROUND SURFACE (FT BGS) (OR BELOW BEDROCK SURFACE) AND ≤ 45 FT BGS.

GRAPHIC SCALE
0' 40' 40'

TETRA TECH

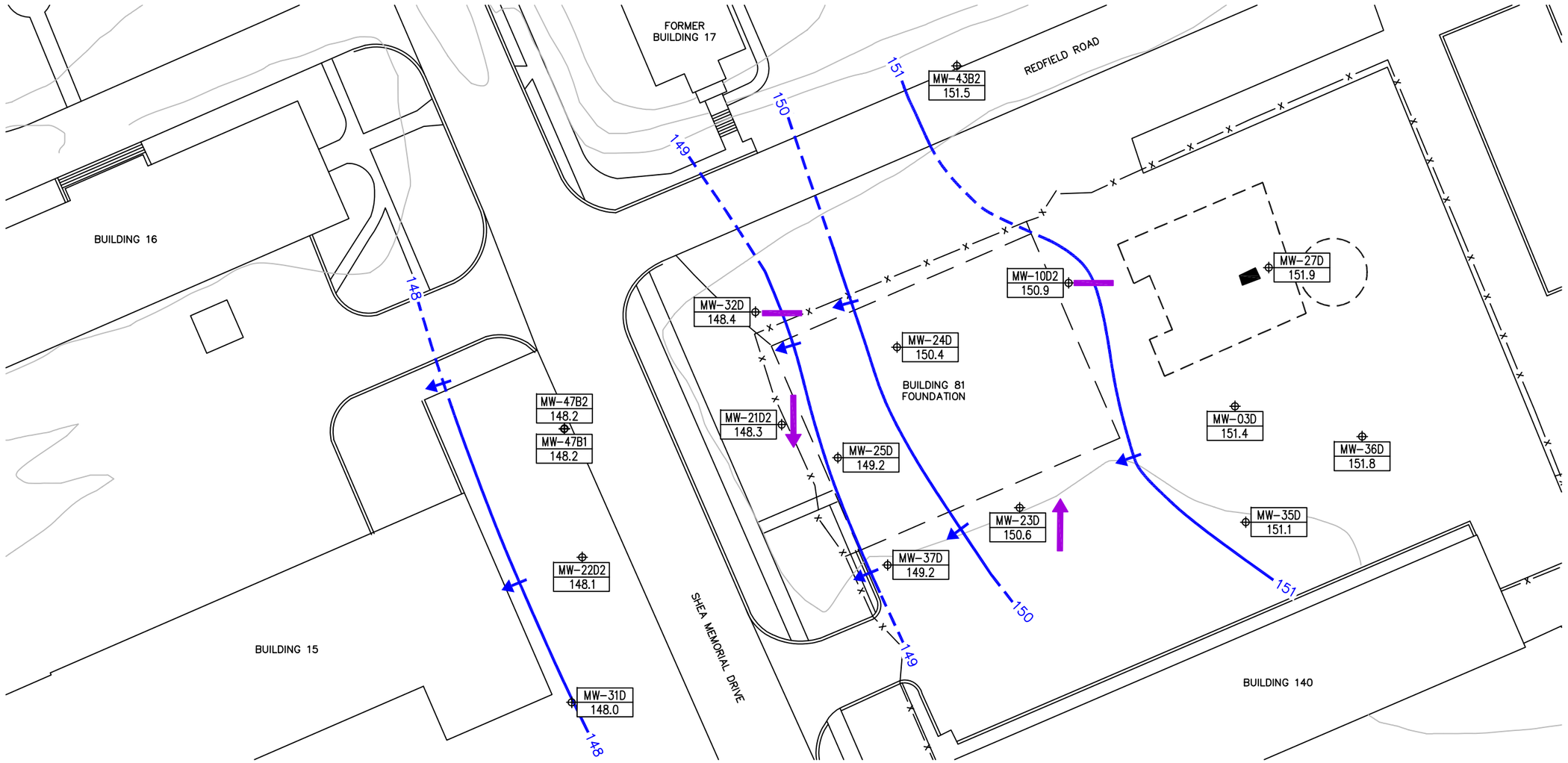
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

SHALLOW BEDROCK GROUNDWATER CONTOUR MAP - FEBRUARY 9, 2010

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_GW_CONTOUR_020910_SB.DWG	PER SCALE BAR
FIGURE NUMBER	REV / DATE
1-11	0 / 12/27/12

I:\02073\FS.DF.B81\B81_GW_CONTOUR_020910_DB.dwg BOS DWM 12/27/12



GRAPHIC SCALE

0' 40' 40'

LEGEND:

- MW-31D / 148.0 — MONITORING WELL ID / MEASURED GROUNDWATER ELEVATION (FEET)
- 150 — GROUNDWATER ELEVATION CONTOUR (FEET) (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- APPROXIMATE LOCATION OF TANK GRAVE
- APPROXIMATE LOCATION 1998 EXCAVATION
- FENCELINE
- TOPOGRAPHIC CONTOUR
- DIRECTION OF VERTICAL GRADIENT BETWEEN SHALLOW BEDROCK AND DEEP BEDROCK FLAT LINE REPRESENTS NO VERTICAL GRADIENT (CALCULATED IN TABLE 3-3)

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83) MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND 2010 SURVEY BY FEDERICI ASSOCIATES.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.
8. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
9. GROUNDWATER ELEVATION MEASURED FEBRUARY 9, 2010 BY TETRA TECH NUS, INC.
10. DEEP BEDROCK WELLS BASED ON TOP OF SCREEN > 45 FEET BELOW GROUND SURFACE (FT BGS).

TETRA TECH

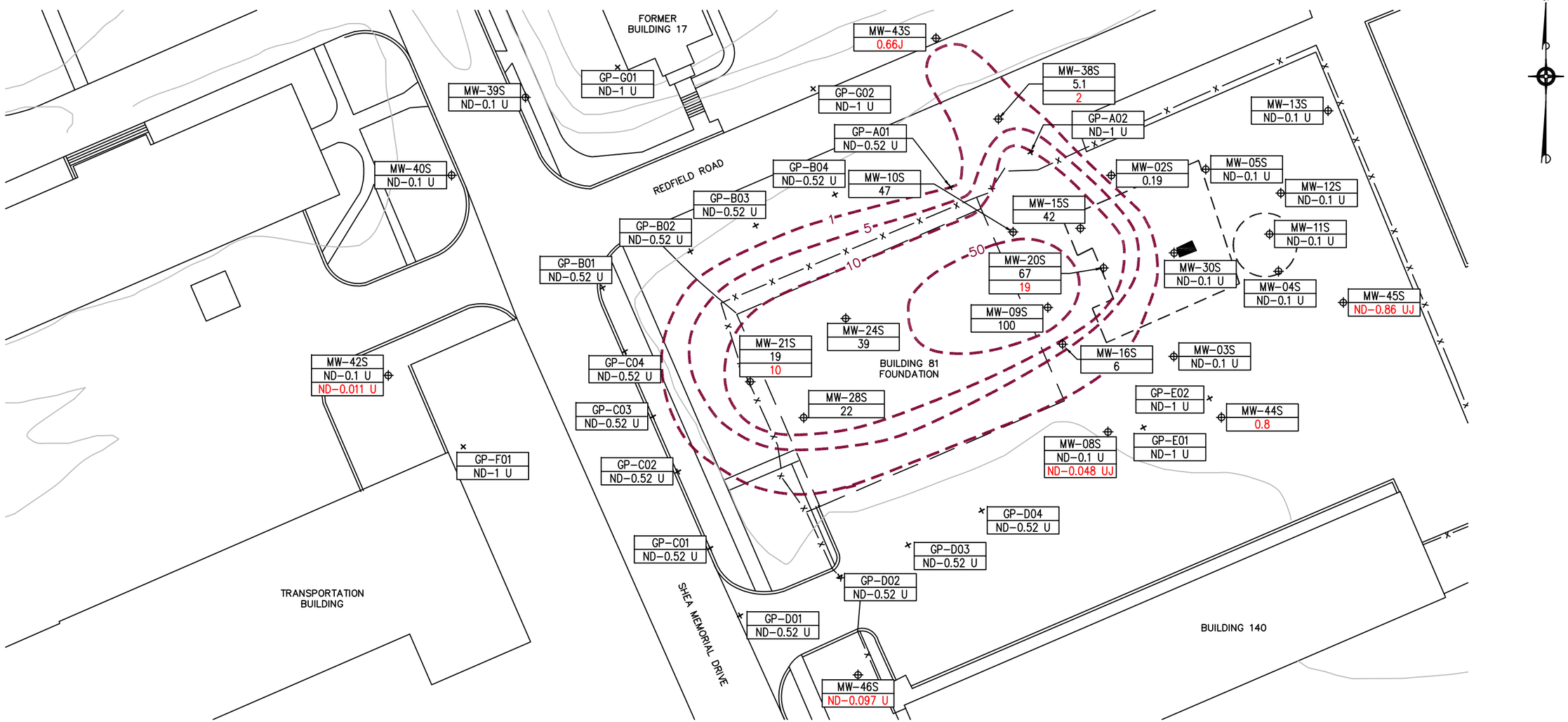
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

DEEP BEDROCK GROUNDWATER CONTOUR MAP - FEBRUARY 9, 2010

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_GW_CONTOUR_020910_DB.DWG	PER SCALE BAR
FIGURE NUMBER 1-12	REV 0 / DATE 12/27/12

I:\02073\FS.DF.B81\B81_PCE_CONTOUR_WT.dwg BOS DWM 12/27/12



LEGEND:

MW-42S	SAMPLE LOCATION ID
ND-0.1 U	DETECTED CONCENTRATION OF TETRACHLOROETHENE µg/L (2006)
ND-0.011 U	DETECTED CONCENTRATION OF TETRACHLOROETHENE µg/L (2009–2010)
ND–	TETRACHLOROETHENE NOT DETECTED – VALUE SHOWN IS DETECTION LIMIT
×	RI GROUNDWATER PROFILING SAMPLE LOCATIONS
– –1– –	APPROXIMATE TETRACHLOROETHENE CONCENTRATION CONTOUR
	APPROXIMATE LOCATION OF TANK GRAVE
— — —	APPROXIMATE LOCATION 1998 EXCAVATION
—— x ——	FENCELINE
	TOPOGRAPHIC CONTOUR

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83) MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND 2010 SURVEY BY FEDERICI ASSOCIATES.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.
8. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
9. EPA REGION 9 PRG FOR RESIDENTIAL GROUNDWATER FOR TETRACHLOROETHENE IS 0.1 µg/L.
10. U.S. EPA AND MA DRINKING WATER MCL FOR TETRACHLOROETHENE IS 5 µg/L.
11. WATER TABLE INTERVAL WELLS BASED ON TOP OF SCREEN ≤ 7 FEET BELOW GROUND SURFACE (FT BGS).
12. AT LOCATIONS WITH DATA FROM 2006 AND 2009–2010, THE MOST RECENT DATA WAS USED FOR CONTOURING.

GRAPHIC SCALE
0' 40' 80'

TETRA TECH

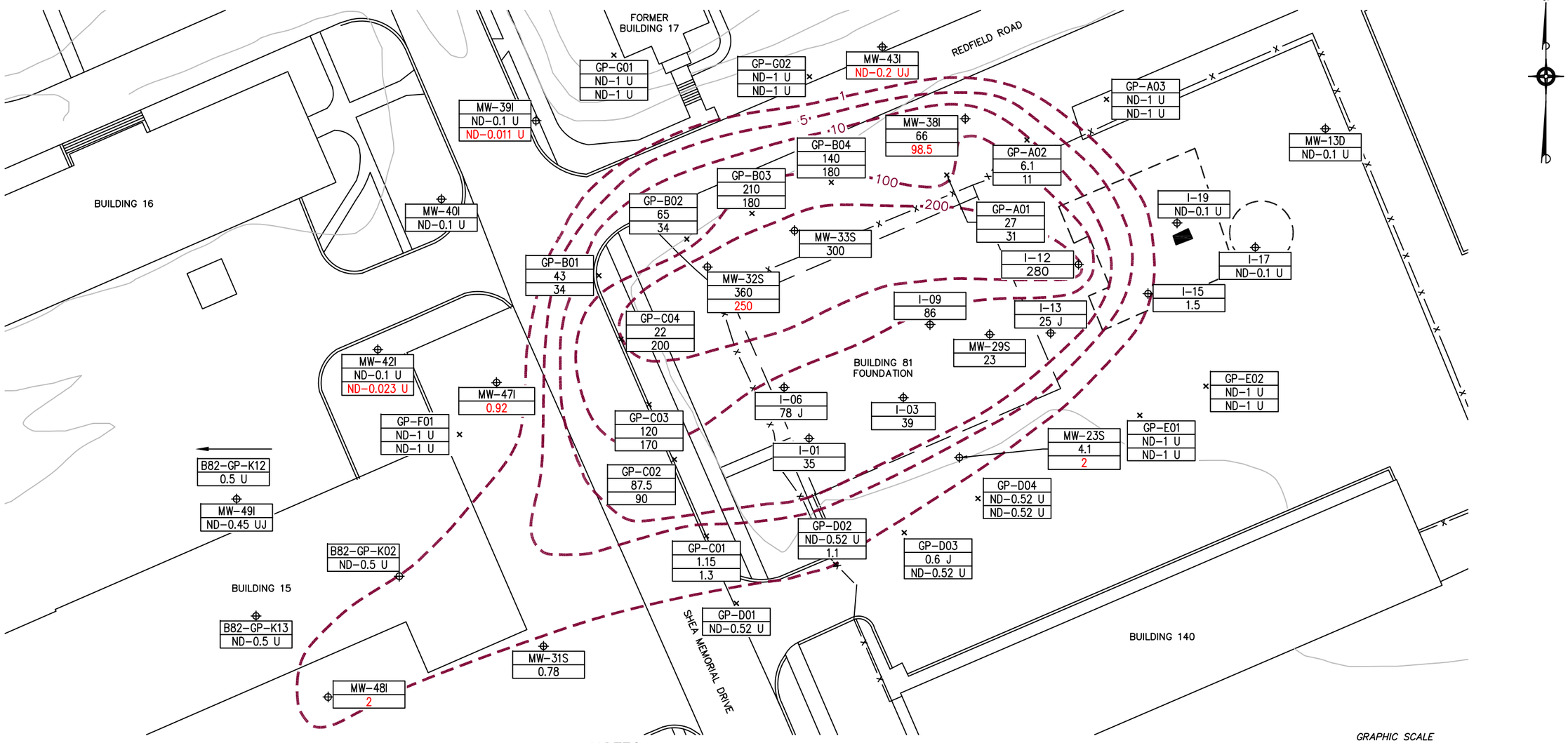
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

TETRACHLOROETHENE CONCENTRATION CONTOURS - WATER TABLE INTERVAL

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_PCE_CONTOUR_WT.DWG	PER SCALE BAR
FIGURE NUMBER 1–13	REV 0 / DATE 12/27/12

I:\02073\FS.DF.B81\B81_PCE_CONTOUR_DO.dwg BOS DWM 12/27/12



LEGEND:

MW-42I	SAMPLE LOCATION ID
ND-0.1U	DETECTED CONCENTRATION OF TETRACHLOROETHENE µg/L (2006)
ND-0.023 U	DETECTED CONCENTRATION OF TETRACHLOROETHENE µg/L (2009–2010)
ND–	TETRACHLOROETHENE NOT DETECTED – VALUE SHOWN IS DETECTION LIMIT
×	RI GROUNDWATER PROFILING SAMPLE LOCATIONS
1	APPROXIMATE TETRACHLOROETHENE CONCENTRATION CONTOUR
	APPROXIMATE LOCATION OF TANK GRAVE
	APPROXIMATE LOCATION 1998 EXCAVATION
x	FENCELINE
	TOPOGRAPHIC CONTOUR
GP-D04 ND-0.52 U ND-0.52 U	LOCATIONS WITH SAMPLES FROM TWO DIFFERENT DEPTH INTERVALS WITHIN DEEP OVERBURDEN. HIGHER VALUE USED FOR CONTOURING PURPOSES

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83) MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND 2010 SURVEY BY FEDERICI ASSOCIATES.
5. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
6. PLAN NOT TO BE USED FOR DESIGN.
7. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
8. EPA REGION 9 PRG FOR RESIDENTIAL GROUNDWATER FOR TETRACHLOROETHENE IS 0.1 µg/L.
9. U.S. EPA AND MA DRINKING WATER MCL FOR TETRACHLOROETHENE IS 5 µg/L.
10. DEEP OVERBURDEN WELLS BASED ON TOP OF SCREEN > 7 FEET BELOW GROUND SURFACE (FT BGS) AND < 20 FT BGS (OR ABOVE BEDROCK SURFACE).
11. AT LOCATIONS WITH DATA FROM 2006 AND 2009–2010, THE MOST RECENT DATA WAS USED FOR CONTOURING.

GRAPHIC SCALE
0' 40' 80'

TETRA TECH

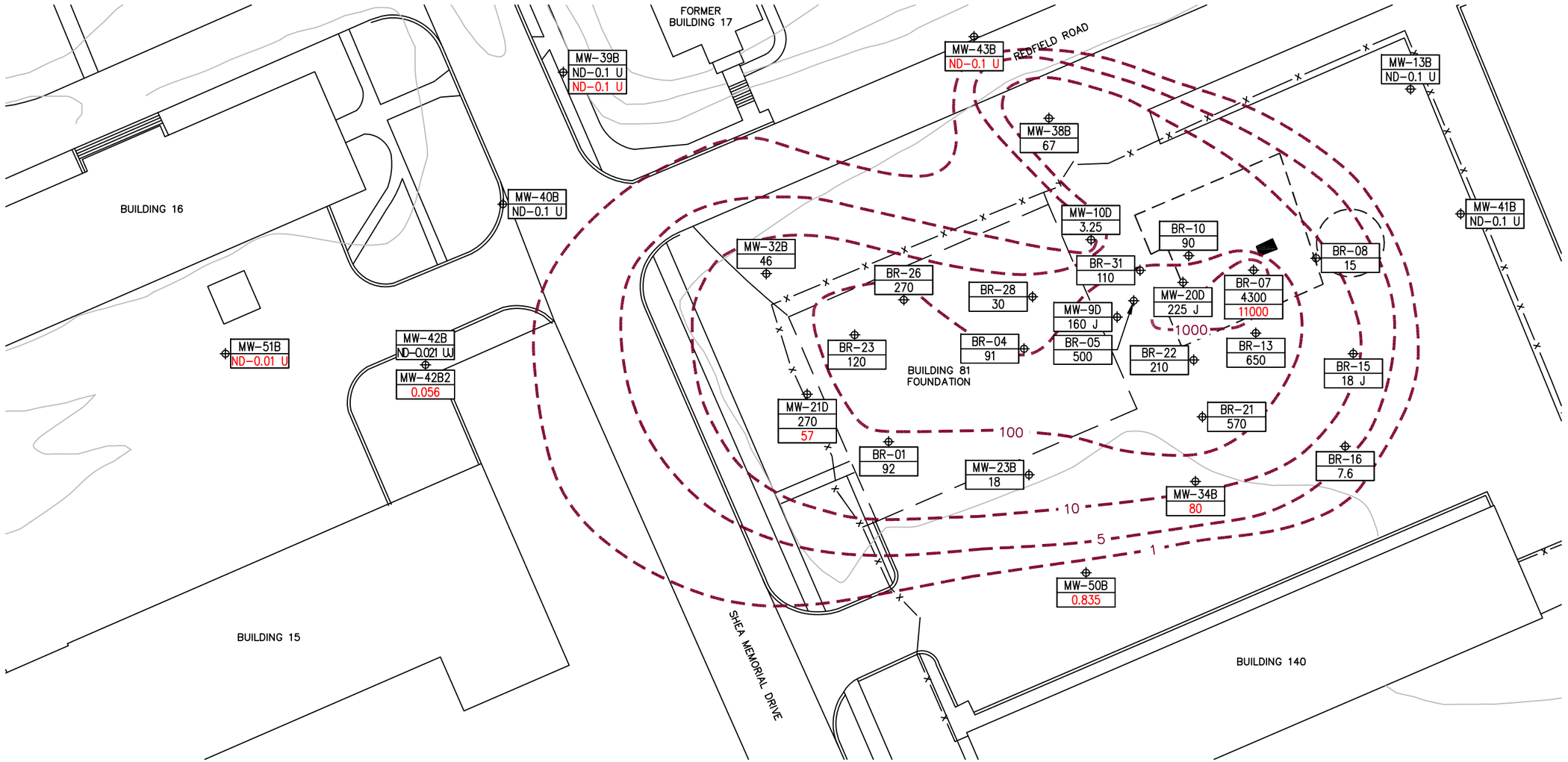
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

TETRACHLOROETHENE CONCENTRATION CONTOURS - DEEP OVERBURDEN GROUNDWATER

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_PCE_CONTOUR_DO.DWG	PER SCALE BAR
FIGURE NUMBER 1–14	REV 0 / DATE 12/27/12

I:\02073\FS.DF.B81\B81_PCE_CONTOUR_SB.dwg BOS DWM 12/27/12



LEGEND:

MW-39B	SAMPLE LOCATION ID
ND-0.1 U	DETECTED CONCENTRATION OF TETRACHLOROETHENE µg/L (2006)
ND-0.1 U	DETECTED CONCENTRATION OF TETRACHLOROETHENE µg/L (2009–2010)
ND–	TETRACHLOROETHENE NOT DETECTED – VALUE SHOWN IS DETECTION LIMIT
– –1– –	APPROXIMATE TETRACHLOROETHENE CONCENTRATION CONTOUR
	APPROXIMATE LOCATION OF TANK GRAVE
— — —	APPROXIMATE LOCATION 1998 EXCAVATION
—— x ——	FENCELINE
	TOPOGRAPHIC CONTOUR

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83) MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND 2010 SURVEY BY FEDERICI ASSOCIATES.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.
8. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
9. EPA REGION 9 PRG FOR RESIDENTIAL GROUNDWATER FOR TETRACHLOROETHENE IS 0.1 µg/L.
10. US EPA AND MA DRINKING WATER MCL FOR TETRACHLOROETHENE IS 5 µg/L.
11. SHALLOW BEDROCK WELLS BASED ON TOP OF SCREEN ≥ 17 FEET BELOW GROUND SURFACE (FT BGS) (OR BELOW BEDROCK SURFACE) AND ≤ 45 FT BGS.
12. AT LOCATIONS WITH DATA FROM 2006 AND 2009–2010, THE MOST RECENT DATA WAS USED FOR CONTOURING.

GRAPHIC SCALE
0' 40' 80'

TETRA TECH

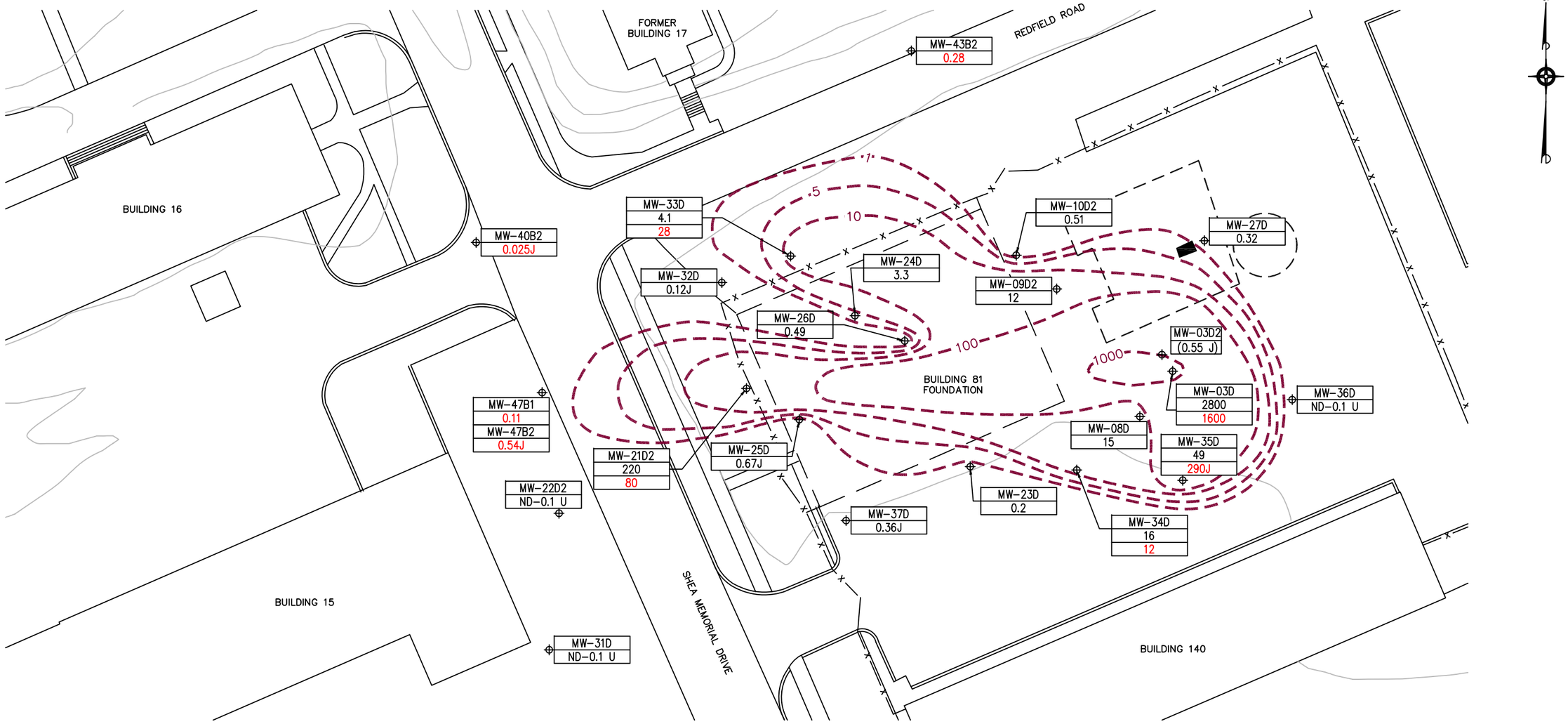
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

TETRACHLOROETHENE CONCENTRATION CONTOURS - SHALLOW BEDROCK GROUNDWATER

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_PCE_CONTOUR_SB.DWG	PER SCALE BAR
FIGURE NUMBER	REV / DATE
1–15	12/27/12

I:\02073\FS.DF.B81\B81_PCE_CONTOUR_DB.dwg BOS DWM 12/27/12



LEGEND:

MW-21D2	SAMPLE LOCATION ID
220	DETECTED CONCENTRATION OF TETRACHLOROETHENE (2006) µg/L
80	DETECTED CONCENTRATION OF TETRACHLOROETHENE (2009 AND 2010) µg/L
ND-	TETRACHLOROETHENE NOT DETECTED – VALUE SHOWN IS DETECTION LIMIT
(0.55 J)	VALUE NOT USED FOR CONTOURING BASED ON WELL SCREEN DEPTH
– –1– –	APPROXIMATE TETRACHLOROETHENE CONCENTRATION CONTOUR
	APPROXIMATE LOCATION OF TANK GRAVE
— — —	APPROXIMATE LOCATION 1998 EXCAVATION
—— x ——	FENCELINE
	TOPOGRAPHIC CONTOUR

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83) MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND 2010 SURVEY BY FEDERICI ASSOCIATES.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.
8. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
9. EPA REGION 9 PRG FOR RESIDENTIAL GROUNDWATER FOR TETRACHLOROETHENE IS 0.1 µg/L.
10. U.S. EPA AND MA DRINKING WATER MCL FOR TETRACHLOROETHENE IS 5 µg/L.
11. DEEP BEDROCK WELLS BASED ON TOP OF SCREEN > 45 FEET BELOW GROUND SURFACE (FT BGS).
12. AT LOCATIONS WITH DATA FROM 2006 AND 2009–2010, THE MOST RECENT DATE WAS USED FOR CONTOURING.

GRAPHIC SCALE

0' 40' 80'

TETRA TECH

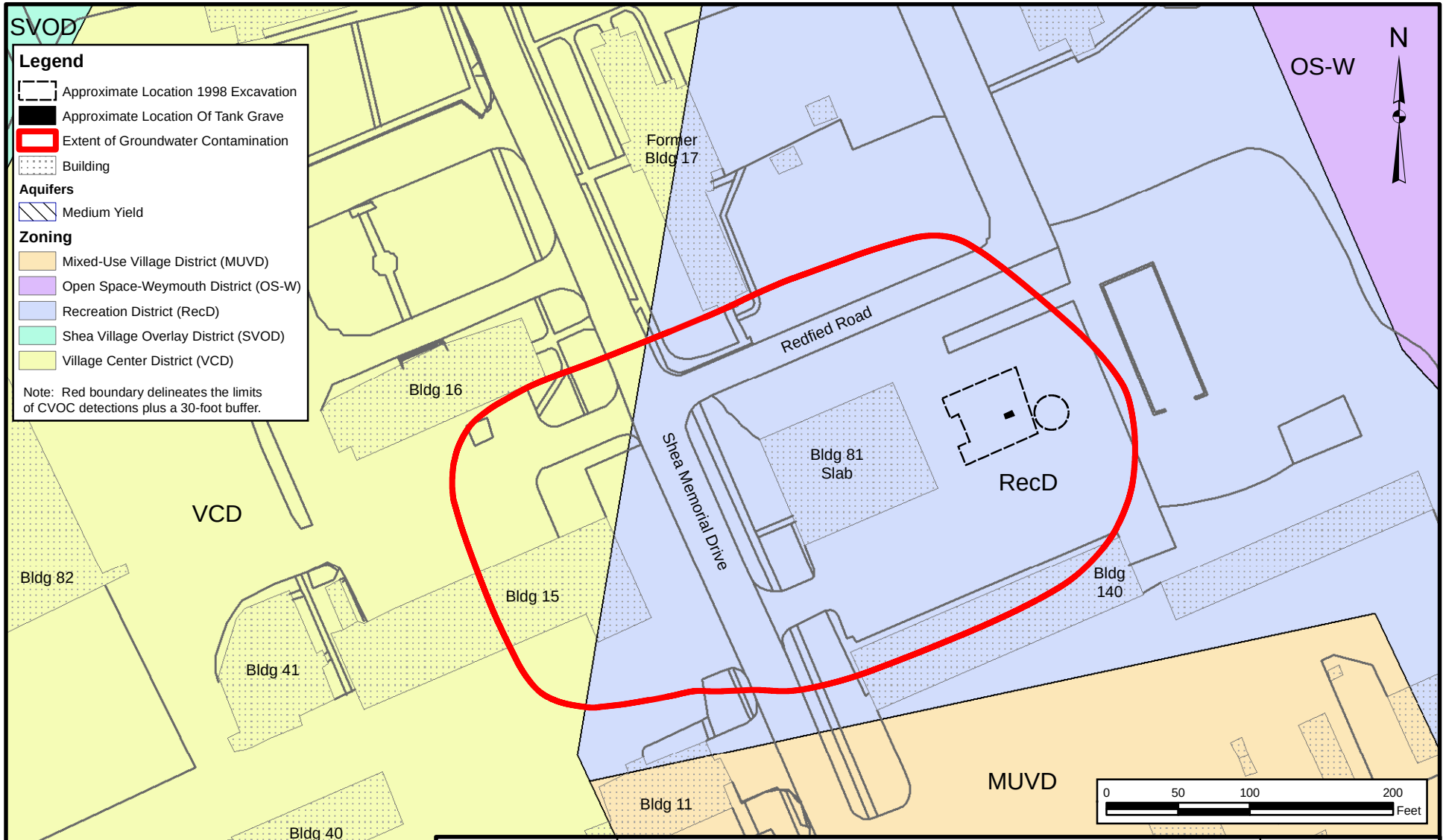
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

TETRACHLOROETHENE CONCENTRATION CONTOURS - DEEP BEDROCK GROUNDWATER

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_PCE_CONTOUR_DB.DWG	PER SCALE BAR
FIGURE NUMBER 1–16	REV / DATE 12/27/12

I:\02073\FS.DF.B81\B81_AQUIFERS&ZONING.MXD DWM 01/07/13



TETRA TECH

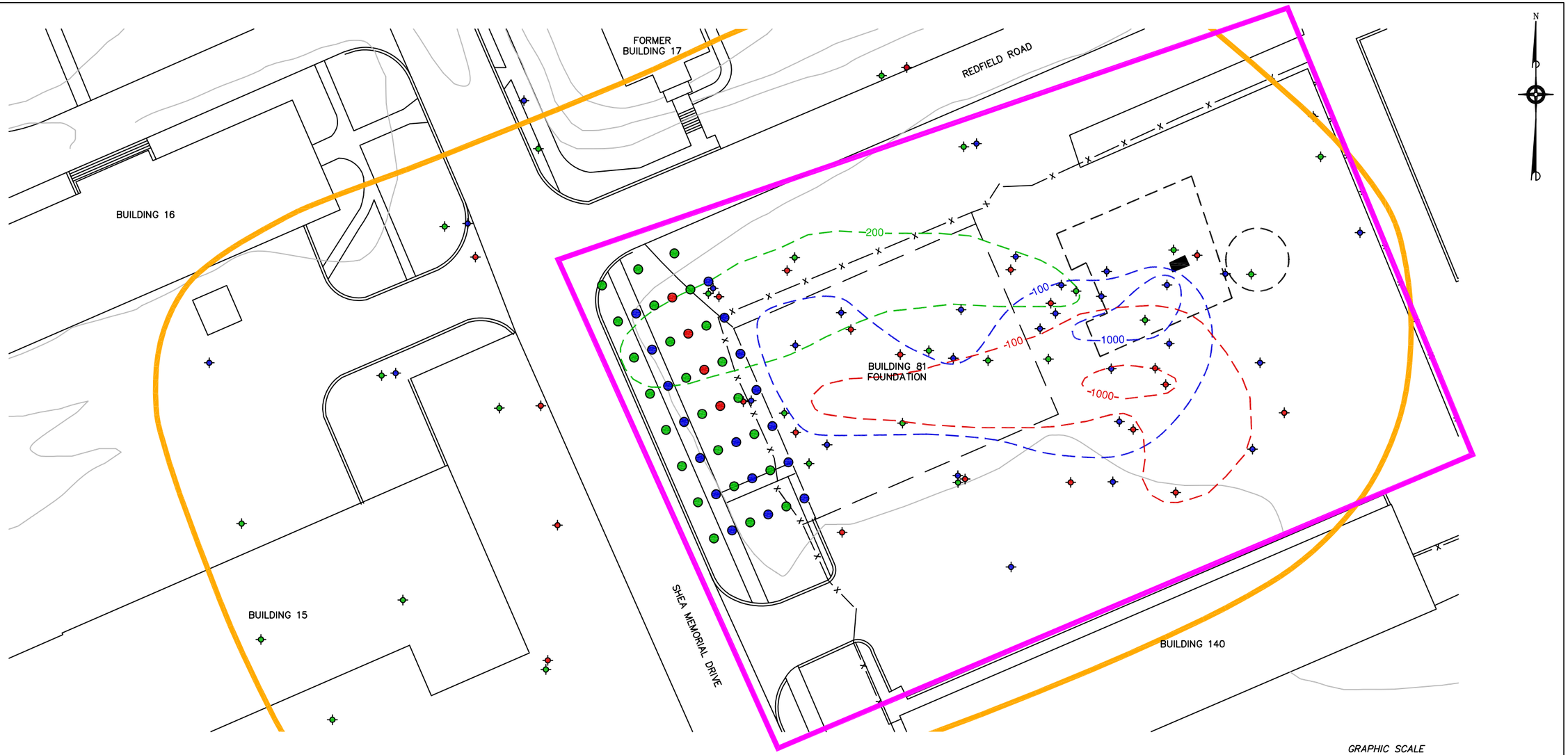
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

EXTENT OF GROUNDWATER CONTAMINATION

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

SCALE	
PER SCALE BAR	
FILE	
I:\..\B81_AQUIFERS&ZONING.MXD	
REV	DATE
0	01/07/13
FIGURE NUMBER	
2-1	

I:\02073\FS.DF.B81\B81_ALT_G-2_R1.DWG BOS DWM 1/2/13



GRAPHIC SCALE
0' 40' 80'

LEGEND:

- APPROXIMATE LOCATION OF TANK GRAVE
- APPROXIMATE LOCATION 1998 EXCAVATION
- FENCELINE
- TOPOGRAPHIC CONTOUR
- INTERIM LAND USE CONTROL (LUC) BOUNDARY (SEE FIGURE 4-2)
- LONG-TERM LAND USE CONTROL (LUC) BOUNDARY (SEE FIGURE 4-2)
- DEEP OVERBURDEN MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL

TETRACHLOROETHENE CONCENTRATION CONTOUR (µg/L)

- DEEP OVERBURDEN
- SHALLOW BEDROCK
- DEEP BEDROCK

BIO-BARRIER WELL

- OVERBURDEN 7-18 bgs
- SHALLOW BEDROCK 18-40 bgs
- SHALLOW & DEEP BEDROCK 18-60 bgs

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83), MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND 2010 SURVEY BY FEDERICI ASSOCIATES.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.
8. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
10. SHALLOW OVERBURDEN WELLS BASED ON TOP OF SCREEN ≤ 7 FEET BELOW GROUND SURFACE (FT BGS).

TETRA TECH

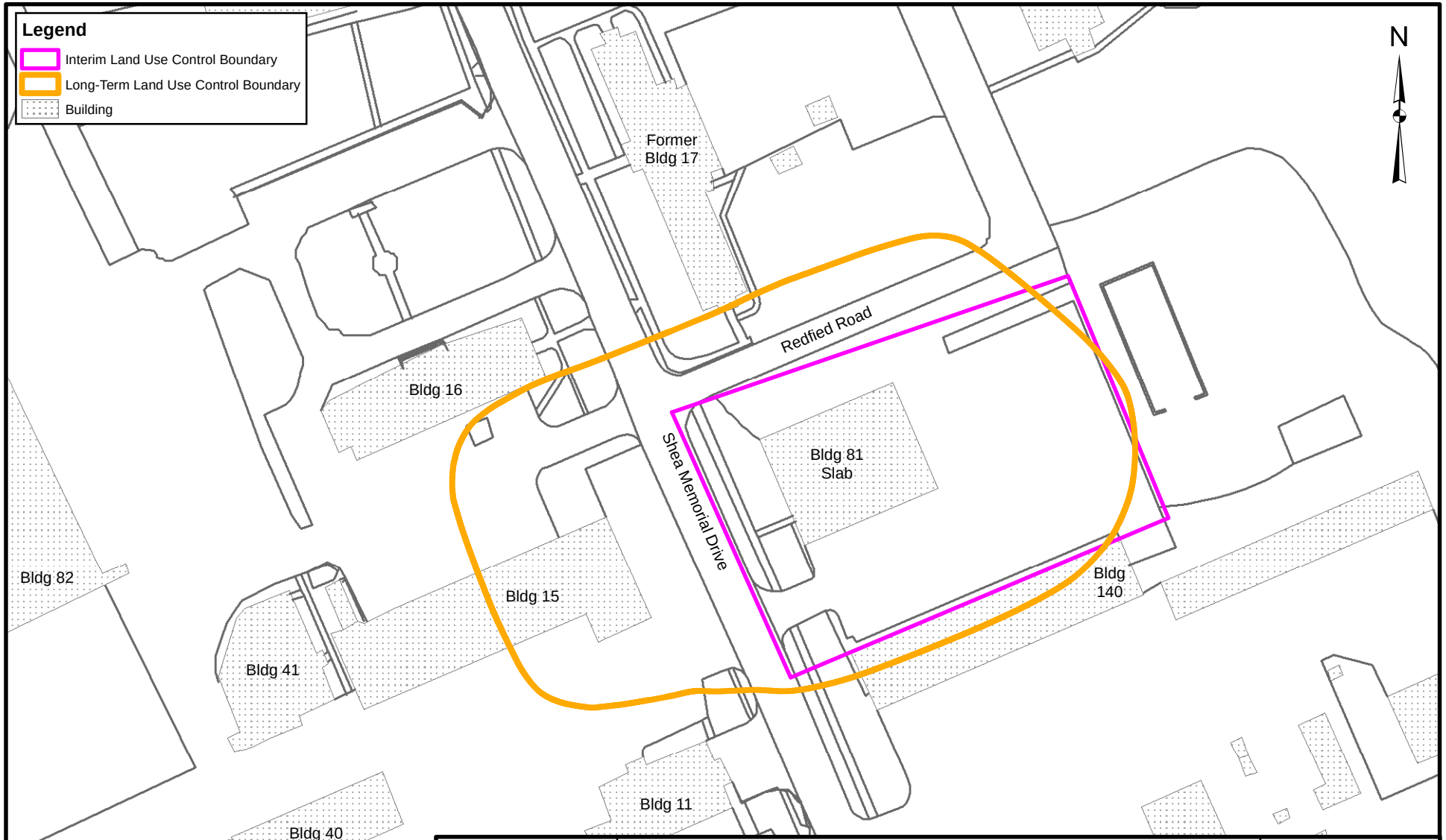
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

ALTERNATIVE G-2
BIO-BARRIERS, MNA, AND LUCs

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_ALT_G-2_R1.DWG	PER SCALE BAR
FIGURE NUMBER	REV / DATE
4-1	1 / 1/2/13

I:\02073\FS.DF.B81\B81_LUC_BOUNDARIES.MXD DWM 12/27/12



TETRA TECH

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

LAND USE CONTROL BOUNDARIES

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

SCALE	
PER SCALE BAR	
FILE	
\.\B81_LUC_BOUNDARIES.MXD	
REV	DATE
0	12/27/12
FIGURE NUMBER	
4-2	

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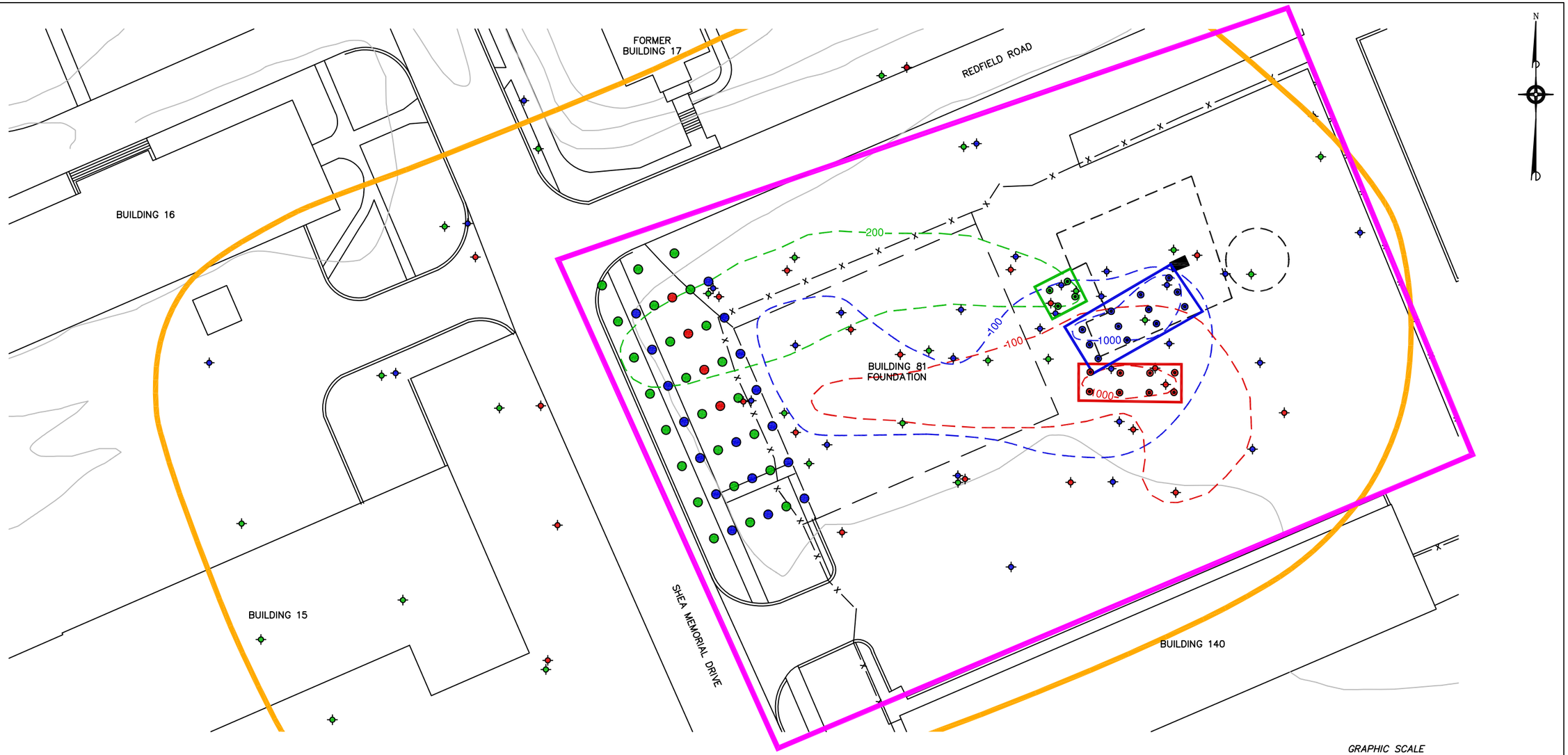


GRAPHIC SCALE
0' 40' 80'

LEGEND:

- APPROXIMATE LOCATION OF TANK GRAVE
- APPROXIMATE LOCATION 1998 EXCAVATION
- FENCELINE
- TOPOGRAPHIC CONTOUR
- INTERIM LAND USE CONTROL (LUC) BOUNDARY (SEE FIGURE 4-2)
- LONG-TERM LAND USE CONTROL (LUC) BOUNDARY (SEE FIGURE 4-2)
- DEEP OVERBURDEN MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL

TETRACHLOROETHENE CONCENTRATION CONTOUR (µg/L)

- DEEP OVERBURDEN
- SHALLOW BEDROCK
- DEEP BEDROCK

BIO-BARRIER WELL

- OVERBURDEN 7-18 bgs
- SHALLOW BEDROCK 18-40 bgs
- SHALLOW & DEEP BEDROCK 18-60 bgs

SOURCE AREA TARGET TREATMENT ZONE (TTZ) AND INJECTION WELLS

- OVERBURDEN 7-18 bgs
- SHALLOW BEDROCK 18-40 bgs
- DEEP BEDROCK 40-60 bgs

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
3. HORIZONTAL COORDINATES REFERENCED TO THE NORTH AMERICAN DATUM (NAD 83), MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, IN UNITS OF FEET.
4. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988, IN UNITS OF FEET.
5. WELL LOCATION COORDINATES FROM 2005 & 2006 SURVEY BY OEST AND 2010 SURVEY BY FEDERICI ASSOCIATES.
6. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
7. PLAN NOT TO BE USED FOR DESIGN.
8. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
10. SHALLOW OVERBURDEN WELLS BASED ON TOP OF SCREEN ≤ 7 FEET BELOW GROUND SURFACE (FT BGS).

TETRA TECH

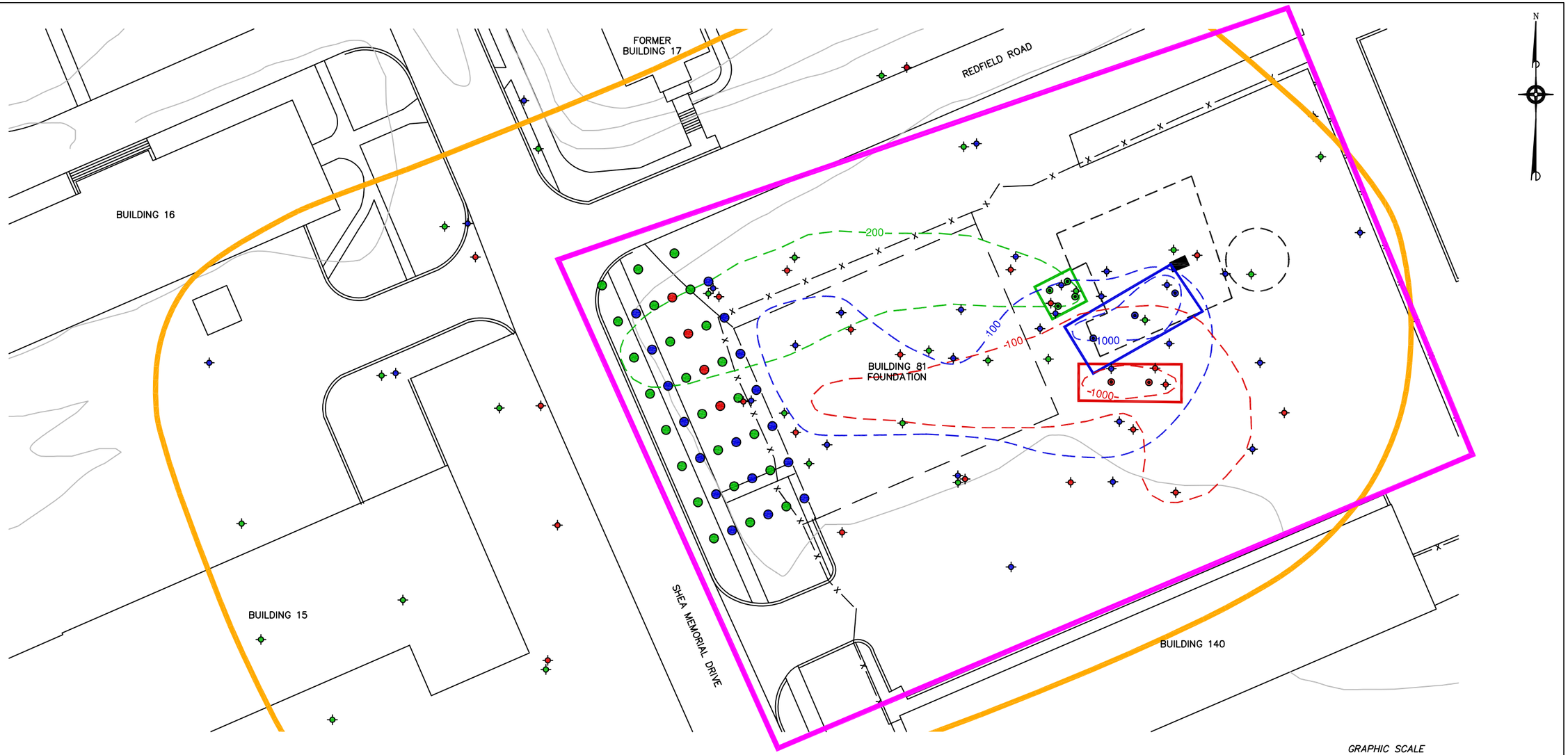
FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

ALTERNATIVE G-3
IN-SITU ENHANCED BIOREMEDIATION, BIO-BARRIERS, MNA, AND LUCs

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_ALT_G-3_R1.DWG	PER SCALE BAR
FIGURE NUMBER 4-3	REV 1 / DATE 1/2/13

I:\02073\FS.DF.B81\B81_ALT_G-4_R1.DWG BOS DWM 1/2/13



GRAPHIC SCALE
0' 40' 80'

LEGEND:

- APPROXIMATE LOCATION OF TANK GRAVE
- APPROXIMATE LOCATION 1998 EXCAVATION
- FENCELINE
- TOPOGRAPHIC CONTOUR
- INTERIM LAND USE CONTROL (LUC) BOUNDARY (SEE FIGURE 4-2)
- LONG-TERM LAND USE CONTROL (LUC) BOUNDARY (SEE FIGURE 4-2)
- DEEP OVERBURDEN MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL

TETRACHLOROETHENE CONCENTRATION CONTOUR (µg/L)

- DEEP OVERBURDEN
- SHALLOW BEDROCK
- DEEP BEDROCK

BIO-BARRIER WELL

- OVERBURDEN 7-18 bgs
- SHALLOW BEDROCK 18-40 bgs
- SHALLOW & DEEP BEDROCK 18-60 bgs

SOURCE AREA TARGET TREATMENT ZONE (TTZ) AND INJECTION WELLS

- OVERBURDEN 7-18 bgs
- SHALLOW BEDROCK 18-40 bgs
- DEEP BEDROCK 40-60 bgs

NOTES:

1. PLAN LOCATIONS AND SHAPEFILES IMPORTED INTO AUTOCAD AND PROVIDED BY ENSR INTERNATIONAL IN MARCH 2005.
2. ORIGINAL SHAPEFILE COORDINATES CONVERTED USING BLUE MARBLE GEOGRAPHIC'S "GEOGRAPHIC CALCULATOR" (VERSION 4.2).
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8. FLOOR PLAN AND DRAIN DETAILS FROM ENGINEERING PLANS OF ARMORY BUILDING FOR MASSACHUSETTS NATIONAL GUARD. DRAWING NUMBER 661895 – 661899.
10. SHALLOW OVERBURDEN WELLS BASED ON TOP OF SCREEN ≤ 7 FEET BELOW GROUND SURFACE (FT BGS).

TETRA TECH

FORMER NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

ALTERNATIVE G-4
IN-SITU CHEMICAL OXIDATION,
BIO-BARRIERS, MNA, AND LUCs

BUILDING 81 SITE
FEASIBILITY STUDY REPORT

FILE	SCALE
I:\..\B81_ALT_G-4_R1.DWG	PER SCALE BAR
FIGURE NUMBER	REV / DATE
4-4	1 / 1/2/13

REFERENCES

REFERENCES

DoD (Department of Defense), 2003. Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-ROD Actions. October.

EA Engineering, 1998. Final Phase II Environmental Baseline Survey Sampling Work Plan. November 1998.

HNUS (Halliburton NUS), 1995. Phase I Initial Site Investigation Report, Building 81 – Former Waste Oil Tank Area, Naval Air Station South Weymouth. April 1995.

Navy, 2006. Navy Environmental Restoration Program Manual. August.

SSTTDC/LNR, 2011. Various communications via email between SSTTDC, LNR, Navy, EPA and MassDEP. October – November, 2011.

Tetra Tech, 1999. Release Abatement Measure Completion and Additional PCE Assessment Report, Building 81 Site, Naval Air Station South Weymouth. May 1999.

Tetra Tech, 2002. In-Situ Chemical Oxidation (ISCO) Pilot Test Performance Assessment, Building 81 Site, Naval Air Station South Weymouth. March 2002.

Tetra Tech (Tetra Tech, Inc.), 2011. Remedial Investigation, Building 81. Former Naval Air Station, South Weymouth. October.

USEPA (United States Environmental Protection Agency), 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (Interim Final).* Office of Emergency Remedial Response, United States Environmental Protection Agency, Washington, DC. October.

USEPA (United States Environmental Protection Agency), 1999. OSWER Directive 9200.4-17P. *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites.* Office of Solid Waste and Emergency Remedial Response, United States Environmental Protection Agency, Washington, DC. April 21, 1999.

Zen, et al., 1983. Bedrock Geologic Map of Massachusetts. United States Geological Survey (USGS).

APPENDIX A

RI REPORT – SELECTED TABLES

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-A01-0608	B81-GP-A02-0608	B81-GP-B01-0507	B81-GP-B02-0507	B81-GP-B03-0508	B81-GP-B04-0608	B81-GP-C01-0507	B81-GP-C02-0507	B81-GP-C03-0507	B81-GP-C04-0507
LOCATION ID				B81-GP-A01	B81-GP-A02	B81-GP-B01	B81-GP-B02	B81-GP-B03	B81-GP-B04	B81-GP-C01	B81-GP-C02	B81-GP-C03	B81-GP-C04
TOP DEPTH				6	6	5	5	5	6	5	5	5	5
BOTTOM DEPTH				8	8	7	7	8	8	7	7	7	7
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/06/06	07/07/06	06/28/06	06/29/06	06/29/06	07/06/06	06/26/06	06/27/06	06/27/06	06/28/06
VOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1,2-TRICHLOROETHANE	5	0.2		0.75 U	1 U	NA	NA	NA	0.75 U	NA	NA	NA	NA
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		0.38 U	1 U	0.38 U	NA	NA	0.38 U	NA	NA	NA	0.38 U
1,2,3-TRICHLOROBENZENE	70	0.72		0.66 U	1 U	NA	NA	NA	0.66 U	NA	NA	NA	NA
1,2,4-TRICHLOROBENZENE	70	0.72		0.62 U	1 U	NA	NA	NA	0.62 U	NA	NA	NA	NA
1,2,4-TRIMETHYLBENZENE		1.2		0.65 U	1 U	NA	NA	NA	0.65 U	NA	NA	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048		1.9 U	1 U	NA	NA	NA	1.9 U	NA	NA	NA	NA
ACETONE		550		3.9 U	77	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U
BENZENE	5	0.35		0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	70	6.1		0.53 U	1 U	0.53 U	0.53 U	0.53 U	0.53 U	0.53 U	0.53 U	0.53 U	0.53 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		0.52 U	1 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U
CHLORODIBROMOMETHANE	80	0.13		0.8 U	1 U	NA	NA	NA	0.8 U	NA	NA	NA	NA
CYCLOHEXANE		1000		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DICHLORODIFLUOROMETHANE		39		1.7 U	5 U	NA	NA	NA	1.7 U	NA	NA	NA	NA
ETHYLBENZENE	700	130		0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE		66		0.61 U	1 U	NA	NA	NA	0.61 U	NA	NA	NA	NA
METHYL CYCLOHEXANE		520		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-BUTYLBENZENE		24		0.5 U	1 U	NA	NA	NA	0.5 U	NA	NA	NA	NA
N-PROPYLBENZENE		24		0.88 U	1 U	NA	NA	NA	0.88 U	NA	NA	NA	NA
O-XYLENE		21		0.61 U	1 U	NA	NA	NA	0.61 U	NA	NA	NA	NA
P-XYLENE		21		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL XYLENES		21		1.5 U	1 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
SEC-BUTYLBENZENE		24		0.5 U	1 U	NA	NA	NA	0.5 U	NA	NA	NA	NA
TETRACHLOROETHENE	5	0.1		0.52 U	1 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U	0.52 U
TOLUENE	1000	72		0.33 U	1 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U
TRICHLOROETHENE	5	0.028	0.73	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	2	0.02		0.51 U	1 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U
TOTAL CHLORINATED ETHENES				0.51 U	1 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U
TOTAL CHLORINATED VOCS				0.8 U	1.1 U	0.66 U	0.69 U	0.69 U	0.8 U	0.69 U	0.69 U	0.69 U	0.66 U
BTEX				0.71 U	1 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-A01-0608	B81-GP-A02-0608	B81-GP-B01-0507	B81-GP-B02-0507	B81-GP-B03-0508	B81-GP-B04-0608	B81-GP-C01-0507	B81-GP-C02-0507	B81-GP-C03-0507	B81-GP-C04-0507
LOCATION ID				B81-GP-A01	B81-GP-A02	B81-GP-B01	B81-GP-B02	B81-GP-B03	B81-GP-B04	B81-GP-C01	B81-GP-C02	B81-GP-C03	B81-GP-C04
TOP DEPTH				6	6	5	5	5	6	5	5	5	5
BOTTOM DEPTH				8	8	7	7	8	8	7	7	7	7
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/06/06	07/07/06	06/28/06	06/29/06	06/29/06	07/06/06	06/26/06	06/27/06	06/27/06	06/28/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1-BIPHENYL		30		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE		0.62		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE		36		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZALDEHYDE		360		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CAPROLACTAM		1800		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DI-N-BUTYL PHTHALATE		360	3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FLUORANTHENE		150		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FLUORENE		24		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE		0.62		0.4 U	1 U	NA	NA	NA	0.4 U	NA	NA	NA	NA
PHENANTHRENE		180		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HIGH MOLECULAR WEIGHT PAHS				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS				0.4 U	1 U	NA	NA	NA	0.4 U	NA	NA	NA	NA
TOTAL PAHS			0.0775	0.4 U	1 U	NA	NA	NA	0.4 U	NA	NA	NA	NA
PESTICIDES/PCBS (UG/L)													
HEPTACHLOR	0.4	0.015		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	5	1.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-A01-0608	B81-GP-A02-0608	B81-GP-B01-0507	B81-GP-B02-0507	B81-GP-B03-0508	B81-GP-B04-0608	B81-GP-C01-0507	B81-GP-C02-0507	B81-GP-C03-0507	B81-GP-C04-0507
LOCATION ID				B81-GP-A01	B81-GP-A02	B81-GP-B01	B81-GP-B02	B81-GP-B03	B81-GP-B04	B81-GP-C01	B81-GP-C02	B81-GP-C03	B81-GP-C04
TOP DEPTH				6	6	5	5	5	6	5	5	5	5
BOTTOM DEPTH				8	8	7	7	8	8	7	7	7	7
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/06/06	07/07/06	06/28/06	06/29/06	06/29/06	07/06/06	06/26/06	06/27/06	06/27/06	06/28/06
METALS (UG/L) (cont.)													
SILVER		18		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CYANIDE	200	73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DISSOLVED METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	5	1.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)													
AMMONIA-N				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLORIDE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE	10	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ORTHOPHOSPHATE-P				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SULFATE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VOLATILE GASES (UG/L)													
METHANE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FIELD (MG/L)													
FERROUS IRON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-D01-0608	B81-GP-D02-0507	B81-GP-D03-0507	B81-GP-D04-0507	B81-GP-E01-0507	B81-GP-E02-0507	B81-GP-F01-0710	B81-GP-G01-1114	B81-GP-G02-0811	B81-GW-MW2S-0906
LOCATION ID				B81-GP-D01	B81-GP-D02	B81-GP-D03	B81-GP-D04	B81-GP-E01	B81-GP-E02	B81-GP-F01	B81-GP-G01	B81-GP-G02	B81-MW-02S
TOP DEPTH				6	5	5	5	5	5	7	11	8	4
BOTTOM DEPTH				8	7	7	7	7	7	10	14	11	13.5
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/26/06	06/30/06	06/30/06	07/05/06	07/07/06	07/07/06	07/13/06	08/02/06	08/02/06	09/21/06
VOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1,2-TRICHLOROETHANE	5	0.2		NA	0.75 U	0.75 U	0.75 U	1 U	1 U	1 U	1 U	1 U	0.1 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		NA	0.38 U	0.38 U	0.38 U	1 U	1 U	1 U	1 U	1 U	NA
1,2,3-TRICHLOROBENZENE	70	0.72		NA	0.66 U	0.66 U	0.66 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-TRICHLOROBENZENE	70	0.72		NA	0.62 U	0.62 U	0.62 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-TRIMETHYLBENZENE		1.2		NA	0.65 U	0.65 U	0.65 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048		NA	1.9 U	1.9 U	1.9 U	1 U	1 U	1 U	1 U	1 U	0.022 U
ACETONE		550		18	3.9 U	3.9 U	3.9 U	1 U	1 U	1 U	1 U	1 U	5 U
BENZENE	5	0.35		0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	1 U	1 U	1 U	0.1 U
CIS-1,2-DICHLOROETHENE	70	6.1		0.53 U	0.53 U	0.53 U	0.53 U	***6.7***	1 U	1 U	1 U	1 U	1 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		0.52 U	0.52 U	0.52 U	0.52 U	***6.7***	1 U	1 U	1 U	1 U	1 U
CHLORODIBROMOMETHANE	80	0.13		NA	0.8 U	0.8 U	0.8 U	1 U	1 U	1 U	1 U	1 U	0.1 U
CYCLOHEXANE		1000		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DICHLORODIFLUOROMETHANE		39		NA	1.7 U	1.7 U	1.7 U	5 U	5 U	5 U	5 U	5 U	1 U
ETHYLBENZENE	700	130		0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	1 U	1 U	1 U	1 U
ISOPROPYLBENZENE		66		NA	0.61 U	0.61 U	0.61 U	1 U	1 U	1 U	1 U	1 U	1 U
METHYL CYCLOHEXANE		520		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-BUTYLBENZENE		24		NA	0.5 U	0.5 U	0.5 U	1 U	1 U	1 U	1 U	1 U	1 U
N-PROPYLBENZENE		24		NA	0.88 U	0.88 U	0.88 U	1 U	1 U	1 U	1 U	1 U	1 U
O-XYLENE		21		NA	0.61 U	0.61 U	0.61 U	1 U	1 U	1 U	1 U	1 U	1 U
P-XYLENE		21		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL XYLENES		21		1.5 U	1.5 U	1.5 U	1.5 U	1 U	1 U	1 U	1 U	1 U	1 U
SEC-BUTYLBENZENE		24		NA	0.5 U	0.5 U	0.5 U	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	5	0.1		0.52 U	0.52 U	0.52 U	0.52 U	1 U	1 U	1 U	1 U	1 U	***0.19***
TOLUENE	1000	72		0.33 U	0.33 U	0.33 U	0.33 U	1 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	5	0.028	0.73	0.5 U	0.5 U	0.5 U	0.5 U	1 U	1 U	1 U	1 U	1 U	0.1 U
VINYL CHLORIDE	2	0.02		0.51 U	0.51 U	0.51 U	0.51 U	1 U	1 U	1 U	1 U	1 U	0.1 U
TOTAL CHLORINATED ETHENES				0.51 U	0.51 U	0.51 U	0.51 U	6.7	1 U	1 U	1 U	1 U	0.19
TOTAL CHLORINATED VOCS				0.69 U	0.8 U	0.8 U	0.8 U	6.7	1.1 U	1.1 U	1.1 U	1.1 U	0.19
BTEX				0.71 U	0.71 U	0.71 U	0.71 U	1 U	1 U	1 U	1 U	1 U	0.78 U

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-D01-0608	B81-GP-D02-0507	B81-GP-D03-0507	B81-GP-D04-0507	B81-GP-E01-0507	B81-GP-E02-0507	B81-GP-F01-0710	B81-GP-G01-1114	B81-GP-G02-0811	B81-GW-MW2S-0906
LOCATION ID				B81-GP-D01	B81-GP-D02	B81-GP-D03	B81-GP-D04	B81-GP-E01	B81-GP-E02	B81-GP-F01	B81-GP-G01	B81-GP-G02	B81-MW-02S
TOP DEPTH				6	5	5	5	5	5	7	11	8	4
BOTTOM DEPTH				8	7	7	7	7	7	10	14	11	13.5
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/26/06	06/30/06	06/30/06	07/05/06	07/07/06	07/07/06	07/13/06	08/02/06	08/02/06	09/21/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1-BIPHENYL		30		NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U
2-METHYLNAPHTHALENE		0.62		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
ACENAPHTHENE		36		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
BENZALDEHYDE		360		NA	NA	NA	NA	NA	NA	NA	NA	NA	10 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	1 U
CAPROLACTAM		1800		NA	NA	NA	NA	NA	NA	NA	NA	NA	22 J
DI-N-BUTYL PHTHALATE		360	3	NA	NA	NA	NA	NA	NA	NA	NA	NA	1 U
FLUORANTHENE		150		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
FLUORENE		24		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
NAPHTHALENE		0.62		NA	0.4 U	***5.7***	0.4 U	1 U	1 U	1 U	1 U	1 U	0.1 U
PHENANTHRENE		180		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
HIGH MOLECULAR WEIGHT PAHS				NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
LOW MOLECULAR WEIGHT PAHS				NA	0.4 U	5.7	0.4 U	1 U	1 U	1 U	1 U	1 U	0.1 U
TOTAL PAHS			0.0775	NA	0.4 U	5.7	0.4 U	1 U	1 U	1 U	1 U	1 U	0.1 U
PESTICIDES/PCBS (UG/L)													
HEPTACHLOR	0.4	0.015		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01 U
METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	1490
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.345 UJ
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.7
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.133 J
CADMIUM	5	1.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	1.33
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	3680
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.03 UJ
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.492 J
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.25 J
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	***1300***
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	2.56
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	834
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	39.7
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	591 J
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.29 UJ

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-D01-0608	B81-GP-D02-0507	B81-GP-D03-0507	B81-GP-D04-0507	B81-GP-E01-0507	B81-GP-E02-0507	B81-GP-F01-0710	B81-GP-G01-1114	B81-GP-G02-0811	B81-GW-MW2S-0906
LOCATION ID				B81-GP-D01	B81-GP-D02	B81-GP-D03	B81-GP-D04	B81-GP-E01	B81-GP-E02	B81-GP-F01	B81-GP-G01	B81-GP-G02	B81-MW-02S
TOP DEPTH				6	5	5	5	5	5	7	11	8	4
BOTTOM DEPTH				8	7	7	7	7	7	10	14	11	13.5
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/26/06	06/30/06	06/30/06	07/05/06	07/07/06	07/07/06	07/13/06	08/02/06	08/02/06	09/21/06
METALS (UG/L) (cont.)													
SILVER		18		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.085 U
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	1650
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.17
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	130
CYANIDE	200	73		NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 UJ
DISSOLVED METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	5	1.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)													
AMMONIA-N				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLORIDE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE	10	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ORTHOPHOSPHATE-P				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SULFATE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VOLATILE GASES (UG/L)													
METHANE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FIELD (MG/L)													
FERROUS IRON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW3S-0906-AVG	B81-GW-MW4S-0906	B81-GW-MW5S-0906	B81-GW-MW8S-1006	B81-GW-MW9S-1006	B81-GW-MW10S-0906	B81-GW-MW11S-0906	B81-GW-MW12S-0906	B81-GW-MW13S-0906
LOCATION ID				B81-MW-03S	B81-MW-04S	B81-MW-05S	B81-MW-08S	B81-MW-09S	B81-MW-10S	B81-MW-11S	B81-MW-12S	B81-MW-13S
TOP DEPTH				3.6	3	4	4	3.9	4.45	3.3	3	2.8
BOTTOM DEPTH				13.1	12.5	12.9	13	12.9	13.45	12.3	12	11.8
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/25/06	09/25/06	09/26/06	10/04/06	10/12/06	09/26/06	09/29/06	09/26/06	09/26/06
VOLATILE ORGANIC COMPOUNDS (UG/L)												
1,1,2-TRICHLOROETHANE	5	0.2		0.1 U	0.1 U	0.1 U	0.1 U	0.5 UJ	0.1 U	0.1 U	0.1 U	0.1 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		NA	NA	NA	0.5 U	120	NA	NA	NA	NA
1,2,3-TRICHLOROBENZENE	70	0.72		1 U	1 U	1 U	0.5 U	0.5 U	1 U	1 U	1 U	1 U
1,2,4-TRICHLOROBENZENE	70	0.72		1 U	1 U	1 U	0.5 U	***0.97***	***1***	1 U	1 U	1 U
1,2,4-TRIMETHYLBENZENE		1.2		1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048		0.0215 U	0.024 U	0.023 U	0.021 U	0.02 U	***0.14 J***	0.026 U	0.023 U	0.021 U
ACETONE		550		5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 UJ	5 U	5 U	5 U
BENZENE	5	0.35		0.1 U	0.1 U	0.1 U	0.1 U	***0.8***	0.16	0.1 U	0.1 U	0.1 U
CIS-1,2-DICHLOROETHENE	70	6.1		1 U	1 U	1 U	0.71	***19***	2	1 U	1 U	1 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		1 U	1 U	1 U	0.71	***19***	2	1 U	1 U	1 U
CHLORODIBROMOMETHANE	80	0.13		0.1 U	0.1 U	0.1 U	0.1 U	0.4 U	0.1 U	0.1 U	0.1 U	***0.36***
CYCLOHEXANE		1000		NA	NA	NA	0.5 U	1.3	NA	NA	NA	NA
DICHLORODIFLUOROMETHANE		39		1 U	1 U	1 U	0.5 U	5.5	1 U	1 U	1 UJ	1 UJ
ETHYLBENZENE	700	130		1 U	1 U	1 U	0.5 U	0.36 J	1 U	1 U	1 U	1 U
ISOPROPYLBENZENE		66		1 U	1 U	1 U	0.5 U	1.9	2	1 U	1 U	1 U
METHYL CYCLOHEXANE		520		NA	NA	NA	0.5 U	1.4	NA	NA	NA	NA
N-BUTYLBENZENE		24		1 U	1 U	1 U	NA	NA	2	1 U	1 U	1 U
N-PROPYLBENZENE		24		1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U
O-XYLENE		21		1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U
P-XYLENE		21		NA	NA	NA	NA	NA	NA	1 U	1 U	1 U
TOTAL XYLENES		21		1 U	1 U	1 U	0.5 U	0.5 U	1 U	1 U	1 U	1 U
SEC-BUTYLBENZENE		24		1 U	1 U	1 U	NA	NA	4	1 U	1 U	1 U
TETRACHLOROETHENE	5	0.1		0.1 U	0.1 U	0.1 U	0.1 U	***100***	***47***	0.1 U	0.1 U	0.1 U
TOLUENE	1000	72		1 U	1 U	1 U	0.5 U	0.5 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	5	0.028	0.73	0.1 U	0.1 U	0.1 U	0.1 U	***13***	***0.8***	0.1 U	0.1 U	0.1 U
VINYL CHLORIDE	2	0.02		0.1 U	0.1 U	0.1 U	0.1 U	0.4 U	0.1 U	0.17 U	0.1 U	0.1 U
TOTAL CHLORINATED ETHENES				0.32 U	0.32 U	0.32 U	0.71	132	49.8	0.34 U	0.32 U	0.32 U
TOTAL CHLORINATED VOCS				0.61 U	0.61 U	0.61 U	0.71 J	258.47 J	50.94 J	0.61 U	0.61 UJ	0.36 J
BTEX				0.78 U	0.78 U	0.78 U	0.4 U	1.16 J	0.16	0.78 U	0.78 U	0.78 U

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID	MCL	PRG	BKG	B81-GW-MW3S-0906-AVG	B81-GW-MW4S-0906	B81-GW-MW5S-0906	B81-GW-MW8S-1006	B81-GW-MW9S-1006	B81-GW-MW10S-0906	B81-GW-MW11S-0906	B81-GW-MW12S-0906	B81-GW-MW13S-0906
LOCATION ID				B81-MW-03S	B81-MW-04S	B81-MW-05S	B81-MW-08S	B81-MW-09S	B81-MW-10S	B81-MW-11S	B81-MW-12S	B81-MW-13S
TOP DEPTH				3.6	3	4	4	3.9	4.45	3.3	3	2.8
BOTTOM DEPTH				13.1	12.5	12.9	13	12.9	13.45	12.3	12	11.8
SAMPLE DATE				09/25/06	09/25/06	09/26/06	10/04/06	10/12/06	09/26/06	09/29/06	09/26/06	09/26/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)												
1,1-BIPHENYL		30		10 U	10 U	10 U	10 U	10 U	2 J	10 U	10 U	10 U
2-METHYLNAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
ACENAPHTHENE		36		0.1 U	0.1 U	0.1 U	0.1 U	0.14	0.17	0.1 U	0.1 U	0.1 U
BENZALDEHYDE		360		10 UJ	10 UJ	10 UJ	20 UJ	20 UJ	10 UJ	10 UJ	10 UJ	10 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U
CAPROLACTAM		1800		71.5 J	71 J	23 J	2 J	10 UJ	10 UJ	54 J	22 J	45 J
DI-N-BUTYL PHTHALATE		360	3	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U
FLUORANTHENE		150		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
FLUORENE		24		0.1 U	0.1 U	0.1 U	0.1 U	0.15	0.34	0.1 U	0.1 U	0.1 U
NAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U	0.1 U	0.44	0.26	0.1	0.1 U	0.1 U
PHENANTHRENE		180		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.23	0.1 U	0.1 U	0.1 U
HIGH MOLECULAR WEIGHT PAHS				0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 UJ	0.1 U	0.1 U	0.1 U
LOW MOLECULAR WEIGHT PAHS				0.1 U	0.1 U	0.1 U	0.1 U	0.73	1 J	0.1	0.1 U	0.1 U
TOTAL PAHS			0.0775	0.1 U	0.1 U	0.1 U	0.1 U	0.73	1 J	0.1	0.1 U	0.1 U
PESTICIDES/PCBS (UG/L)												
HEPTACHLOR	0.4	0.015		0.01 U	0.01 U	0.01 U	0.01 U	***0.024 J***	0.01 U	0.01 U	0.01 U	0.01 U
METALS (UG/L)												
ALUMINUM		3600	15341.35	37.2 J	NA	38.6 J	32 UJ	117	43.2 J	304 J	103	41.6 J
ARSENIC	10	0.045		0.144 UJ	NA	0.111 UJ	0.11 UJ	***0.693 J***	***0.519 J***	0.135 UJ	0.154 UJ	0.1 U
BARIUM	2000	260	181.32	15.8 U	NA	3.1	10.5 J	11.8 U	12.5 U	9.15	35.9	11.4 U
BERYLLIUM	4	7.3	0.77	0.0976 J	NA	0.043 U	0.043 U	0.043 U	0.043 U	0.043 UJ	0.043 U	0.043 U
CADMIUM	5	1.8		0.304 J	NA	0.094 U	0.121 J	0.094 U	0.142 J	***11.3***	1.4	0.094 U
CALCIUM			19187.09	6840	NA	2500	11100	13600	11400	4520	21000	5700
CHROMIUM	100	11	18.1	0.89 UJ	NA	1.33 U	0.832 UJ	0.12 U	1.03 U	0.189 J	1.14 U	0.849 UJ
COBALT		73	8.5	0.196 J	NA	0.0357 J	0.42 J	1.05 UJ	0.181 UJ	0.22 UJ	0.114 UJ	0.059 J
COPPER	1300	150	13.5	0.66 J	NA	0.52 UJ	1.25 J	1.95 J	0.817 J	0.867 J	1.44 J	1.37 J
IRON		1100	44137.52	61.5 J	NA	56.2 J	86.8 J	322 J	107 J	298 J	199 J	39.5 J
LEAD	15	15		0.075 U	NA	0.075 U	0.075 U	0.516 UJ	0.075 U	0.396 UJ	0.0842 J	0.0934 J
MAGNESIUM			14205.47	1850	NA	909	3860 J	1100 J	3130	675	1060	2080
MANGANESE		88	2680.63	***704***	NA	4.63 J	***1580 J***	***759***	***1190***	***111***	10.8	3.81 J
NICKEL		73		1.66	NA	0.786 J	2.04 J	1.37 J	0.999 J	0.975 J	1.26 J	0.94 J
POTASSIUM			6177.62	588	NA	313	775	2460 J	5190	731 J	6720	664
SELENIUM	50	18		0.284 UJ	NA	0.483 UJ	0.45 UJ	0.11 U	0.407 UJ	0.456 UJ	0.504 UJ	0.289 UJ

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW3S-0906-AVG	B81-GW-MW4S-0906	B81-GW-MW5S-0906	B81-GW-MW8S-1006	B81-GW-MW9S-1006	B81-GW-MW10S-0906	B81-GW-MW11S-0906	B81-GW-MW12S-0906	B81-GW-MW13S-0906
LOCATION ID				B81-MW-03S	B81-MW-04S	B81-MW-05S	B81-MW-08S	B81-MW-09S	B81-MW-10S	B81-MW-11S	B81-MW-12S	B81-MW-13S
TOP DEPTH				3.6	3	4	4	3.9	4.45	3.3	3	2.8
BOTTOM DEPTH				13.1	12.5	12.9	13	12.9	13.45	12.3	12	11.8
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/25/06	09/25/06	09/26/06	10/04/06	10/12/06	09/26/06	09/29/06	09/26/06	09/26/06
METALS (UG/L) (cont.)												
SILVER		18		0.085 U	NA	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U
SODIUM			47342.14	8910	NA	2880	15400 J	13400	17800	4890	29300	6490
VANADIUM		3.6	22.6	0.155 J	NA	0.371 J	0.464 J	0.994 J	0.42 J	0.494 J	0.438 J	0.326 J
ZINC		1100	51.7	37 J	NA	4.31 UJ	30.6 J	26 U	37 J	203	13.8 J	21.3 J
CYANIDE	200	73		1.2 UJ	NA	2.6 J	1.2 UJ	4.5 UJ	1.2 J	1.2 U	1.2 UJ	1.2 UJ
DISSOLVED METALS (UG/L)												
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	5	1.8		NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)												
AMMONIA-N				NA	NA	NA	NA	0.2 U	NA	NA	0.45 J	0.23 J
CHLORIDE	250			NA	NA	NA	NA	3.1 J	NA	NA	24	5.4
NITRATE	10	1		NA	NA	NA	NA	0.13 U	NA	NA	NA	NA
NITRATE-N	10			NA	NA	NA	NA	NA	NA	NA	0.19	0.13 U
ORTHOPHOSPHATE-P				NA	NA	NA	NA	0.62 J	NA	NA	0.5 UJ	0.5 UJ
SULFATE	250			NA	NA	NA	NA	12	NA	NA	17	29
TOTAL ORGANIC CARBON				NA	NA	NA	NA	3.3	NA	NA	4.3	1 U
VOLATILE GASES (UG/L)												
METHANE				NA	NA	NA	NA	200	NA	NA	14 U	14 U
FIELD (MG/L)												
FERROUS IRON				NA	NA	NA	NA	0.2	NA	NA	0.03 U	0.03 U

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW15S-0906	B81-GW-MW16S-0906	B81-GW-MW20S-1006-AVG	B81-GW-MW21S-1006	B81-GW-MW24S-1006	B81-GW-MW28S-1006	B81-GW-MW30S-0906-AVG	B81-GW-MW38S-1006
LOCATION ID				B81-MW-15S	B81-MW-16S	B81-MW-20S	B81-MW-21S	B81-MW-24S	B81-MW-28S	B81-MW-30S	B81-MW-38S
TOP DEPTH				3.7	4.1	2.6	4.7	7	4	5	3
BOTTOM DEPTH				15.2	16.6	12.6	14.7	17	14	14	8
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/28/06	09/28/06	10/02/06	10/05/06	10/03/06	10/05/06	09/29/06	10/13/06
VOLATILE ORGANIC COMPOUNDS (UG/L)											
1,1,2-TRICHLOROETHANE	5	0.2		***0.97***	0.15	0.4 U	0.1 U	0.1 U	0.1 UJ	0.1 U	0.5 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		NA	NA	140	1.6	31	0.5 U	NA	16
1,2,3-TRICHLOROBENZENE	70	0.72		1 U	1 U	0.365 J	0.5 U	0.5 U	0.5 U	1 U	0.5 U
1,2,4-TRICHLOROBENZENE	70	0.72		***3***	1 U	***1.65***	0.5 U	0.5 U	0.5 U	1 U	0.5 U
1,2,4-TRIMETHYLBENZENE		1.2		***7***	1 U	NA	NA	NA	NA	1 U	NA
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048		0.022 U	0.021 U	0.024 U	0.021 U	0.022 U	0.023 U	0.021 U	0.02 U
ACETONE		550		5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 UJ
BENZENE	5	0.35		***0.67***	0.1	0.4 U	0.1 U	***0.56***	0.1 UJ	0.1 U	***0.38***
CIS-1,2-DICHLOROETHENE	70	6.1		1 U	3	***18 J***	0.33 J	2.7	0.5 U	1 U	0.46 J
TOTAL 1,2-DICHLOROETHENE	5	6.1		1 U	3	***18 J***	0.33 J	2.7	0.5 U	1 U	0.46 J
CHLORODIBROMOMETHANE	80	0.13		0.4 U	0.1 U	0.4 U	0.1 U	0.1 U	0.1 UJ	0.1 U	0.1 U
CYCLOHEXANE		1000		NA	NA	2.1 J	0.5 U	0.5 U	0.5 U	NA	0.5 U
DICHLORODIFLUOROMETHANE		39		1 U	1 UJ	0.5 U	0.5 U	3.2	0.5 U	1 U	0.5 U
ETHYLBENZENE	700	130		2	1 U	21.5	0.5 U	0.5 U	0.5 U	1 U	0.5 U
ISOPROPYLBENZENE		66		4	1 U	5.75	0.5 U	0.5 U	0.5 U	1 U	0.5 U
METHYL CYCLOHEXANE		520		NA	NA	1.04 J	0.5 U	0.5 U	0.5 U	NA	0.5 U
N-BUTYLBENZENE		24		2	1 U	NA	NA	NA	NA	1 U	NA
N-PROPYLBENZENE		24		2	1 U	NA	NA	NA	NA	1 U	NA
O-XYLENE		21		3	1 U	NA	NA	NA	NA	1 U	NA
P-XYLENE		21		2	1 U	NA	NA	NA	NA	1 U	NA
TOTAL XYLENES		21		5	1 U	***60***	0.5 U	0.5 U	0.5 U	1 U	0.5 U
SEC-BUTYLBENZENE		24		3	1 U	NA	NA	NA	NA	1 U	NA
TETRACHLOROETHENE	5	0.1		***42***	***6***	***67 J***	***19***	***39***	***22***	0.1 U	***5.1***
TOLUENE	1000	72		1 U	1 U	3.8	0.5 U	0.5 U	0.5 U	1 U	0.5 U
TRICHLOROETHENE	5	0.028	0.73	0.4 U	***0.81***	***6.6***	***0.13 J***	***1.3***	0.1 UJ	0.1 U	***0.13***
VINYL CHLORIDE	2	0.02		0.4 U	0.1 U	0.4 U	0.1 U	***0.12***	0.1 UJ	0.16 U	0.5 U
TOTAL CHLORINATED ETHENES				42	9.81	91.6 J	19.46 J	43.12	22 J	0.34 U	5.69 J
TOTAL CHLORINATED VOCS				45.97	9.96 J	233.615 J	21.06 J	77.32	22 J	0.61 U	21.69 J
BTEX				7.67	0.1	85.3	0.4 U	0.56	0.4 UJ	0.78 U	0.38

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW15S-0906	B81-GW-MW16S-0906	B81-GW-MW20S-1006-AVG	B81-GW-MW21S-1006	B81-GW-MW24S-1006	B81-GW-MW28S-1006	B81-GW-MW30S-0906-AVG	B81-GW-MW38S-1006
LOCATION ID				B81-MW-15S	B81-MW-16S	B81-MW-20S	B81-MW-21S	B81-MW-24S	B81-MW-28S	B81-MW-30S	B81-MW-38S
TOP DEPTH				3.7	4.1	2.6	4.7	7	4	5	3
BOTTOM DEPTH				15.2	16.6	12.6	14.7	17	14	14	8
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/28/06	09/28/06	10/02/06	10/05/06	10/03/06	10/05/06	09/29/06	10/13/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)											
1,1-BIPHENYL		30		10 U	10 U	0.85 J	10 U	10 U	10 U	10 U	10 U
2-METHYLNAPHTHALENE		0.62		0.1 U	0.1 U	***12.9 J***	0.1 U	0.1 U	0.1 U	0.16	0.1 U
ACENAPHTHENE		36		0.1 U	0.1 U	0.095	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
BENZALDEHYDE		360		0.9 J	10 UJ	20 UJ	20 UJ	20 UJ	20 UJ	10 UJ	20 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1
CAPROLACTAM		1800		66 J	41 J	10 J	12 J	4 J	3 J	23 J	10 UJ
DI-N-BUTYL PHTHALATE		360	3	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U
FLUORANTHENE		150		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1	0.1 U
FLUORENE		24		0.1 U	0.1 U	0.195	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
NAPHTHALENE		0.62		***57***	0.1 U	***28 J***	0.1 U	0.1 U	0.1 U	0.33	0.1 U
PHENANTHRENE		180		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.13	0.1 U
HIGH MOLECULAR WEIGHT PAHS				0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1	0.1 UJ
LOW MOLECULAR WEIGHT PAHS				57	0.1 U	41.19 J	0.1 U	0.1 U	0.1 U	0.62	0.1 U
TOTAL PAHS			0.0775	57	0.1 U	41.19 J	0.1 U	0.1 U	0.1 U	0.72	0.1 UJ
PESTICIDES/PCBS (UG/L)											
HEPTACHLOR	0.4	0.015		0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U
METALS (UG/L)											
ALUMINUM		3600	15341.35	182 J	40.6 J	1980 J	32 UJ	918 J	112 J	232 J	32 U
ARSENIC	10	0.045		***1.78***	0.6 UJ	***1 J***	0.1 U	0.373 UJ	0.201 UJ	***4.55***	0.1 U
BARIUM	2000	260	181.32	5.68	5.84	37.8 J	2.13	27.3 J	20.6	8.73	3.86 U
BERYLLIUM	4	7.3	0.77	0.043 UJ	0.043 UJ	0.19 J	0.043 U	0.159 J	0.043 U	0.043 UJ	0.043 U
CADMIUM	5	1.8		0.199 J	0.147 J	0.162 J	0.094 U	0.169 J	0.094 U	0.094 U	0.094 U
CALCIUM			19187.09	7750	7440	17200	5770	14300	10900	2780	4560
CHROMIUM	100	11	18.1	0.403 J	0.12 UJ	3.03 UJ	0.451 J	2.34 UJ	0.599 J	0.377 J	0.147 J
COBALT		73	8.5	2.41	2.01 J	0.992 J	0.0664 UJ	5.87	0.117 UJ	3.28 J	0.614 UJ
COPPER	1300	150	13.5	0.649 J	1.51 J	5.64 J	0.538 UJ	3.24 J	0.52 U	0.52 U	0.522 J
IRON		1100	44137.52	***1470 J***	163 J	***2280 J***	30.6 J	***2080 J***	169	***18100 J***	52.2 UJ
LEAD	15	15		0.534 J	0.346 UJ	7.73 J	0.075 U	***18.6 J***	0.289 J	0.528 J	0.075 UJ
MAGNESIUM			14205.47	2240	2230	1010 J	2010	2980 J	1380	928	1700 J
MANGANESE		88	2680.63	***2160***	***2170***	***144 J***	3.72 J	***357 J***	6.88	***1730***	65.9
NICKEL		73		1.92 J	1.78 J	2.02 J	0.448 UJ	2.19 J	0.828 J	0.649 UJ	0.736 J
POTASSIUM			6177.62	578 J	729 J	1590	418 J	3450	3380 J	986 J	612 J
SELENIUM	50	18		0.37 UJ	0.573 UJ	1.01 UJ	0.18 UJ	0.677 UJ	0.268 UJ	0.71 UJ	0.11 U

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW15S-0906	B81-GW-MW16S-0906	B81-GW-MW20S-1006-AVG	B81-GW-MW21S-1006	B81-GW-MW24S-1006	B81-GW-MW28S-1006	B81-GW-MW30S-0906-AVG	B81-GW-MW38S-1006
LOCATION ID				B81-MW-15S	B81-MW-16S	B81-MW-20S	B81-MW-21S	B81-MW-24S	B81-MW-28S	B81-MW-30S	B81-MW-38S
TOP DEPTH				3.7	4.1	2.6	4.7	7	4	5	3
BOTTOM DEPTH				15.2	16.6	12.6	14.7	17	14	14	8
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/28/06	09/28/06	10/02/06	10/05/06	10/03/06	10/05/06	09/29/06	10/13/06
METALS (UG/L) (cont.)											
SILVER		18		0.085 U	0.085 U	0.0748 J	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U
SODIUM			47342.14	3100	13700	2170 J	14100	14200 J	8100	2100	7810
VANADIUM		3.6	22.6	0.497 J	0.434 J	3.51	0.392 J	2.12	0.897 J	0.95 J	0.313 J
ZINC		1100	51.7	11.1	32.8	71.5 J	4.06 UJ	88.7 J	7.36 UJ	9.02 J	3.21 UJ
CYANIDE	200	73		5.9 UJ	4 UJ	2.75 UJ	1.2 UJ	1.2 UJ	1.2 UJ	3 UJ	2.2 UJ
DISSOLVED METALS (UG/L)											
ALUMINUM		3600	15341.35	NA	NA	38.1	NA	32 U	NA	NA	NA
ARSENIC	10	0.045		NA	NA	***0.676 J***	NA	0.205 UJ	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	13.3 J	NA	9.99 J	NA	NA	NA
CADMIUM	5	1.8		NA	NA	0.08 J	NA	0.094 U	NA	NA	NA
CALCIUM			19187.09	NA	NA	16900	NA	14400	NA	NA	NA
COBALT		73	8.5	NA	NA	0.271 UJ	NA	4.52	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	1.7 J	NA	0.97 J	NA	NA	NA
IRON		1100	44137.52	NA	NA	116	NA	141	NA	NA	NA
LEAD	15	15		NA	NA	0.0892 J	NA	0.08 J	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	808	NA	3000	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	***121 J***	NA	***135 J***	NA	NA	NA
NICKEL		73		NA	NA	1.4 J	NA	1.57 J	NA	NA	NA
POTASSIUM			6177.62	NA	NA	1380	NA	3610	NA	NA	NA
SODIUM			47342.14	NA	NA	2140	NA	15400	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	0.64 J	NA	0.652 J	NA	NA	NA
ZINC		1100	51.7	NA	NA	24.7 J	NA	10.4 UJ	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)											
AMMONIA-N				NA	NA	0.255	NA	0.24	NA	NA	NA
CHLORIDE	250			NA	NA	2.8	NA	2.9	NA	NA	NA
NITRATE	10	1		NA	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			NA	NA	0.13 UJ	NA	0.58 J	NA	NA	NA
ORTHOPHOSPHATE-P				NA	NA	0.615 J	NA	0.51 J	NA	NA	NA
SULFATE	250			NA	NA	8.85 U	NA	19 U	NA	NA	NA
TOTAL ORGANIC CARBON				NA	NA	3.35	NA	1.4	NA	NA	NA
VOLATILE GASES (UG/L)											
METHANE				NA	NA	232 J	NA	14 U	NA	NA	NA
FIELD (MG/L)											
FERROUS IRON				NA	NA	0.16 U	NA	0.03 U	NA	NA	NA

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW39S-1006	B81-GW-MW40S-1006	B81-GW-MW42S-1006
LOCATION ID				B81-MW-39S	B81-MW-40S	B81-MW-42S
TOP DEPTH				3	3	4
BOTTOM DEPTH				9	9	9
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/12/06	10/12/06	10/12/06
VOLATILE ORGANIC COMPOUNDS (UG/L)						
1,1,2-TRICHLOROETHANE	5	0.2		0.5 UJ	0.1 U	0.1 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROBENZENE	70	0.72		0.5 U	0.5 U	0.5 U
1,2,4-TRICHLOROBENZENE	70	0.72		0.5 U	0.5 U	0.5 U
1,2,4-TRIMETHYLBENZENE		1.2		NA	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048		0.025 U	0.02 U	0.02 U
ACETONE		550		5 U	5 U	5 U
BENZENE	5	0.35		0.1 U	0.1 U	0.1 U
CIS-1,2-DICHLOROETHENE	70	6.1		0.5 U	0.5 U	0.5 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		0.5 U	0.5 U	0.5 U
CHLORODIBROMOMETHANE	80	0.13		0.1 U	0.1 U	0.1 U
CYCLOHEXANE		1000		0.5 U	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE		39		0.5 U	0.5 U	0.5 U
ETHYLBENZENE	700	130		0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE		66		0.5 U	0.5 U	0.5 U
METHYL CYCLOHEXANE		520		0.5 U	0.5 U	0.5 U
N-BUTYLBENZENE		24		NA	NA	NA
N-PROPYLBENZENE		24		NA	NA	NA
O-XYLENE		21		NA	NA	NA
P-XYLENE		21		NA	NA	NA
TOTAL XYLENES		21		0.5 U	0.5 U	0.5 U
SEC-BUTYLBENZENE		24		NA	NA	NA
TETRACHLOROETHENE	5	0.1		0.1 U	0.1 U	0.1 U
TOLUENE	1000	72		0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	5	0.028	0.73	0.1 U	0.1 U	0.1 U
VINYL CHLORIDE	2	0.02		0.1 U	0.1 U	0.1 U
TOTAL CHLORINATED ETHENES				0.2 U	0.2 U	0.2 U
TOTAL CHLORINATED VOCS				0.36 UJ	0.34 UJ	0.34 UJ
BTEX				0.4 U	0.4 U	0.4 U

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW39S-1006	B81-GW-MW40S-1006	B81-GW-MW42S-1006
LOCATION ID				B81-MW-39S	B81-MW-40S	B81-MW-42S
TOP DEPTH				3	3	4
BOTTOM DEPTH				9	9	9
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/12/06	10/12/06	10/12/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)						
1,1-BIPHENYL		30		10 U	NA	NA
2-METHYLNAPHTHALENE		0.62		0.1 U	NA	NA
ACENAPHTHENE		36		0.1 U	NA	NA
BENZALDEHYDE		360		20 UJ	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		1 U	NA	NA
CAPROLACTAM		1800		10 UJ	NA	NA
DI-N-BUTYL PHTHALATE		360	3	1 U	NA	NA
FLUORANTHENE		150		0.1 U	NA	NA
FLUORENE		24		0.1 U	NA	NA
NAPHTHALENE		0.62		0.1 U	NA	NA
PHENANTHRENE		180		0.1 U	NA	NA
HIGH MOLECULAR WEIGHT PAHS				0.1 U	NA	NA
LOW MOLECULAR WEIGHT PAHS				0.1 U	NA	NA
TOTAL PAHS			0.0775	0.1 U	NA	NA
PESTICIDES/PCBS (UG/L)						
HEPTACHLOR	0.4	0.015		0.01 U	NA	NA
METALS (UG/L)						
ALUMINUM		3600	15341.35	1620	NA	NA
ARSENIC	10	0.045		***0.721 J***	NA	NA
BARIUM	2000	260	181.32	33.5 U	NA	NA
BERYLLIUM	4	7.3	0.77	0.316 J	NA	NA
CADMIUM	5	1.8		0.172 J	NA	NA
CALCIUM			19187.09	9370	NA	NA
CHROMIUM	100	11	18.1	2.11	NA	NA
COBALT		73	8.5	2.33 J	NA	NA
COPPER	1300	150	13.5	4.3 J	NA	NA
IRON		1100	44137.52	***2080 J***	NA	NA
LEAD	15	15		7.96 J	NA	NA
MAGNESIUM			14205.47	2750 J	NA	NA
MANGANESE		88	2680.63	***743***	NA	NA
NICKEL		73		2.97 J	NA	NA
POTASSIUM			6177.62	1700 J	NA	NA
SELENIUM	50	18		0.709 J	NA	NA

TABLE 4-5
SUMMARY OF ANALYTICAL DATA[1] - WATER TABLE INTERVAL GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW39S-1006	B81-GW-MW40S-1006	B81-GW-MW42S-1006
LOCATION ID				B81-MW-39S	B81-MW-40S	B81-MW-42S
TOP DEPTH				3	3	4
BOTTOM DEPTH				9	9	9
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/12/06	10/12/06	10/12/06
METALS (UG/L) (cont.)						
SILVER		18		0.085 U	NA	NA
SODIUM			47342.14	36700	NA	NA
VANADIUM		3.6	22.6	***4.04***	NA	NA
ZINC		1100	51.7	78.5	NA	NA
CYANIDE	200	73		3.1 UJ	NA	NA
DISSOLVED METALS (UG/L)						
ALUMINUM		3600	15341.35	NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA
CADMIUM	5	1.8		NA	NA	NA
CALCIUM			19187.09	NA	NA	NA
COBALT		73	8.5	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA
LEAD	15	15		NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA
NICKEL		73		NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA
SODIUM			47342.14	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)						
AMMONIA-N				0.2 U	NA	NA
CHLORIDE	250			4.9 J	NA	NA
NITRATE	10	1		0.42	NA	NA
NITRATE-N	10			NA	NA	NA
ORTHOPHOSPHATE-P				0.5 UJ	NA	NA
SULFATE	250			24	NA	NA
TOTAL ORGANIC CARBON				2	NA	NA
VOLATILE GASES (UG/L)						
METHANE				14 U	NA	NA
FIELD (MG/L)						
FERROUS IRON				0.51	NA	NA

Notes:

1) This table contains the detect and non-detect results for all parameters detected in at least one sample in this media subgroup. Complete results for all parameters are presented in Appendix F.

PRG - EPA Region IX PRGs for tap water (EPA. 2004) (human health risk based values). The PRG values presented represent a cancer risk level of 10-6 and a hazard quotient of 0.1.

MCL - The lower of the U.S. EPA Maximum Contaminant Level (MCL) for drinking water and the Massachusetts MCL (MMCL).

BKG - NAS South Weymouth Background Value (Stone & Webster, 2002)

Black Background/White print - Primary Criteria Exceeded

Bold Italics (black or gray background) - Secondary Criteria Exceeded

Gray Background - Detected

B or JB - Possible Field Blank Contamination

U - Not Detected

UJ - Detection Limit Approximate

J - Quantitation Limit Approximate

R - Rejected

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-A01-1012	B81-GP-A01-1416	B81-GP-A02-1012	B81-GP-A02-1114-AVG	B81-GP-A03-1012	B81-GP-A03-1315	B81-GP-B01-1012	B81-GP-B01-1518	B81-GP-B02-1012-AVG	B81-GP-B02-1517
LOCATION ID				B81-GP-A01	B81-GP-A01	B81-GP-A02	B81-GP-A02	B81-GP-A03	B81-GP-A03	B81-GP-B01	B81-GP-B01	B81-GP-B02	B81-GP-B02
TOP DEPTH				10	14	10	11	10	13	10	15	10	15
BOTTOM DEPTH				12	16	12	14	12	15	12	18	12	17
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/06/06	07/07/06	07/10/06	07/11/06	07/11/06	07/11/06	06/28/06	06/28/06	06/29/06	06/29/06
VOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1,2-TRICHLOROETHANE	5	0.2		0.75 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	0.75 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		85	100	31	35	1 U	1 U	43	38	87	42
1,2,3-TRICHLOROBENZENE	70	0.72		0.66 U	1 U	1 U	1 U	1 U	1 U	***1***	NA	NA	0.66 U
1,2,4-TRICHLOROBENZENE	70	0.72		0.62 U	1 U	***0.8 J***	1 U	1 U	1 U	NA	NA	NA	0.62 U
1,2,4-TRIMETHYLBENZENE		1.2		0.65 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	0.65 U
1,3,5-TRIMETHYLBENZENE		1.2		0.71 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	0.71 U
ACETONE		550		3.9 U	1 U	5.6	1 U	1 U	1 U	3.9 U	3.9 U	3.9 U	3.9 U
BENZENE	5	0.35		0.5 U	***1.1***	***2.1***	***3.75***	1 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROFORM	80	0.17	3.2	0.35 U	1 U	1 U	1 U	1 U	1 U	0.35 U	0.35 U	0.35 U	0.35 U
CHLOROMETHANE		16		0.58 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	2.2
CIS-1,2-DICHLOROETHENE	70	6.1		1.3	***6.2***	1.7	2.7	1 U	1 U	3.9	2.7	***6.45***	4
TOTAL 1,2-DICHLOROETHENE	5	6.1		1.3	***6.2***	1.7	2.7	1 U	1 U	3.9	2.7	***6.45***	4
CYCLOHEXANE		1000		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DICHLORODIFLUOROMETHANE		39		1.7 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA	1.7 U
ETHYLBENZENE	700	130		0.5 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE		66		0.61 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	0.61 U
METHYL CYCLOHEXANE		520		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METHYL TERT-BUTYL ETHER		6.2		0.71 U	1 U	1 U	1 U	1 U	1 U	0.92	NA	NA	0.71 U
N-BUTYLBENZENE		24		0.5 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	0.5 U
N-PROPYLBENZENE		24		0.88 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	0.88 U
O-XYLENE		21		0.61 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	0.61 U
P-XYLENE		21		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL XYLENES		21		1.5 U	1 U	1 U	1 U	1 U	1 U	1.5 U	1.5 U	1.5 U	1.5 U
SEC-BUTYLBENZENE		24		0.5 U	1.3	1.3	3	1 U	1 U	NA	NA	NA	0.5 U
TETRACHLOROETHENE	5	0.1		***27***	***31***	***6.1***	***11***	1 U	1 U	***43***	***34***	***65***	***34***
TOLUENE	1000	72		0.33 U	1 U	1 U	1 U	1 U	1 U	0.33 U	0.33 U	0.33 U	0.33 U
TRICHLOROETHENE	5	0.028	0.73	***0.63 J***	***1.2***	1 U	1 U	1 U	1 U	***1.2***	***0.89 J***	***2.25***	***1.3***
VINYL CHLORIDE	2	0.02		0.51 U	1 U	1 U	1 U	1 U	1 U	0.51 U	0.51 U	0.51 U	0.51 U
TOTAL CHLORINATED ETHENES				28.93 J	38.4	7.8	13.7	1 U	1 U	48.1	37.59 J	73.7	39.3
TOTAL CHLORINATED VOCS				113.93 J	138.4	39.6 J	48.7	1.1 U	1.1 U	92.1	75.59 J	160.7	83.5
BTEX				0.71 U	1.1	2.1	3.75	1 U	1 U	0.71 U	0.71 U	0.71 U	0.71 U

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-A01-1012	B81-GP-A01-1416	B81-GP-A02-1012	B81-GP-A02-1114-AVG	B81-GP-A03-1012	B81-GP-A03-1315	B81-GP-B01-1012	B81-GP-B01-1518	B81-GP-B02-1012-AVG	B81-GP-B02-1517
LOCATION ID				B81-GP-A01	B81-GP-A01	B81-GP-A02	B81-GP-A02	B81-GP-A03	B81-GP-A03	B81-GP-B01	B81-GP-B01	B81-GP-B02	B81-GP-B02
TOP DEPTH				10	14	10	11	10	13	10	15	10	15
BOTTOM DEPTH				12	16	12	14	12	15	12	18	12	17
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/06/06	07/07/06	07/10/06	07/11/06	07/11/06	07/11/06	06/28/06	06/28/06	06/29/06	06/29/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1-BIPHENYL		30		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)		0.27		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE		0.62		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-METHYLPHENOL		180		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE		36		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CAPROLACTAM		1800		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CARBAZOLE		3.4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZOFURAN		1.2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FLUORENE		24		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE		0.62		0.4 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	0.4 U
PHENANTHRENE		180		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS				0.4 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	0.4 U
TOTAL PAHS			0.0775	0.4 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	0.4 U
PESTICIDES/PCBS (UG/L)													
4,4'-DDT		0.2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIELDRIN		0.0042		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENDRIN ALDEHYDE		1.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HEPTACHLOR	0.4	0.015		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HEPTACHLOR EPOXIDE	0.2	0.0074		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	5	1.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-A01-1012	B81-GP-A01-1416	B81-GP-A02-1012	B81-GP-A02-1114-AVG	B81-GP-A03-1012	B81-GP-A03-1315	B81-GP-B01-1012	B81-GP-B01-1518	B81-GP-B02-1012-AVG	B81-GP-B02-1517
LOCATION ID				B81-GP-A01	B81-GP-A01	B81-GP-A02	B81-GP-A02	B81-GP-A03	B81-GP-A03	B81-GP-B01	B81-GP-B01	B81-GP-B02	B81-GP-B02
TOP DEPTH				10	14	10	11	10	13	10	15	10	15
BOTTOM DEPTH				12	16	12	14	12	15	12	18	12	17
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/06/06	07/07/06	07/10/06	07/11/06	07/11/06	07/11/06	06/28/06	06/28/06	06/29/06	06/29/06
METALS (UG/L) (cont.)													
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CYANIDE	200	73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DISSOLVED METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MERCURY		1.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)													
AMMONIA-N				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLORIDE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE	10	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ORTHOPHOSPHATE-P				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SULFATE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-A01-1012	B81-GP-A01-1416	B81-GP-A02-1012	B81-GP-A02-1114-AVG	B81-GP-A03-1012	B81-GP-A03-1315	B81-GP-B01-1012	B81-GP-B01-1518	B81-GP-B02-1012-AVG	B81-GP-B02-1517
LOCATION ID				B81-GP-A01	B81-GP-A01	B81-GP-A02	B81-GP-A02	B81-GP-A03	B81-GP-A03	B81-GP-B01	B81-GP-B01	B81-GP-B02	B81-GP-B02
TOP DEPTH				10	14	10	11	10	13	10	15	10	15
BOTTOM DEPTH				12	16	12	14	12	15	12	18	12	17
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/06/06	07/07/06	07/10/06	07/11/06	07/11/06	07/11/06	06/28/06	06/28/06	06/29/06	06/29/06
VOLATILE GASES (UG/L)													
METHANE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FIELD (MG/L)													
FERROUS IRON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-B03-1013	B81-GP-B03-1518	B81-GP-B04-1012	B81-GP-B04-12.5-15.5-AVG	B81-GP-C01-1214-AVG	B81-GP-C01-1517	B81-GP-C02-1013-AVG	B81-GP-C02-1518	B81-GP-C03-1214	B81-GP-C03-1417
LOCATION ID				B81-GP-B03	B81-GP-B03	B81-GP-B04	B81-GP-B04	B81-GP-C01	B81-GP-C01	B81-GP-C02	B81-GP-C02	B81-GP-C03	B81-GP-C03
TOP DEPTH				10	15	10	12.5	12	15	10	15	12	14
BOTTOM DEPTH				13	18	12	15.5	14	17	13	18	14	17
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/29/06	06/29/06	07/06/06	07/07/06	06/26/06	06/27/06	06/30/06	06/30/06	06/27/06	06/27/06
VOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1,2-TRICHLOROETHANE	5	0.2		NA	0.75 U	1 U	1 U	NA	NA	0.75 U	0.75 U	NA	NA
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		370	120	280 E	395 E	NA	NA	0.38 U	26	99	150
1,2,3-TRICHLOROBENZENE	70	0.72		NA	0.66 U	1 U	1 U	NA	NA	0.66 U	0.66 U	NA	NA
1,2,4-TRICHLOROBENZENE	70	0.72		NA	0.62 U	1 U	1 U	NA	NA	0.62 U	0.62 U	NA	NA
1,2,4-TRIMETHYLBENZENE		1.2		NA	0.65 U	1 U	1 U	NA	NA	0.65 U	0.65 U	NA	NA
1,3,5-TRIMETHYLBENZENE		1.2		NA	0.71 U	1 U	1 U	NA	NA	0.71 U	0.71 U	NA	NA
ACETONE		550		3.9 U	3.9 U	1 U	1 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U
BENZENE	5	0.35		***6.1***	***1.7***	***2.4***	***8.55***	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROFORM	80	0.17	3.2	0.35 U	0.35 U	1 U	1 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U
CHLOROMETHANE		16		NA	0.58 U	1 U	1 U	NA	NA	0.58 U	0.58 U	NA	NA
CIS-1,2-DICHLOROETHENE	70	6.1		***32***	***22***	***15***	***20***	0.53 U	0.53 U	0.53 U	2.4	5.7	***13***
TOTAL 1,2-DICHLOROETHENE	5	6.1		***32***	***22***	***15***	***20***	0.52 U	0.52 U	0.52 U	2.4	5.7	***13***
CYCLOHEXANE		1000		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DICHLORODIFLUOROMETHANE		39		NA	1.7 U	5 U	5 U	NA	NA	1.7 U	1.7 U	NA	NA
ETHYLBENZENE	700	130		0.5 U	0.5 U	1 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE		66		NA	0.61 U	1 U	1 U	NA	NA	0.61 U	0.61 U	NA	NA
METHYL CYCLOHEXANE		520		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METHYL TERT-BUTYL ETHER		6.2		2.7	1.4	1 U	1 U	NA	NA	0.71 U	0.71 U	NA	4.7
N-BUTYLBENZENE		24		NA	0.5 U	1 U	0.515 J	NA	NA	0.5 U	0.5 U	NA	NA
N-PROPYLBENZENE		24		NA	0.88 U	1 U	1 U	NA	NA	0.88 U	0.88 U	NA	NA
O-XYLENE		21		NA	0.61 U	1 U	1 U	NA	NA	0.61 U	0.61 U	NA	NA
P-XYLENE		21		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL XYLENES		21		1.5 U	1.5 U	1 U	1 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
SEC-BUTYLBENZENE		24		NA	0.5 U	1 U	1.25	NA	NA	0.5 U	0.5 U	NA	NA
TETRACHLOROETHENE	5	0.1		***210***	***180***	***140***	***180***	***1.15***	***1.3***	***87.5***	***90***	***120***	***170***
TOLUENE	1000	72		0.33 U	0.33 U	1 U	1 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U
TRICHLOROETHENE	5	0.028	0.73	***9.2***	***6.6***	***3.9***	***4.9***	0.5 U	0.5 U	0.5 U	0.5 U	***2.2***	***4.2***
VINYL CHLORIDE	2	0.02		***2.8***	***1.1***	1 U	1 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U
TOTAL CHLORINATED ETHENES				324	209.7	158.9	204.9	1.15	1.3	87.5	92.4	127.9	187.2
TOTAL CHLORINATED VOCS				694	459.7	438.9	599.9	1.15	1.3	87.5	118.4	226.9	337.2
BTEX				6.1	1.7	2.4	8.55	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-B03-1013	B81-GP-B03-1518	B81-GP-B04-1012	B81-GP-B04-12.5-15.5-AVG	B81-GP-C01-1214-AVG	B81-GP-C01-1517	B81-GP-C02-1013-AVG	B81-GP-C02-1518	B81-GP-C03-1214	B81-GP-C03-1417
LOCATION ID				B81-GP-B03	B81-GP-B03	B81-GP-B04	B81-GP-B04	B81-GP-C01	B81-GP-C01	B81-GP-C02	B81-GP-C02	B81-GP-C03	B81-GP-C03
TOP DEPTH				10	15	10	12.5	12	15	10	15	12	14
BOTTOM DEPTH				13	18	12	15.5	14	17	13	18	14	17
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/29/06	06/29/06	07/06/06	07/07/06	06/26/06	06/27/06	06/30/06	06/30/06	06/27/06	06/27/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1-BIPHENYL		30		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)		0.27		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE		0.62		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-METHYLPHENOL		180		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE		36		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CAPROLACTAM		1800		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CARBAZOLE		3.4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZOFURAN		1.2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FLUORENE		24		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE		0.62		NA	0.4 U	***1.4***	1 U	NA	NA	0.4 U	0.4 U	NA	NA
PHENANTHRENE		180		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS				NA	0.4 U	1.4	1 U	NA	NA	0.4 U	0.4 U	NA	NA
TOTAL PAHS			0.0775	NA	0.4 U	1.4	1 U	NA	NA	0.4 U	0.4 U	NA	NA
PESTICIDES/PCBS (UG/L)													
4,4'-DDT		0.2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIELDRIN		0.0042		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENDRIN ALDEHYDE		1.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HEPTACHLOR	0.4	0.015		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HEPTACHLOR EPOXIDE	0.2	0.0074		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	5	1.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-B03-1013	B81-GP-B03-1518	B81-GP-B04-1012	B81-GP-B04-12.5-15.5-AVG	B81-GP-C01-1214-AVG	B81-GP-C01-1517	B81-GP-C02-1013-AVG	B81-GP-C02-1518	B81-GP-C03-1214	B81-GP-C03-1417
LOCATION ID				B81-GP-B03	B81-GP-B03	B81-GP-B04	B81-GP-B04	B81-GP-C01	B81-GP-C01	B81-GP-C02	B81-GP-C02	B81-GP-C03	B81-GP-C03
TOP DEPTH				10	15	10	12.5	12	15	10	15	12	14
BOTTOM DEPTH				13	18	12	15.5	14	17	13	18	14	17
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/29/06	06/29/06	07/06/06	07/07/06	06/26/06	06/27/06	06/30/06	06/30/06	06/27/06	06/27/06
METALS (UG/L) (cont.)													
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CYANIDE	200	73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DISSOLVED METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MERCURY		1.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)													
AMMONIA-N				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLORIDE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE	10	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ORTHOPHOSPHATE-P				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SULFATE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-B03-1013	B81-GP-B03-1518	B81-GP-B04-1012	B81-GP-B04-12.5-15.5-AVG	B81-GP-C01-1214-AVG	B81-GP-C01-1517	B81-GP-C02-1013-AVG	B81-GP-C02-1518	B81-GP-C03-1214	B81-GP-C03-1417
LOCATION ID				B81-GP-B03	B81-GP-B03	B81-GP-B04	B81-GP-B04	B81-GP-C01	B81-GP-C01	B81-GP-C02	B81-GP-C02	B81-GP-C03	B81-GP-C03
TOP DEPTH				10	15	10	12.5	12	15	10	15	12	14
BOTTOM DEPTH				13	18	12	15.5	14	17	13	18	14	17
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/29/06	06/29/06	07/06/06	07/07/06	06/26/06	06/27/06	06/30/06	06/30/06	06/27/06	06/27/06
VOLATILE GASES (UG/L)													
METHANE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FIELD (MG/L)													
FERROUS IRON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-C04-1012	B81-GP-C04-1517	B81-GP-D01-1214	B81-GP-D02-1012	B81-GP-D02-1618	B81-GP-D03-1012	B81-GP-D03-1417	B81-GP-D04-1012	B81-GP-D04-15.5-17.5	B81-GP-E01-1012
LOCATION ID				B81-GP-C04	B81-GP-C04	B81-GP-D01	B81-GP-D02	B81-GP-D02	B81-GP-D03	B81-GP-D03	B81-GP-D04	B81-GP-D04	B81-GP-E01
TOP DEPTH				10	15	12	10	16	10	14	10	15.5	10
BOTTOM DEPTH				12	17	14	12	18	12	17	12	17.5	12
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/28/06	06/28/06	06/26/06	06/30/06	06/30/06	07/05/06	07/05/06	07/05/06	07/06/06	07/07/06
VOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1,2-TRICHLOROETHANE	5	0.2		NA	NA	NA	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	1 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		12	190	NA	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	1 U
1,2,3-TRICHLOROBENZENE	70	0.72		NA	NA	NA	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	1 U
1,2,4-TRICHLOROBENZENE	70	0.72		NA	NA	NA	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U	1 U
1,2,4-TRIMETHYLBENZENE		1.2		NA	NA	NA	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	0.65 U	1 U
1,3,5-TRIMETHYLBENZENE		1.2		NA	NA	NA	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	1 U
ACETONE		550		3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	1 U
BENZENE	5	0.35		0.5 U	***1.8***	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U
CHLOROFORM	80	0.17	3.2	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	1 U
CHLOROMETHANE		16		NA	NA	NA	0.58 U	0.58 U	0.58 U	0.58 U	0.58 U	0.58 U	1 U
CIS-1,2-DICHLOROETHENE	70	6.1		1.1	***18***	0.53 U	0.53 U	1.9	1.2	0.53 U	0.53 U	0.53 U	1 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		1.1	***18***	0.52 U	0.52 U	1.9	1.2	0.52 U	0.52 U	0.52 U	1 U
CYCLOHEXANE		1000		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DICHLORODIFLUOROMETHANE		39		NA	NA	NA	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	5 U
ETHYLBENZENE	700	130		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U
ISOPROPYLBENZENE		66		NA	NA	NA	0.61 U	0.61 U	0.61 U	0.61 U	0.61 U	0.61 U	1 U
METHYL CYCLOHEXANE		520		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METHYL TERT-BUTYL ETHER		6.2		NA	3.6	NA	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	1 U
N-BUTYLBENZENE		24		NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U
N-PROPYLBENZENE		24		NA	NA	NA	0.88 U	0.88 U	0.88 U	0.88 U	0.88 U	0.88 U	1 U
O-XYLENE		21		NA	NA	NA	0.61 U	0.61 U	0.61 U	0.61 U	0.61 U	0.61 U	1 U
P-XYLENE		21		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL XYLENES		21		1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1 U
SEC-BUTYLBENZENE		24		NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U
TETRACHLOROETHENE	5	0.1		***22***	***200***	0.52 U	0.52 U	***1.1***	***0.6 J***	0.52 U	0.52 U	0.52 U	1 U
TOLUENE	1000	72		0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U
TRICHLOROETHENE	5	0.028	0.73	0.5 U	***6***	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U
VINYL CHLORIDE	2	0.02		0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	1 U
TOTAL CHLORINATED ETHENES				23.1	224	0.51 U	0.51 U	3	1.8 J	0.51 U	0.51 U	0.51 U	1 U
TOTAL CHLORINATED VOCS				35.1	414	0.69 U	0.8 U	3	1.8 J	0.8 U	0.8 U	0.8 U	1.1 U
BTEX				0.71 U	1.8	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	0.71 U	1 U

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-C04-1012	B81-GP-C04-1517	B81-GP-D01-1214	B81-GP-D02-1012	B81-GP-D02-1618	B81-GP-D03-1012	B81-GP-D03-1417	B81-GP-D04-1012	B81-GP-D04-15.5-17.5	B81-GP-E01-1012
LOCATION ID				B81-GP-C04	B81-GP-C04	B81-GP-D01	B81-GP-D02	B81-GP-D02	B81-GP-D03	B81-GP-D03	B81-GP-D04	B81-GP-D04	B81-GP-E01
TOP DEPTH				10	15	12	10	16	10	14	10	15.5	10
BOTTOM DEPTH				12	17	14	12	18	12	17	12	17.5	12
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/28/06	06/28/06	06/26/06	06/30/06	06/30/06	07/05/06	07/05/06	07/05/06	07/06/06	07/07/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1-BIPHENYL		30		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-OXYBIS(1-CHLOROPROPANE)		0.27		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE		0.62		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-METHYLPHENOL		180		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ACENAPHTHENE		36		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CAPROLACTAM		1800		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CARBAZOLE		3.4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIBENZOFURAN		1.2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FLUORENE		24		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NAPHTHALENE		0.62		NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	1 U
PHENANTHRENE		180		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LOW MOLECULAR WEIGHT PAHS				NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	1 U
TOTAL PAHS			0.0775	NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	1 U
PESTICIDES/PCBS (UG/L)													
4,4'-DDT		0.2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIELDRIN		0.0042		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENDRIN ALDEHYDE		1.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HEPTACHLOR	0.4	0.015		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HEPTACHLOR EPOXIDE	0.2	0.0074		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	5	1.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-C04-1012	B81-GP-C04-1517	B81-GP-D01-1214	B81-GP-D02-1012	B81-GP-D02-1618	B81-GP-D03-1012	B81-GP-D03-1417	B81-GP-D04-1012	B81-GP-D04-15.5-17.5	B81-GP-E01-1012
LOCATION ID				B81-GP-C04	B81-GP-C04	B81-GP-D01	B81-GP-D02	B81-GP-D02	B81-GP-D03	B81-GP-D03	B81-GP-D04	B81-GP-D04	B81-GP-E01
TOP DEPTH				10	15	12	10	16	10	14	10	15.5	10
BOTTOM DEPTH				12	17	14	12	18	12	17	12	17.5	12
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/28/06	06/28/06	06/26/06	06/30/06	06/30/06	07/05/06	07/05/06	07/05/06	07/06/06	07/07/06
METALS (UG/L) (cont.)													
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CYANIDE	200	73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DISSOLVED METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MERCURY		1.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)													
AMMONIA-N				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLORIDE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE	10	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ORTHOPHOSPHATE-P				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SULFATE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-C04-1012	B81-GP-C04-1517	B81-GP-D01-1214	B81-GP-D02-1012	B81-GP-D02-1618	B81-GP-D03-1012	B81-GP-D03-1417	B81-GP-D04-1012	B81-GP-D04-15.5-17.5	B81-GP-E01-1012
LOCATION ID				B81-GP-C04	B81-GP-C04	B81-GP-D01	B81-GP-D02	B81-GP-D02	B81-GP-D03	B81-GP-D03	B81-GP-D04	B81-GP-D04	B81-GP-E01
TOP DEPTH				10	15	12	10	16	10	14	10	15.5	10
BOTTOM DEPTH				12	17	14	12	18	12	17	12	17.5	12
SAMPLE DATE	**MCL**	**PRG**	**BKG**	06/28/06	06/28/06	06/26/06	06/30/06	06/30/06	07/05/06	07/05/06	07/05/06	07/06/06	07/07/06
VOLATILE GASES (UG/L)													
METHANE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FIELD (MG/L)													
FERROUS IRON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-E01-2022	B81-GP-E02-1012	B81-GP-E02-1517	B81-GP-F01-1215	B81-GP-F01-15.5-18.5-AVG	B81-GP-G01-1417-AVG	B81-GP-G01-1720	B81-GP-G02-1114	B81-GP-G02-1416	B81-GW-I1-0906
LOCATION ID				B81-GP-E01	B81-GP-E02	B81-GP-E02	B81-GP-F01	B81-GP-F01	B81-GP-G01	B81-GP-G01	B81-GP-G02	B81-GP-G02	B81-I-01
TOP DEPTH				20	10	15	12	15.5	14	17	11	14	15
BOTTOM DEPTH				22	12	17	15	18.5	17	20	14	16	19
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/10/06	07/07/06	07/10/06	07/13/06	07/13/06	08/02/06	08/02/06	08/02/06	08/02/06	09/19/06
VOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1,2-TRICHLOROETHANE	5	0.2		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
1,2,3-TRICHLOROBENZENE	70	0.72		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-TRICHLOROBENZENE	70	0.72		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-TRIMETHYLBENZENE		1.2		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,3,5-TRIMETHYLBENZENE		1.2		1 U	1 U	1 U	***4.4***	1 U	1 U	1 U	1 U	1 U	1 U
ACETONE		550		1 U	7.6	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5 U
BENZENE	5	0.35		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	80	0.17	3.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	***2.6***
CHLOROMETHANE		16		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	70	6.1		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2
TOTAL 1,2-DICHLOROETHENE	5	6.1		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2
CYCLOHEXANE		1000		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DICHLORODIFLUOROMETHANE		39		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1 U
ETHYLBENZENE	700	130		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
ISOPROPYLBENZENE		66		1 U	1 U	1 U	1.3	1 U	1 U	1 U	1 U	1 U	1 U
METHYL CYCLOHEXANE		520		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METHYL TERT-BUTYL ETHER		6.2		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
N-BUTYLBENZENE		24		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
N-PROPYLBENZENE		24		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
O-XYLENE		21		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
P-XYLENE		21		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL XYLENES		21		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
SEC-BUTYLBENZENE		24		1 U	1.1	1 U	2.7	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	5	0.1		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	***35***
TOLUENE	1000	72		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	5	0.028	0.73	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	***0.9 J***
VINYL CHLORIDE	2	0.02		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TOTAL CHLORINATED ETHENES				1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	37.9 J
TOTAL CHLORINATED VOCS				1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	40.5 J
BTEX				1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-E01-2022	B81-GP-E02-1012	B81-GP-E02-1517	B81-GP-F01-1215	B81-GP-F01-15.5-18.5-AVG	B81-GP-G01-1417-AVG	B81-GP-G01-1720	B81-GP-G02-1114	B81-GP-G02-1416	B81-GW-I1-0906
LOCATION ID				B81-GP-E01	B81-GP-E02	B81-GP-E02	B81-GP-F01	B81-GP-F01	B81-GP-G01	B81-GP-G01	B81-GP-G02	B81-GP-G02	B81-I-01
TOP DEPTH				20	10	15	12	15.5	14	17	11	14	15
BOTTOM DEPTH				22	12	17	15	18.5	17	20	14	16	19
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/10/06	07/07/06	07/10/06	07/13/06	07/13/06	08/02/06	08/02/06	08/02/06	08/02/06	09/19/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1-BIPHENYL		30		NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U
2,2'-OXYBIS(1-CHLOROPROPANE)		0.27		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
2-METHYLNAPHTHALENE		0.62		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
2-METHYLPHENOL		180		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 UJ
ACENAPHTHENE		36		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	1 U
CAPROLACTAM		1800		NA	NA	NA	NA	NA	NA	NA	NA	NA	10 UJ
CARBAZOLE		3.4		NA	NA	NA	NA	NA	NA	NA	NA	NA	1 U
DIBENZOFURAN		1.2		NA	NA	NA	NA	NA	NA	NA	NA	NA	1 U
FLUORENE		24		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
NAPHTHALENE		0.62		1 U	1 U	1 U	***1.1***	1 U	1 U	1 U	1 U	1 U	0.1 U
PHENANTHRENE		180		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.1 U
LOW MOLECULAR WEIGHT PAHS				1 U	1 U	1 U	1.1	1 U	1 U	1 U	1 U	1 U	0.1 U
TOTAL PAHS			0.0775	1 U	1 U	1 U	1.1	1 U	1 U	1 U	1 U	1 U	0.1 U
PESTICIDES/PCBS (UG/L)													
4,4'-DDT		0.2		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.02 U
DIELDRIN		0.0042		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.004 U
ENDRIN ALDEHYDE		1.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.02 U
HEPTACHLOR	0.4	0.015		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01 U
HEPTACHLOR EPOXIDE	0.2	0.0074		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01 U
METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	32 U
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.106 UJ
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.8
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.043 U
CADMIUM	5	1.8		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.094 U
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	11600
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.894 UJ
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.269 J
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.529 J
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	***4770***
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	4410

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-E01-2022	B81-GP-E02-1012	B81-GP-E02-1517	B81-GP-F01-1215	B81-GP-F01-15.5-18.5-AVG	B81-GP-G01-1417-AVG	B81-GP-G01-1720	B81-GP-G02-1114	B81-GP-G02-1416	B81-GW-I1-0906
LOCATION ID				B81-GP-E01	B81-GP-E02	B81-GP-E02	B81-GP-F01	B81-GP-F01	B81-GP-G01	B81-GP-G01	B81-GP-G02	B81-GP-G02	B81-I-01
TOP DEPTH				20	10	15	12	15.5	14	17	11	14	15
BOTTOM DEPTH				22	12	17	15	18.5	17	20	14	16	19
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/10/06	07/07/06	07/10/06	07/13/06	07/13/06	08/02/06	08/02/06	08/02/06	08/02/06	09/19/06
METALS (UG/L) (cont.)													
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	49.3
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.949 J
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	728 J
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.481 UJ
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	19900
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.195 J
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	300
CYANIDE	200	73		NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4 UJ
DISSOLVED METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MERCURY		1.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)													
AMMONIA-N				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLORIDE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE	10	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ORTHOPHOSPHATE-P				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SULFATE	250			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GP-E01-2022	B81-GP-E02-1012	B81-GP-E02-1517	B81-GP-F01-1215	B81-GP-F01-15.5-18.5-AVG	B81-GP-G01-1417-AVG	B81-GP-G01-1720	B81-GP-G02-1114	B81-GP-G02-1416	B81-GW-I1-0906
LOCATION ID				B81-GP-E01	B81-GP-E02	B81-GP-E02	B81-GP-F01	B81-GP-F01	B81-GP-G01	B81-GP-G01	B81-GP-G02	B81-GP-G02	B81-I-01
TOP DEPTH				20	10	15	12	15.5	14	17	11	14	15
BOTTOM DEPTH				22	12	17	15	18.5	17	20	14	16	19
SAMPLE DATE	**MCL**	**PRG**	**BKG**	07/10/06	07/07/06	07/10/06	07/13/06	07/13/06	08/02/06	08/02/06	08/02/06	08/02/06	09/19/06
VOLATILE GASES (UG/L)													
METHANE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FIELD (MG/L)													
FERROUS IRON				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-I3-0906	B81-GW-I6-0906	B81-GW-I9-0906	B81-GW-I12-0906	B81-GW-I13-0906-AVG	B81-GW-I15-0906	B81-GW-I17-0906	B81-GW-I19-0906	B81-GW-MW13D-1006	B81-GW-MW23S-1006
LOCATION ID				B81-I-03	B81-I-06	B81-I-09	B81-I-12	B81-I-13	B81-I-15	B81-I-17	B81-I-19	B81-MW-13D	B81-MW-23S
TOP DEPTH				15	11.5	15	14.5	14.5	15	12	12	15.4	9
BOTTOM DEPTH				19	15.5	19	17.5	17.5	18	15	15	17.4	14
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/21/06	09/27/06	09/27/06	09/26/06	09/28/06	09/20/06	09/25/06	09/26/06	10/02/06	10/04/06
VOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1,2-TRICHLOROETHANE	5	0.2		0.1 U	0.3 UJ	0.4 U	1 U	***0.36***	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	1.8
1,2,3-TRICHLOROBENZENE	70	0.72		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.5 U
1,2,4-TRICHLOROBENZENE	70	0.72		1 U	1 U	1 U	***4***	1 U	1 U	1 U	1 U	0.5 U	0.5 U
1,2,4-TRIMETHYLBENZENE		1.2		1 U	1 U	1 U	***2***	1 U	1 U	1 U	1 U	NA	NA
1,3,5-TRIMETHYLBENZENE		1.2		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA
ACETONE		550		5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 UJ	5 UJ	5 UJ
BENZENE	5	0.35		0.13	0.3 UJ	0.4 U	***12***	0.3	0.1 U	0.1 U	0.24	0.1 U	0.13
CHLOROFORM	80	0.17	3.2	0.1 U	0.72 UJ	0.93 U	1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.21 UJ
CHLOROMETHANE		16		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	70	6.1		5	2	4	***100***	***7.5***	1 U	1 U	1 U	0.5 U	0.42 J
TOTAL 1,2-DICHLOROETHENE	5	6.1		5	2	4	***100***	***7.5***	1 U	1 U	1 U	0.5 U	0.42 J
CYCLOHEXANE		1000		NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE		39		1 U	1 U	1 UJ	1 UJ	1 UJ	1 U	1 U	1 U	0.5 U	0.5 U
ETHYLBENZENE	700	130		1 U	1 U	1 U	12	1 U	1 U	1 U	1 U	0.5 U	0.5 U
ISOPROPYLBENZENE		66		1 U	1 U	1 U	12	1 U	1 U	1 U	1 U	0.5 U	0.5 U
METHYL CYCLOHEXANE		520		NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	0.5 U
METHYL TERT-BUTYL ETHER		6.2		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.5 U
N-BUTYLBENZENE		24		1 U	1 U	1 U	7	1 U	1 U	1 U	1 U	NA	NA
N-PROPYLBENZENE		24		1 U	1 U	1 U	7	1 U	1 U	1 U	1 U	NA	NA
O-XYLENE		21		1 U	1 U	1 U	5	1 U	1 U	1 U	1 U	NA	NA
P-XYLENE		21		NA	1 U	1 U	2	1 U	NA	NA	NA	NA	NA
TOTAL XYLENES		21		1 U	1 U	1 U	7	1 U	1 U	1 U	1 U	0.5 U	0.5 U
SEC-BUTYLBENZENE		24		1 U	1 U	1 U	8	2	1 U	1 U	1 U	NA	NA
TETRACHLOROETHENE	5	0.1		***39***	***78 J***	***86***	***280***	***25 J***	***1.5***	0.1 U	0.1 U	0.1 U	***4.1***
TOLUENE	1000	72		1 U	1 U	1 U	2	1 U	1 U	1 U	1 U	0.5 U	0.5 U
TRICHLOROETHENE	5	0.028	0.73	***0.87***	***0.96 J***	***2.4***	***20***	***1.05***	0.1 U	0.1 U	0.1 U	0.1 U	***0.27***
VINYL CHLORIDE	2	0.02		0.1 U	0.3 UJ	0.4 U	***11***	0.1 U	0.1 U	0.1 U	***0.13***	0.1 U	0.1 U
TOTAL CHLORINATED ETHENES				44.87	80.96 J	92.4	411	33.55 J	1.5	0.32 U	0.13	0.2 U	4.79 J
TOTAL CHLORINATED VOCS				44.87	80.96 J	92.4 J	415 J	33.91 J	1.5	0.61 U	0.13	0.33 UJ	6.59 J
BTEX				0.13	0.82 UJ	0.85 U	33	0.3	0.78 U	0.78 U	0.24	0.4 U	0.13

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-I3-0906	B81-GW-I6-0906	B81-GW-I9-0906	B81-GW-I12-0906	B81-GW-I13-0906-AVG	B81-GW-I15-0906	B81-GW-I17-0906	B81-GW-I19-0906	B81-GW-MW13D-1006	B81-GW-MW23S-1006
LOCATION ID				B81-I-03	B81-I-06	B81-I-09	B81-I-12	B81-I-13	B81-I-15	B81-I-17	B81-I-19	B81-MW-13D	B81-MW-23S
TOP DEPTH				15	11.5	15	14.5	14.5	15	12	12	15.4	9
BOTTOM DEPTH				19	15.5	19	17.5	17.5	18	15	15	17.4	14
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/21/06	09/27/06	09/27/06	09/26/06	09/28/06	09/20/06	09/25/06	09/26/06	10/02/06	10/04/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1-BIPHENYL		30		10 U	10 U	0.2 J	6 J	2.9 J	10 U	10 U	10 U	10 U	10 U
2,2'-OXYBIS(1-CHLOROPROPANE)		0.27		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2-METHYLNAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U	***8.7***	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2-METHYLPHENOL		180		0.1 UJ	0.1 UJ	0.1 UJ	0.17 J	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 U	0.1 U
ACENAPHTHENE		36		0.1 U	0.1 U	0.1 U	0.84	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2	1 U
CAPROLACTAM		1800		240 J	24 J	3 J	13 J	7 J	33 J	6 J	4 J	10 UJ	18 J
CARBAZOLE		3.4		1 U	1 U	1 U	1	1 U	1 U	1 U	1 U	1 U	1 U
DIBENZOFURAN		1.2		1 U	1 U	1 U	1	1 U	1 U	1 U	1 U	1 U	1 U
FLUORENE		24		0.1 U	0.1 U	0.1 U	1.4	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
NAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U	***34***	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PHENANTHRENE		180		0.1 U	0.1 U	0.1 U	0.52	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
LOW MOLECULAR WEIGHT PAHS				0.1 U	0.1 U	0.1 U	45.46	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL PAHS			0.0775	0.1 U	0.1 U	0.1 U	45.46	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PESTICIDES/PCBS (UG/L)													
4,4'-DDT		0.2		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
DIELDRIN		0.0042		0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
ENDRIN ALDEHYDE		1.1		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
HEPTACHLOR	0.4	0.015		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
HEPTACHLOR EPOXIDE	0.2	0.0074		***0.01 J***	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
METALS (UG/L)													
ALUMINUM		3600	15341.35	497	32 U	32 U	32 U	32 U	36.8 J	32 U	32 U	83.9 J	508 J
ARSENIC	10	0.045		0.42 UJ	0.148 UJ	0.1 U	***2.66***	0.567 UJ	***1.1***	0.179 UJ	***4.4***	0.178 UJ	0.433 UJ
BARIUM	2000	260	181.32	3.38	2.99 U	35.7	19.1 U	7.68	9.18	6.95 U	7.19 U	28.8 J	11.7 J
BERYLLIUM	4	7.3	0.77	0.215 J	0.043 U	0.043 U	0.043 U	0.043 UJ	0.043 U	0.043 U	0.043 U	0.043 U	0.0501 J
CADMIUM	5	1.8		0.109 J	0.094 U	0.094 U	0.094 U	0.094 U	0.094 U	0.094 U	0.094 U	***1.86***	0.0957 J
CALCIUM			19187.09	12500	9760	29600	16200	13600	7080	5710	2810	26300	10700
CHROMIUM	100	11	18.1	4.58 UJ	0.671 U	0.776 UJ	0.614 UJ	0.12 UJ	0.863 UJ	0.605 UJ	0.813 UJ	1.16 UJ	1.32 UJ
COBALT		73	8.5	1.22 J	0.361 J	0.35 UJ	0.208 UJ	0.241 UJ	0.252 UJ	1.08 J	0.0796 UJ	0.358 UJ	0.655 J
COPPER	1300	150	13.5	2.76 J	0.52 UJ	0.63 J	0.52 UJ	0.438 J	0.52 U	0.52 UJ	0.52 UJ	1.83 J	2.4 J
IRON		1100	44137.52	***35200***	***4650 J***	***7470 J***	***28200 J***	***11600 J***	***28000***	***11900 J***	***35000 J***	291 J	688 J
LEAD	15	15		2.83	0.133 J	0.143 J	0.145 J	0.0896 UJ	0.194 J	0.075 U	0.075 U	0.318 J	1.78 J
MAGNESIUM			14205.47	4640	3220	3020	3820	5500	2650	2010	905	1400 J	4260 J

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-I3-0906	B81-GW-I6-0906	B81-GW-I9-0906	B81-GW-I12-0906	B81-GW-I13-0906-AVG	B81-GW-I15-0906	B81-GW-I17-0906	B81-GW-I19-0906	B81-GW-MW13D-1006	B81-GW-MW23S-1006
LOCATION ID				B81-I-03	B81-I-06	B81-I-09	B81-I-12	B81-I-13	B81-I-15	B81-I-17	B81-I-19	B81-MW-13D	B81-MW-23S
TOP DEPTH				15	11.5	15	14.5	14.5	15	12	12	15.4	9
BOTTOM DEPTH				19	15.5	19	17.5	17.5	18	15	15	17.4	14
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/21/06	09/27/06	09/27/06	09/26/06	09/28/06	09/20/06	09/25/06	09/26/06	10/02/06	10/04/06
METALS (UG/L) (cont.)													
MANGANESE		88	2680.63	***433***	***110***	***343***	***3230***	***993***	***2410***	***909***	***1870***	23.3 J	***110 J***
NICKEL		73		1.95 UJ	0.722 J	1.28 UJ	1.28 UJ	0.964 UJ	0.636 UJ	0.775 J	0.262 UJ	3.85 J	1.75 J
POTASSIUM			6177.62	1170 J	1010	7090	3300	1080 J	4000 J	1220	2570	1870	1580
SELENIUM	50	18		0.484 UJ	0.597 UJ	0.46 UJ	0.701 UJ	0.676 UJ	0.11 U	0.573 UJ	0.383 UJ	0.585 UJ	0.444 UJ
SODIUM			47342.14	16000	22100	13300	7720	9330	4250	9050	3680	4280 J	15300 J
VANADIUM		3.6	22.6	0.877 J	0.262 J	0.049 U	0.209 J	0.049 U	0.17 J	0.049 U	0.255 J	0.806 J	3.16
ZINC		1100	51.7	258	***4510 J***	***1120 J***	135 J	668	108	***2320 J***	171 J	331 J	21.4 J
CYANIDE	200	73		2.4 UJ	1.2 UJ	4.3 J	1.2 UJ	2.5 UJ	2.8 UJ	8.6 J	2.1 J	1.4 UJ	1.2 UJ
DISSOLVED METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	32 U
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.99 J
BERYLLIUM	4	7.3	0.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.043 U
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	10800
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.844 UJ
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.85 J
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.981 J
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	70.7
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.075 U
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	4300
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	76.2 J
MERCURY		1.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0317 J
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	1.85 J
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	1470
SELENIUM	50	18		NA	NA	NA	NA	NA	NA	NA	NA	NA	0.611 UJ
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	15500
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.73 J
MISCELLANEOUS PARAMETERS (MG/L)													
AMMONIA-N				NA	0.21	0.36 J	0.62 J	0.2 U	NA	NA	NA	0.2 U	NA
CHLORIDE	250			NA	2.8	3.7	4.2	3.4	NA	NA	NA	6.8	NA
NITRATE	10	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			NA	0.34	0.13 U	0.13 U	0.13 U	NA	NA	NA	0.13 U	NA
ORTHOPHOSPHATE-P				NA	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	NA	NA	NA	0.5 U	NA
SULFATE	250			NA	24 J	22	8	8.3 J	NA	NA	NA	9.2 U	NA
TOTAL ORGANIC CARBON				NA	4.1	2.1	8	2.2	NA	NA	NA	1.6	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-I3-0906	B81-GW-I6-0906	B81-GW-I9-0906	B81-GW-I12-0906	B81-GW-I13-0906-AVG	B81-GW-I15-0906	B81-GW-I17-0906	B81-GW-I19-0906	B81-GW-MW13D-1006	B81-GW-MW23S-1006
LOCATION ID				B81-I-03	B81-I-06	B81-I-09	B81-I-12	B81-I-13	B81-I-15	B81-I-17	B81-I-19	B81-MW-13D	B81-MW-23S
TOP DEPTH				15	11.5	15	14.5	14.5	15	12	12	15.4	9
BOTTOM DEPTH				19	15.5	19	17.5	17.5	18	15	15	17.4	14
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/21/06	09/27/06	09/27/06	09/26/06	09/28/06	09/20/06	09/25/06	09/26/06	10/02/06	10/04/06
VOLATILE GASES (UG/L)													
METHANE				NA	14 U	94	1000	440	NA	NA	NA	14 U	NA
FIELD (MG/L)													
FERROUS IRON				NA	2.39	5.7	20.1 J	7.15 J	NA	NA	NA	0.12 U	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW29S-1006	B81-GW-MW31S-1006	B81-GW-MW32S-1006	B81-GW-MW33S-1006	B81-GW-MW38I-1006	B81-GW-MW39I-1006	B81-GW-MW40I-1006	B81-GW-MW42I-1006
LOCATION ID				B81-MW-29S	B81-MW-31S	B81-MW-32S	B81-MW-33S	B81-MW-38I	B81-MW-39I	B81-MW-40I	B81-MW-42I
TOP DEPTH				7	8	9	8	10.5	11	12.5	11
BOTTOM DEPTH				17	18	19	18	15.5	16	17.5	16
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/03/06	10/13/06	10/12/06	10/12/06	10/17/06	10/12/06	10/16/06	10/17/06
VOLATILE ORGANIC COMPOUNDS (UG/L)											
1,1,2-TRICHLOROETHANE	5	0.2		0.1 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		8.7	0.44 J	440	340	120	0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROBENZENE	70	0.72		0.5 U	0.5 U	0.5 U	0.35 J	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRICHLOROBENZENE	70	0.72		0.5 U	0.5 U	***1.3***	***1.4***	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRIMETHYLBENZENE		1.2		NA	NA	NA	NA	NA	NA	NA	NA
1,3,5-TRIMETHYLBENZENE		1.2		NA	NA	NA	NA	NA	NA	NA	NA
ACETONE		550		5 UJ	5 UJ	5 U	39 U	5 UJ	5 UJ	5 UJ	5 UJ
BENZENE	5	0.35		0.1 U	0.1 U	***7.5***	***5.1***	***1.6 J***	0.1 U	0.1 U	0.1 U
CHLOROFORM	80	0.17	3.2	0.1 UJ	0.1 U	0.4 U	0.4 U	0.3 U	0.12 U	0.1 U	0.14 U
CHLOROMETHANE		16		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	70	6.1		2.8	0.5 U	***35***	***33***	4.2	0.5 U	0.5 U	0.5 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		2.8	0.5 U	***35 J***	***33 J***	4.2	0.5 U	0.5 U	0.5 U
CYCLOHEXANE		1000		0.5 U	0.5 U	2.7	2.6	0.5 U	0.5 U	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE		39		0.5 U	0.5 U	***56 J***	***42 J***	3.4	0.5 U	0.5 U	0.5 U
ETHYLBENZENE	700	130		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE		66		0.5 U	0.5 U	0.72	1	0.5 U	0.5 U	0.5 U	0.5 U
METHYL CYCLOHEXANE		520		0.5 U	0.5 U	2.1	2	0.5 U	0.5 U	0.5 U	0.5 U
METHYL TERT-BUTYL ETHER		6.2		0.5 U	0.5 U	2.2	1.5	0.5 U	1.1	0.87	0.4 J
N-BUTYLBENZENE		24		NA	NA	NA	NA	NA	NA	NA	NA
N-PROPYLBENZENE		24		NA	NA	NA	NA	NA	NA	NA	NA
O-XYLENE		21		NA	NA	NA	NA	NA	NA	NA	NA
P-XYLENE		21		NA	NA	NA	NA	NA	NA	NA	NA
TOTAL XYLENES		21		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
SEC-BUTYLBENZENE		24		NA	NA	NA	NA	NA	NA	NA	NA
TETRACHLOROETHENE	5	0.1		***23***	***0.78***	***360***	***300***	***66***	0.1 U	0.1 U	0.1 U
TOLUENE	1000	72		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	5	0.028	0.73	***0.9***	***0.33***	***12***	***11***	***0.85***	0.1 U	0.1 U	***0.59***
VINYL CHLORIDE	2	0.02		0.1 U	0.1 U	***4.1***	***3.1***	0.3 U	0.1 U	0.1 U	0.1 U
TOTAL CHLORINATED ETHENES				26.7	1.11	411.1 J	347.1 J	71.05	0.2 U	0.2 U	0.59
TOTAL CHLORINATED VOCS				35.4 J	1.55 J	908.4 J	730.85 J	194.45	0.35 U	0.35 U	0.59
BTEX				0.4 U	0.4 U	7.5	5.1	1.6 J	0.4 U	0.4 U	0.4 U

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW29S-1006	B81-GW-MW31S-1006	B81-GW-MW32S-1006	B81-GW-MW33S-1006	B81-GW-MW38I-1006	B81-GW-MW39I-1006	B81-GW-MW40I-1006	B81-GW-MW42I-1006
LOCATION ID				B81-MW-29S	B81-MW-31S	B81-MW-32S	B81-MW-33S	B81-MW-38I	B81-MW-39I	B81-MW-40I	B81-MW-42I
TOP DEPTH				7	8	9	8	10.5	11	12.5	11
BOTTOM DEPTH				17	18	19	18	15.5	16	17.5	16
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/03/06	10/13/06	10/12/06	10/12/06	10/17/06	10/12/06	10/16/06	10/17/06
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)											
1,1-BIPHENYL		30		10 U	10 U	10 U	0.7 J	10 U	10 U	10 U	10 U
2,2'-OXYBIS(1-CHLOROPROPANE)		0.27		0.1 U	0.1 U	0.1 U	0.12	0.1 U	0.1 U	0.1 U	0.1 U
2-METHYLNAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2-METHYLPHENOL		180		0.1 U	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ
ACENAPHTHENE		36		0.1 U	0.1 U	0.1 U	0.12	0.1 U	0.1 U	0.1 U	0.1 U
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		1 U	1 U	1	1 U	1 U	1 U	1 U	1 U
CAPROLACTAM		1800		48 J	32 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	14 U
CARBAZOLE		3.4		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
DIBENZOFURAN		1.2		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
FLUORENE		24		0.1 U	0.1 U	0.1 U	0.14	0.1 U	0.1 U	0.1 U	0.1 U
NAPHTHALENE		0.62		0.1 U	0.1 U	0.18	0.26	0.1 U	0.1 U	0.1 U	0.1 U
PHENANTHRENE		180		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
LOW MOLECULAR WEIGHT PAHS				0.1 U	0.1 U	0.18	0.52	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL PAHS			0.0775	0.1 U	0.1 UJ	0.18	0.52	0.1 U	0.1 UJ	0.1 UJ	0.1 U
PESTICIDES/PCBS (UG/L)											
4,4'-DDT		0.2		0.02 U	0.02 U	0.02 UJ	0.02 UJ	0.02 U	0.02 U	0.091 J	0.02 U
DIELDRIN		0.0042		0.004 U	0.004 U	0.004 UJ	0.004 UJ	0.004 U	0.004 U	***0.03 J***	0.004 U
ENDRIN ALDEHYDE		1.1		0.02 U	0.02 U	0.02 UJ	0.02 UJ	0.02 U	0.02 U	0.04 J	0.02 U
HEPTACHLOR	0.4	0.015		0.01 U	0.01 U	***0.021 J***	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U
HEPTACHLOR EPOXIDE	0.2	0.0074		0.01 U	0.01 U	0.01 UJ	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U
METALS (UG/L)											
ALUMINUM		3600	15341.35	46.8 J	32 U	292	32 U	47.9 J	32 U	45.7 J	32 U
ARSENIC	10	0.045		0.1 U	0.1 U	0.254 UJ	0.215 UJ	***0.155 J***	0.1 U	0.1 U	0.1 U
BARIUM	2000	260	181.32	11 J	43.6	15.7 U	8.31 U	5.91	62.3	35.7	21.8
BERYLLIUM	4	7.3	0.77	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U
CADMIUM	5	1.8		0.094 U	0.094 U	0.094 U	0.094 U	0.094 U	0.094 U	0.094 U	0.094 U
CALCIUM			19187.09	9600	19500	26600	24000	16100	29800	25700	17900
CHROMIUM	100	11	18.1	1.12 UJ	0.147 J	0.495 J	0.12 U	0.575 UJ	0.289 J	0.948 UJ	0.818 UJ
COBALT		73	8.5	0.48 J	0.367 UJ	1.02 UJ	2.44 J	0.42 UJ	1.87 J	0.367 UJ	0.198 UJ
COPPER	1300	150	13.5	0.809 J	0.869 J	2.16 J	1.48 J	1.33 J	0.844 J	1.36 J	0.898 J
IRON		1100	44137.52	140 J	112 UJ	498 J	85.6 UJ	156 J	155 UJ	123 J	108 J
LEAD	15	15		0.156 J	0.075 UJ	0.652 UJ	0.075 UJ	0.075 U	0.114 UJ	0.155 J	0.0825 J
MAGNESIUM			14205.47	1250 J	6610 J	13900 J	11800 J	8870	10000 J	8150	6630

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW29S-1006	B81-GW-MW31S-1006	B81-GW-MW32S-1006	B81-GW-MW33S-1006	B81-GW-MW38I-1006	B81-GW-MW39I-1006	B81-GW-MW40I-1006	B81-GW-MW42I-1006
LOCATION ID				B81-MW-29S	B81-MW-31S	B81-MW-32S	B81-MW-33S	B81-MW-38I	B81-MW-39I	B81-MW-40I	B81-MW-42I
TOP DEPTH				7	8	9	8	10.5	11	12.5	11
BOTTOM DEPTH				17	18	19	18	15.5	16	17.5	16
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/03/06	10/13/06	10/12/06	10/12/06	10/17/06	10/12/06	10/16/06	10/17/06
METALS (UG/L) (cont.)											
MANGANESE		88	2680.63	***130 J***	3.92 J	***357***	***206***	***98***	50.4	13.3	35.6
NICKEL		73		0.81 J	1.62 UJ	2.05 J	1.92 J	1.25 UJ	1.77 UJ	1.57 UJ	1.45 UJ
POTASSIUM			6177.62	3570	1910 J	1510 J	1200 J	1010	1260 J	1130	1120
SELENIUM	50	18		0.504 UJ	0.3 J	0.256 J	0.113 J	0.263 UJ	0.262 J	0.425 UJ	0.317 UJ
SODIUM			47342.14	12900 J	33700	21000	17300	15700	43800	45400	42600
VANADIUM		3.6	22.6	0.371 J	0.371 J	0.796 J	0.601 J	0.462 J	0.146 J	0.253 J	0.158 J
ZINC		1100	51.7	8.01 UJ	4.02 UJ	19.8 U	18.2 U	4.48 J	7.14 UJ	4.33 J	5.84 J
CYANIDE	200	73		1.2 UJ	2.1 UJ	4.9 UJ	4.6 UJ	3.9 UJ	5.1 UJ	2.4 UJ	3.6 UJ
DISSOLVED METALS (UG/L)											
ALUMINUM		3600	15341.35	NA	NA	32 U	479	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	12.5 U	12.9 U	NA	NA	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA	0.043 U	0.0774 J	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	28300	24300	NA	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	0.12 U	0.898 J	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	2.49 J	0.636 UJ	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	1.1 J	1.88 J	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	114 UJ	764 J	NA	NA	NA	NA
LEAD	15	15		NA	NA	0.115 UJ	1.32 J	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	13300 J	11700 J	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	***373***	***255***	NA	NA	NA	NA
MERCURY		1.1		NA	NA	0.0277 UJ	0.0282 UJ	NA	NA	NA	NA
NICKEL		73		NA	NA	1.77 J	2.1 J	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	1380 J	1240 J	NA	NA	NA	NA
SELENIUM	50	18		NA	NA	0.206 J	0.11 U	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	22500	16800	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	0.283 J	1.72 J	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)											
AMMONIA-N				0.35	NA	NA	NA	NA	0.2 U	0.2 U	NA
CHLORIDE	250			3.4	NA	NA	NA	NA	62 J	82 J	NA
NITRATE	10	1		NA	NA	NA	NA	NA	0.74	0.96	NA
NITRATE-N	10			0.55 J	NA	NA	NA	NA	NA	NA	NA
ORTHOPHOSPHATE-P				0.51 J	NA	NA	NA	NA	0.5 UJ	0.5 UJ	NA
SULFATE	250			21 U	NA	NA	NA	NA	16	18	NA
TOTAL ORGANIC CARBON				1.6	NA	NA	NA	NA	1 U	1 U	NA

TABLE 4-6
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW29S-1006	B81-GW-MW31S-1006	B81-GW-MW32S-1006	B81-GW-MW33S-1006	B81-GW-MW38I-1006	B81-GW-MW39I-1006	B81-GW-MW40I-1006	B81-GW-MW42I-1006
LOCATION ID				B81-MW-29S	B81-MW-31S	B81-MW-32S	B81-MW-33S	B81-MW-38I	B81-MW-39I	B81-MW-40I	B81-MW-42I
TOP DEPTH				7	8	9	8	10.5	11	12.5	11
BOTTOM DEPTH				17	18	19	18	15.5	16	17.5	16
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/03/06	10/13/06	10/12/06	10/12/06	10/17/06	10/12/06	10/16/06	10/17/06
VOLATILE GASES (UG/L)											
METHANE				14 U	NA	NA	NA	NA	14 U	14 U	NA
FIELD (MG/L)											
FERROUS IRON				0.03 U	NA	NA	NA	NA	0.04	0.03	NA

Notes:

1) This table contains the detect and non-detect results for all parameters detected in at least one sample in this media subgroup. Complete results for all parameters are presented in Appendix F.

PRG - EPA Region IX PRGs for tap water (EPA. 2004) (human health risk based values). The PRG values presented represent a cancer risk level of 10-6 and a hazard quotient of 0.1.

MCL - The lower of the U.S. EPA Maximum Contaminant Level (MCL) for drinking water and the Massachusetts MCL (MMCL).

BKG - NAS South Weymouth Background Value (Stone & Webster, 2002)

Black Background/White print - Primary Criteria Exceeded

Bold Italics (black or gray background) - Secondary Criteria Exceeded

Gray Background - Detected

B or JB - Possible Field Blank Contamination

U - Not Detected

UJ - Detection Limit Approximate

J - Quantitation Limit Approximate

R - Rejected

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-BR1-0906	B81-GW-BR4-0906-AVG	B81-GW-BR5-0906	B81-GW-BR7-0906	B81-GW-BR8-1006	B81-GW-BR10-0906	B81-GW-BR13-0906	B81-GW-BR15-0906	B81-GW-BR16-1006	B81-GW-BR21-0906
LOCATION ID				B81-BR-01	B81-BR-04	B81-BR-05	B81-BR-07	B81-BR-08	B81-BR-10	B81-BR-13	B81-BR-15	B81-BR-16	B81-BR-21
TOP DEPTH				23	29.6	24.6	22.6	24.6	28.3	23.6	29	27.5	27
BOTTOM DEPTH				33	39.6	35.3	33.3	35.3	33.3	34.3	34	37.5	37
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/20/06	09/27/06	09/21/06	09/22/06	10/03/06	09/25/06	09/26/06	09/28/06	10/05/06	09/29/06
VOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1,2-TRICHLOROETHANE	5	0.2		1 U	0.4 U	0.1 U	0.1 U	0.1 U	0.1 U	1 U	0.1 U	0.1 U	1 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		NA	NA	NA	NA	2.6	NA	NA	NA	1	NA
1,1-DICHLOROETHENE	7	34		1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.5 U	1 U
1,2,3-TRICHLOROBENZENE	70	0.72		1 U	1 U	1 U	1 U	0.5 U	1 U	1 U	1 U	0.5 U	1 U
1,2,4-TRICHLOROBENZENE	70	0.72		1 U	1 U	***2***	1 U	0.5 U	1 U	1 U	1 U	0.5 U	1 U
1,2,4-TRIMETHYLBENZENE		1.2		1 U	1 U	***9***	1 U	NA	1 U	1 U	1 U	NA	1 U
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048		0.021 U	0.021 U	0.022 U	0.022 U	0.021 U	0.022 U	0.026 U	0.021 U	0.022 U	0.021 U
ACETONE		550		5 U	5 U	5 U	4 J	5 UJ	5 UJ	5 UJ	5 U	5 UJ	5 U
BENZENE	5	0.35		1 U	***1.1***	***1.7 J***	***1.5***	0.15 J	***0.37***	1 U	0.1 U	0.1 U	1 U
BROMOCHLOROMETHANE				1 U	1 U	1 U	1 U	0.5 U	1 U	1 U	1 U	0.5 U	1 U
BROMODICHLOROMETHANE	80	0.18		1 U	0.4 U	0.1 U	0.1 U	0.1 U	0.1 U	1 U	0.1 U	0.1 U	1 U
CARBON DISULFIDE		100		1 U	0.4 U	0.1 U	0.24 J	0.16 J	0.1 U	1 U	0.32 J	0.11	1 U
CHLOROFORM	80	0.17	3.2	1 U	1.1 U	0.1 U	0.1 U	0.1 UJ	0.11	1 U	0.1 U	0.1 U	1 U
CIS-1,2-DICHLOROETHENE	70	6.1		3	***12***	***61***	3	0.44 J	1 U	1 U	1 U	0.5 U	1 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		3	***12***	***61***	3	0.44 J	1 U	1 U	1 U	0.5 U	1 U
CYCLOHEXANE		1000		NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U	NA
DICHLORODIFLUOROMETHANE		39		1 U	1 UJ	1 U	1 U	0.5 U	1 U	1 U	1 U	0.5 U	1 U
ETHYLBENZENE	700	130		1 U	0.8 J	23	2	0.66	8	1 U	2	0.64	1 U
ISOPROPYLBENZENE		66		1 U	1 U	6	1 U	0.5 U	1 U	1 U	1 U	0.5 U	1 U
METHYL CYCLOHEXANE		520		NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U	NA
METHYL TERT-BUTYL ETHER		6.2		1 U	1 U	1 U	1 U	0.5 U	1 U	1 U	1 U	0.5 U	1 U
N-BUTYLBENZENE		24		1 U	1 U	2	1 U	NA	1 U	1 U	1 U	NA	1 U
N-PROPYLBENZENE		24		1 U	1 U	8	1 U	NA	1 U	1 U	1 U	NA	1 U
M+P-XYLENES		21		1 U	NA	3	5	NA	13	1 U	NA	NA	NA
O-XYLENE		21		1 U	1	3	2	NA	6	1 U	2	NA	1 U
P-XYLENE		21		NA	3	NA	NA	NA	NA	NA	4	NA	1 U
TOTAL XYLENES		21		1 U	4	6	7	1.5	20	1 U	6	1.5	1 U
SEC-BUTYLBENZENE		24		1 U	1 U	4	1 U	NA	1 U	1 U	1 U	NA	1 U
STYRENE	100	160		1 U	1 U	1 U	1 U	0.5 U	1 U	1 U	1 U	0.5 U	1 U
TETRACHLOROETHENE	5	0.1		***92***	***91***	***600***	***4300***	***15***	***99***	***650***	***18 J***	***7.6***	***570***
TOLUENE	1000	72		8	32	12	***110***	24	***480***	5	***85***	24	28
TRICHLOROETHENE	5	0.028	0.73	***2***	***2.2***	***36***	***39***	***0.42 J***	***0.78***	***21***	***0.32***	***0.2***	***19***
VINYL CHLORIDE	2	0.02		1 U	0.4 U	***0.63 J***	***0.51***	0.1 U	0.1 U	1 U	0.1 U	0.1 U	1 U

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-BR1-0906	B81-GW-BR4-0906-AVG	B81-GW-BR5-0906	B81-GW-BR7-0906	B81-GW-BR8-1006	B81-GW-BR10-0906	B81-GW-BR13-0906	B81-GW-BR15-0906	B81-GW-BR16-1006	B81-GW-BR21-0906
LOCATION ID				B81-BR-01	B81-BR-04	B81-BR-05	B81-BR-07	B81-BR-08	B81-BR-10	B81-BR-13	B81-BR-15	B81-BR-16	B81-BR-21
TOP DEPTH				23	29.6	24.6	22.6	24.6	28.3	23.6	29	27.5	27
BOTTOM DEPTH				33	39.6	35.3	33.3	35.3	33.3	34.3	34	37.5	37
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/20/06	09/27/06	09/21/06	09/22/06	10/03/06	09/25/06	09/26/06	09/28/06	10/05/06	09/29/06
VOLATILE ORGANIC COMPOUNDS (UG/L) (cont.)													
TOTAL CHLORINATED ETHENES				97	105.2	697.63 J	4342.51	15.86 J	99.78	671	18.32 J	7.8	589
TOTAL CHLORINATED VOCS				97	105.2 J	699.63 J	4342.51	18.46 J	99.89	671	18.32 J	8.8 J	589
BTEX				8	37.9 J	42.7 J	120.5	26.31 J	508.37	5	93	26.14	28
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)													
1,1-BIPHENYL		30		10 U	10 U	3 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-DIOXANE		6.1		1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
2-METHYLNAPHTHALENE		0.62		0.1 U	0.1 U	***18***	0.49	0.1 U	0.1 U	0.1 UJ	0.1 U	0.1 U	0.1 U
2-METHYLPHENOL		180		0.1 UJ	0.14 J	0.17 J	0.1 UJ	0.13	1.3 J	0.1 UJ	0.4 J	0.1 U	0.17 J
ACENAPHTHENE		36		0.1 U	0.1 U	0.33	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		1 U	1 U	1	2	1 U	4	1	***16***	3	1 U
CAPROLACTAM		1800		27 J	10 UJ	29 J	42 J	10 UJ	10 UJ	10 UJ	10 UJ	170 J	10 UJ
FLUORENE		24		0.1 U	0.1 U	0.62	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
NAPHTHALENE		0.62		0.1 U	0.1 U	***38***	0.58	0.1 U	0.17	0.1 UJ	0.16	0.1 U	0.13
N-NITROSODIPHENYLAMINE		13.72		1 U	6	8	***31***	***18***	5	***35***	***16***	***19***	10
PHENANTHRENE		180		0.1 U	0.1 U	0.23	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PHENOL		1100		0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ
LOW MOLECULAR WEIGHT PAHS				0.1 U	0.1 U	57.18	1.07	0.1 U	0.17	0.1 UJ	0.16	0.1 U	0.13
TOTAL PAHS			0.0775	0.1 U	0.1 U	57.18	1.07	0.1 U	0.17	0.1 UJ	0.16	0.1 U	0.13
PESTICIDES/PCBS (UG/L)													
DIELDRIN		0.0042		0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.038 UJ	0.004 U	0.004 U
ENDOSULFAN I		22		0.01 U	0.038 UJ	0.01 U	0.43 UJ	0.01 U	0.01 U	0.42 UJ	0.01 U	0.01 U	0.01 U
ENDOSULFAN SULFATE		22		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.034
ENDRIN KETONE		1.1		0.02 UJ	0.02 U	0.02 UJ	0.02 UJ	0.02 U	0.02 U	0.039	0.02 U	0.02 U	0.02 UJ
HEPTACHLOR EPOXIDE	0.2	0.0074		0.01 U	0.01 U	0.01 U	***0.018***	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
METALS (UG/L)													
ALUMINUM		3600	15341.35	***4830***	927	996	162	32 UJ	37.2 J	117	40.7 J	232 J	45.8 J
ANTIMONY	6	1.5		0.495 UJ	0.497 UJ	0.877 UJ	***6.1 J***	1.15 UJ	***5.87 J***	0.612 UJ	1.18 UJ	1.3 UJ	0.461 UJ
ARSENIC	10	0.045		***0.711 J***	0.349 UJ	***2.41***	***0.736 J***	0.1 U	0.279 UJ	0.328 UJ	0.233 UJ	0.173 UJ	0.175 UJ
BARIUM	2000	260	181.32	***358***	54.4	87.3	30.5	89.1 J	58.3	58.7	115	57.2	63.8
BERYLLIUM	4	7.3	0.77	1.64 J	0.0826 J	0.111 J	0.043 U	0.043 U	0.043 U	0.043 U	0.043 UJ	0.043 U	0.043 UJ
CADMIUM	5	1.8		0.393 J	0.094 U	0.094 U	0.094 U	0.0983 J	0.094 U	0.094 U	0.094 U	0.094 U	0.094 U
CALCIUM			19187.09	18200	22500	19200	26200	15800	20200	24200	19700	10700	15300

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-BR1-0906	B81-GW-BR4-0906-AVG	B81-GW-BR5-0906	B81-GW-BR7-0906	B81-GW-BR8-1006	B81-GW-BR10-0906	B81-GW-BR13-0906	B81-GW-BR15-0906	B81-GW-BR16-1006	B81-GW-BR21-0906
LOCATION ID				B81-BR-01	B81-BR-04	B81-BR-05	B81-BR-07	B81-BR-08	B81-BR-10	B81-BR-13	B81-BR-15	B81-BR-16	B81-BR-21
TOP DEPTH				23	29.6	24.6	22.6	24.6	28.3	23.6	29	27.5	27
BOTTOM DEPTH				33	39.6	35.3	33.3	35.3	33.3	34.3	34	37.5	37
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/20/06	09/27/06	09/21/06	09/22/06	10/03/06	09/25/06	09/26/06	09/28/06	10/05/06	09/29/06
METALS (UG/L) (cont.)													
CHROMIUM	100	11	18.1	4.49 UJ	1.77 U	1.68 UJ	0.847 UJ	0.883 UJ	1.23 U	1.41 U	0.281 J	0.326 J	0.12 UJ
COBALT		73	8.5	5.02 J	0.966 J	1.31 J	0.209 UJ	0.619 J	0.172 UJ	0.246 UJ	0.369 UJ	0.426 J	0.694 J
COPPER	1300	150	13.5	9.22 J	1.81 J	3.01 J	1.83 J	1.05 J	0.679 J	1.05 J	0.773 J	1.2 UJ	0.52 U
IRON		1100	44137.52	***15000***	***10600 J***	***7290***	***2400***	***10400 J***	***3930 J***	***4080 J***	***6410 J***	***6380***	***11800 J***
LEAD	15	15		***49.5***	2.61	3.6	0.547 J	0.42 J	0.249 J	1.1	0.514 J	1.14	0.654 J
MAGNESIUM			14205.47	6320	9130	4860	140	9190 J	2360	3180	6620	3880	7810
MANGANESE		88	2680.63	***658***	***1730***	***1840***	28.1	***372 J***	***98.8***	***359***	***818***	***375***	***590***
MERCURY		1.1		0.026 U	0.026 UJ	0.026 U	0.0516 UJ	0.0385 J	0.026 UJ	0.026 UJ	0.026 UJ	0.018 UJ	0.026 UJ
NICKEL		73		12.2 J	3.67 J	5.17 J	4.13 J	6.38 J	6.36 J	3.43 J	5.63 J	5.78 J	5.09 J
POTASSIUM			6177.62	3110 J	3640	5060 J	3060 J	1280	13900	4170	2150 J	1110 J	1230 J
SELENIUM	50	18		0.83 UJ	0.504 UJ	0.491 UJ	0.303 UJ	0.225 UJ	0.619 UJ	0.463 UJ	0.421 UJ	0.211 UJ	0.546 UJ
SODIUM			47342.14	18400	25600	12600	10900	13600 J	8360	8740	10500	6290	23500
VANADIUM		3.6	22.6	***9***	1.81 J	2.16	0.442 J	0.0673 UJ	0.049 U	0.31 J	0.049 U	0.151 J	0.175 J
ZINC		1100	51.7	386	309 J	146	222	86.2 J	71.1 J	42.2 J	71.7	40.2	36.4
CYANIDE	200	73		3 UJ	3.2 J	3.4 UJ	3.3 UJ	1.2 UJ	4.6 J	1.2 UJ	1.2 U	1.2 UJ	1.6 U
DISSOLVED METALS (UG/L)													
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-BR1-0906	B81-GW-BR4-0906-AVG	B81-GW-BR5-0906	B81-GW-BR7-0906	B81-GW-BR8-1006	B81-GW-BR10-0906	B81-GW-BR13-0906	B81-GW-BR15-0906	B81-GW-BR16-1006	B81-GW-BR21-0906
LOCATION ID				B81-BR-01	B81-BR-04	B81-BR-05	B81-BR-07	B81-BR-08	B81-BR-10	B81-BR-13	B81-BR-15	B81-BR-16	B81-BR-21
TOP DEPTH				23	29.6	24.6	22.6	24.6	28.3	23.6	29	27.5	27
BOTTOM DEPTH				33	39.6	35.3	33.3	35.3	33.3	34.3	34	37.5	37
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/20/06	09/27/06	09/21/06	09/22/06	10/03/06	09/25/06	09/26/06	09/28/06	10/05/06	09/29/06
MISCELLANEOUS PARAMETERS (MG/L)													
AMMONIA-N				NA	0.36 J	NA	NA	NA	NA	NA	NA	NA	NA
CHLORIDE	250			NA	4.85	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE	10	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			NA	0.13 U	NA	NA	NA	NA	NA	NA	NA	NA
SULFATE	250			NA	22.5	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON				NA	2.6	NA	NA	NA	NA	NA	NA	NA	NA
VOLATILE GASES (UG/L)													
METHANE				NA	65	NA	NA	NA	NA	NA	NA	NA	NA
FIELD (MG/L)													
FERROUS IRON				NA	1.63	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID	MCL	PRG	BKG	B81-GW-BR22-1006	B81-GW-BR23-1006	B81-GW-BR26-1006	B81-GW-BR28-1006	B81-GW-BR31-1006	B81-GW-MW9D-0906	B81-GW-MW10D-1006-AVG	B81-GW-MW13B-1006	B81-GW-MW20D-1006-AVG
LOCATION ID				B81-BR-22	B81-BR-23	B81-BR-26	B81-BR-28	B81-BR-31	B81-MW-09D	B81-MW-10D	B81-MW-13B	B81-MW-20D
TOP DEPTH				25	34	25.6	34	23.5	19	30.5	20	21.5
BOTTOM DEPTH				35.7	39	36.3	39	35	29	40.33	30	31.5
SAMPLE DATE	MCL	PRG	BKG	10/06/06	10/06/06	10/02/06	10/10/06	10/16/06	09/27/06	10/04/06	10/02/06	10/06/06
VOLATILE ORGANIC COMPOUNDS (UG/L)												
1,1,2-TRICHLOROETHANE	5	0.2		0.4 U	0.4 U	13 U	0.2 UJ	0.5 U	1.2 J	0.1 U	0.1 U	0.4 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		2.7	43	250	15	150	NA	0.575	0.5 U	325 J
1,1-DICHLOROETHENE	7	34		0.5 U	0.5 U	13 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.595
1,2,3-TRICHLOROBENZENE	70	0.72		0.5 U	0.5 U	13 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.615
1,2,4-TRICHLOROBENZENE	70	0.72		0.5 U	0.5 U	13 U	0.5 U	1.4	2	0.5 U	0.5 U	4.7
1,2,4-TRIMETHYLBENZENE		1.2		NA	NA	NA	NA	NA	1 U	NA	NA	NA
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048		0.021 U	0.022 U	0.024 U	0.02 U	0.021 U	0.02 U	0.5 U	0.023 U	0.022 U
ACETONE		550		5 U	5 U	130 UJ	5 U	5 UJ	5 U	5 UJ	5 UJ	5 U
BENZENE	5	0.35		0.6	2.6	13 U	0.64 J	7.6	0.96 J	0.1 U	0.1 U	8.25
BROMOCHLOROMETHANE				0.5 U	0.5 U	13 U	0.53 J	0.5 U	1 U	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	80	0.18		0.4 U	0.4 U	13 U	0.6 J	0.4 U	0.4 UJ	0.1 U	0.21	0.4 U
CARBON DISULFIDE		100		0.4 U	0.4 U	13 U	0.2 UJ	0.4 U	0.4 UJ	0.1 U	0.1	0.4 U
CHLOROFORM	80	0.17	3.2	0.73 U	2.5 U	13 U	24	0.4 U	0.94 UJ	0.175 UJ	1.2	0.4 U
CIS-1,2-DICHLOROETHENE	70	6.1		1.1	28	39	7.1	14	47	0.38 J	0.5 U	125 J
TOTAL 1,2-DICHLOROETHENE	5	6.1		1.1	28	39	7.1	14	47	0.38 J	0.5 U	125 J
CYCLOHEXANE		1000		0.5 U	0.5 U	13 U	0.5 U	1.9	NA	0.5 U	0.5 U	7.8 J
DICHLORODIFLUOROMETHANE		39		2	0.5 U	13 U	0.5 U	18	1 U	2.5	0.5 U	114 J
ETHYLBENZENE	700	130		1.6	2.4	13 U	0.57	0.5 U	1 U	0.5 U	0.5 U	36 J
ISOPROPYLBENZENE		66		0.5 U	0.5 U	13 U	0.5 U	0.53	3	0.5 U	0.5 U	11
METHYL CYCLOHEXANE		520		0.5 U	0.5 U	13 U	0.61	0.75	NA	0.5 U	0.5 U	5.7 J
METHYL TERT-BUTYL ETHER		6.2		0.5 U	9	13 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U
N-BUTYLBENZENE		24		NA	NA	NA	NA	NA	3	NA	NA	NA
N-PROPYLBENZENE		24		NA	NA	NA	NA	NA	3	NA	NA	NA
M+P-XYLENES		21		NA	NA	NA	NA	NA	NA	NA	NA	NA
O-XYLENE		21		NA	NA	NA	NA	NA	1 U	NA	NA	NA
P-XYLENE		21		NA	NA	NA	NA	NA	1 U	NA	NA	NA
TOTAL XYLENES		21		4.8	6.1	13 U	1.8	0.5 U	1 U	0.5 U	0.5 U	80
SEC-BUTYLBENZENE		24		NA	NA	NA	NA	NA	4	NA	NA	NA
STYRENE	100	160		0.5 U	0.5 U	13 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	1.18
TETRACHLOROETHENE	5	0.1		210	120	270	30	110	160 J	3.25	0.1 U	225 J
TOLUENE	1000	72		130	120	78	18	0.5 U	1 U	0.5 U	0.5 U	6.65
TRICHLOROETHENE	5	0.028	0.73	13	9.3	15	3 J	3	16 J	0.1 U	0.1 U	22.5 J
VINYL CHLORIDE	2	0.02		0.4 U	11	13 U	0.31 J	5.3	0.4 UJ	0.1 U	0.1 U	11

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID	MCL	PRG	BKG	B81-GW-BR22-1006	B81-GW-BR23-1006	B81-GW-BR26-1006	B81-GW-BR28-1006	B81-GW-BR31-1006	B81-GW-MW9D-0906	B81-GW-MW10D-1006-AVG	B81-GW-MW13B-1006	B81-GW-MW20D-1006-AVG
LOCATION ID				B81-BR-22	B81-BR-23	B81-BR-26	B81-BR-28	B81-BR-31	B81-MW-09D	B81-MW-10D	B81-MW-13B	B81-MW-20D
TOP DEPTH				25	34	25.6	34	23.5	19	30.5	20	21.5
BOTTOM DEPTH				35.7	39	36.3	39	35	29	40.33	30	31.5
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/06/06	10/06/06	10/02/06	10/10/06	10/16/06	09/27/06	10/04/06	10/02/06	10/06/06
VOLATILE ORGANIC COMPOUNDS (UG/L) (cont.)												
TOTAL CHLORINATED ETHENES				224.1	168.3	324	40.41 J	132.3	223 J	3.63 J	0.2 U	383.5 J
TOTAL CHLORINATED VOCS				228.8	211.3	574	80.54 J	301.7	226.2 J	6.705 J	1.41	828.41 J
BTEX				137	131.1	78	21.01 J	7.6	0.96 J	0.4 U	0.4 U	130.9 J
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)												
1,1-BIPHENYL		30		10 U	10 U	10 U	10 U	2 J	3 J	10 U	10 U	2.5 J
1,4-DIOXANE		6.1		1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
2-METHYLNAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	***2 J***	0.1 U	0.1 U	***19.5***
2-METHYLPHENOL		180		0.52 J	0.54 J	0.1 U	0.42 J	0.1 UJ	0.19 J	0.1 U	0.1 U	0.255 J
ACENAPHTHENE		36		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.4	0.1 U	0.1 UJ	0.6
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		3	2	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CAPROLACTAM		1800		41 J	1 J	10 UJ	10 UJ	10 UJ	8 J	110 J	36 J	69.5 J
FLUORENE		24		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.6	0.1 U	0.1 U	1.2
NAPHTHALENE		0.62		0.1 U	0.13	0.1 U	0.14	0.16	***1.2 J***	0.1 U	0.1 U	***29***
N-NITROSODIPHENYLAMINE		13.72		***24***	***14***	5	***16***	1 U	1 U	1 U	1 U	1 U
PHENANTHRENE		180		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.14	0.1 U	0.1 U	0.145
PHENOL		1100		0.8 J	0.32 J	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.075 J
LOW MOLECULAR WEIGHT PAHS				0.1 U	0.13	0.1 U	0.14	0.16	4.34 J	0.1 U	0.1 UJ	50.445
TOTAL PAHS			0.0775	0.1 U	0.13	0.1 U	0.14	0.16	4.34 J	0.1 U	0.1 UJ	50.445
PESTICIDES/PCBS (UG/L)												
DIELDRIN		0.0042		0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	***0.0065 J***
ENDOSULFAN I		22		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.064	0.01 U
ENDOSULFAN SULFATE		22		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
ENDRIN KETONE		1.1		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
HEPTACHLOR EPOXIDE	0.2	0.0074		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
METALS (UG/L)												
ALUMINUM		3600	15341.35	43.9 J	231	45.7 J	43.9 J	59	188	520 J	52.5 J	32 UJ
ANTIMONY	6	1.5		1.28 UJ	1.35 UJ	1.5 UJ	0.158 UJ	0.056 U	0.056 UJ	0.485 UJ	0.565 UJ	0.056 U
ARSENIC	10	0.045		0.167 UJ	0.383 UJ	0.355 UJ	0.313 UJ	***0.331 J***	***3.5***	***1.04 J***	***0.574 J***	***2.22***
BARIUM	2000	260	181.32	44.3	59.7	96.3 J	45.5	23.3	34	33.6 J	30.8 J	25.6
BERYLLIUM	4	7.3	0.77	0.043 U	0.0616 J	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U
CADMIUM	5	1.8		0.094 U	0.094 U	0.094 U	0.0996 J	0.094 U	0.094 U	0.094 U	0.094 U	0.094 U
CALCIUM			19187.09	11900	26500 J	39700	13400 J	13100	13400	21200	25000	12800

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-BR22-1006	B81-GW-BR23-1006	B81-GW-BR26-1006	B81-GW-BR28-1006	B81-GW-BR31-1006	B81-GW-MW9D-0906	B81-GW-MW10D-1006-AVG	B81-GW-MW13B-1006	B81-GW-MW20D-1006-AVG
LOCATION ID				B81-BR-22	B81-BR-23	B81-BR-26	B81-BR-28	B81-BR-31	B81-MW-09D	B81-MW-10D	B81-MW-13B	B81-MW-20D
TOP DEPTH				25	34	25.6	34	23.5	19	30.5	20	21.5
BOTTOM DEPTH				35.7	39	36.3	39	35	29	40.33	30	31.5
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/06/06	10/06/06	10/02/06	10/10/06	10/16/06	09/27/06	10/04/06	10/02/06	10/06/06
METALS (UG/L) (cont.)												
CHROMIUM	100	11	18.1	0.413 J	1.23	0.994 UJ	0.257 J	0.533 UJ	1.72 U	3.44 UJ	3.61 UJ	0.298 J
COBALT		73	8.5	0.497 UJ	2.57 J	1 J	2.11 J	0.309 UJ	0.232 UJ	0.855 J	0.142 UJ	0.734 J
COPPER	1300	150	13.5	2.47 UJ	2.91 J	0.562 J	2.07 J	0.52 U	1.1 J	2.9 J	1.07 J	1.08 UJ
IRON		1100	44137.52	***7130***	***29300***	***18100 J***	***6810***	***3220 J***	***23300 J***	366 J	315 J	***23200***
LEAD	15	15		1.06	2.16	0.224 J	0.847 J	0.431 J	0.845 J	1.11 J	0.075 U	0.289 J
MAGNESIUM			14205.47	3300	12300	14900 J	3270	9180	3500	2400 J	8200 J	4450
MANGANESE		88	2680.63	***278***	***3130***	***1520 J***	***745***	***236***	***4590***	78.4 J	4.06 J	***2840***
MERCURY		1.1		0.018 UJ	0.018 UJ	0.026 U	0.018 UJ	0.018 U	0.026 UJ	0.026 U	0.169 J	0.018 UJ
NICKEL		73		8.2 J	13.5 J	5.32 J	4.05 J	0.982 UJ	1.12 UJ	7.5 J	1.39 UJ	1.41 UJ
POTASSIUM			6177.62	13900 J	2900	2110	5760	1000	1100	2120	10500	3660 J
SELENIUM	50	18		0.192 UJ	0.219 UJ	0.577 UJ	0.122 UJ	0.35 UJ	0.545 UJ	0.636 UJ	0.518 UJ	0.433 UJ
SODIUM			47342.14	11900	19300	18300 J	26100	12200	8690	14200 J	18500 J	10800
VANADIUM		3.6	22.6	0.394 J	0.629 J	0.133 UJ	0.0628 J	0.397 J	0.49 J	0.695 J	3.2	0.28 J
ZINC		1100	51.7	44.1	88.5 J	***1310 J***	269 J	2.47 J	7.16 UJ	18.1 J	2.9 UJ	6.1 UJ
CYANIDE	200	73		9.5 UJ	2.3 UJ	1.2 UJ	3 UJ	2.1 UJ	11 J	1.2 UJ	3.2 UJ	8.92 J
DISSOLVED METALS (UG/L)												
ALUMINUM		3600	15341.35	32 UJ	32 U	NA	NA	NA	NA	NA	NA	NA
ARSENIC	10	0.045		0.1 U	0.273 UJ	NA	NA	NA	NA	NA	NA	NA
BARIUM	2000	260	181.32	32.6	45.6	NA	NA	NA	NA	NA	NA	NA
CALCIUM			19187.09	12900	24400 J	NA	NA	NA	NA	NA	NA	NA
COBALT		73	8.5	1.1 J	2.56 J	NA	NA	NA	NA	NA	NA	NA
COPPER	1300	150	13.5	0.578 UJ	0.694 UJ	NA	NA	NA	NA	NA	NA	NA
IRON		1100	44137.52	900	***18600***	NA	NA	NA	NA	NA	NA	NA
LEAD	15	15		0.102 J	0.075 U	NA	NA	NA	NA	NA	NA	NA
MAGNESIUM			14205.47	3560	12000	NA	NA	NA	NA	NA	NA	NA
MANGANESE		88	2680.63	***276***	***3020***	NA	NA	NA	NA	NA	NA	NA
NICKEL		73		5.38 J	11.5 J	NA	NA	NA	NA	NA	NA	NA
POTASSIUM			6177.62	14600 J	2820	NA	NA	NA	NA	NA	NA	NA
SODIUM			47342.14	12400	18900	NA	NA	NA	NA	NA	NA	NA
VANADIUM		3.6	22.6	0.049 U	0.049 U	NA	NA	NA	NA	NA	NA	NA
ZINC		1100	51.7	12	49.7 J	NA	NA	NA	NA	NA	NA	NA

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-BR22-1006	B81-GW-BR23-1006	B81-GW-BR26-1006	B81-GW-BR28-1006	B81-GW-BR31-1006	B81-GW-MW9D-0906	B81-GW-MW10D-1006-AVG	B81-GW-MW13B-1006	B81-GW-MW20D-1006-AVG
LOCATION ID				B81-BR-22	B81-BR-23	B81-BR-26	B81-BR-28	B81-BR-31	B81-MW-09D	B81-MW-10D	B81-MW-13B	B81-MW-20D
TOP DEPTH				25	34	25.6	34	23.5	19	30.5	20	21.5
BOTTOM DEPTH				35.7	39	36.3	39	35	29	40.33	30	31.5
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/06/06	10/06/06	10/02/06	10/10/06	10/16/06	09/27/06	10/04/06	10/02/06	10/06/06
MISCELLANEOUS PARAMETERS (MG/L)												
AMMONIA-N				NA	NA	NA	NA	NA	0.46 J	NA	0.22	NA
CHLORIDE	250			NA	NA	NA	NA	NA	3.6	NA	20	NA
NITRATE	10	1		NA	NA	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			NA	NA	NA	NA	NA	0.13 U	NA	0.25	NA
SULFATE	250			NA	NA	NA	NA	NA	6.3	NA	24 U	NA
TOTAL ORGANIC CARBON				NA	NA	NA	NA	NA	3.4	NA	1.2	NA
VOLATILE GASES (UG/L)												
METHANE				NA	NA	NA	NA	NA	710	NA	14 U	NA
FIELD (MG/L)												
FERROUS IRON				NA	NA	NA	NA	NA	2.7	NA	0.07 U	NA

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW21D-1006	B81-GW-MW23B-1006	B81-GW-MW32B-1006	B81-GW-MW38B-1006	B81-GW-MW39B-1006	B81-GW-MW40B-1006-AVG	B81-GW-MW41B-0906	B81-GW-MW42B-1006
LOCATION ID				B81-MW-21D	B81-MW-23B	B81-MW-32B	B81-MW-38B	B81-MW-39B	B81-MW-40B	B81-MW-41B	B81-MW-42B
TOP DEPTH				20.5	23	21.5	19	19	20	18.5	17
BOTTOM DEPTH				30.5	33	31.5	29	22	30	28.5	30
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/06/06	10/11/06	10/17/06	10/13/06	10/16/06	10/16/06	09/27/06	10/17/06
VOLATILE ORGANIC COMPOUNDS (UG/L)											
1,1,2-TRICHLOROETHANE	5	0.2		0.4 U	0.1 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.1 U	0.5 U
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		240	4.7	76	53	0.5 U	0.5 U	NA	0.5 U
1,1-DICHLOROETHENE	7	34		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
1,2,3-TRICHLOROBENZENE	70	0.72		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
1,2,4-TRICHLOROBENZENE	70	0.72		0.54	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
1,2,4-TRIMETHYLBENZENE		1.2		NA	NA	NA	NA	NA	NA	1 U	NA
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048		0.036 J	0.02 U	0.02 U	0.02 U	0.02 U	0.0205 U	0.022 U	0.02 U
ACETONE		550		22	5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 UJ
BENZENE	5	0.35		***2.7***	0.17 J	0.2 U	***0.39 J***	0.1 U	0.1 UJ	0.1 U	0.1 U
BROMOCHLOROMETHANE				0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
BROMODICHLOROMETHANE	80	0.18		0.4 U	***0.25 J***	0.2 U	0.23 U	0.1 U	0.1 UJ	0.1 U	0.1 U
CARBON DISULFIDE		100		0.4 U	0.1 UJ	0.2 U	0.2 UJ	0.1 U	0.1 UJ	0.1 U	0.1 U
CHLOROFORM	80	0.17	3.2	0.83 U	2.6 U	1.1 U	1.7 U	0.1 U	0.315 U	0.2 U	0.1 U
CIS-1,2-DICHLOROETHENE	70	6.1		***20 J***	1.7	***6.3***	1.5	0.5 U	0.5 U	1 U	0.5 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		***20 J***	1.7	***6.3***	1.5	0.5 U	0.5 U	1 U	0.5 U
CYCLOHEXANE		1000		0.94	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U
DICHLORODIFLUOROMETHANE		39		20 J	0.77	17	0.5 U	0.5 U	0.5 U	1 U	0.5 U
ETHYLBENZENE	700	130		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
ISOPROPYLBENZENE		66		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
METHYL CYCLOHEXANE		520		0.68	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U
METHYL TERT-BUTYL ETHER		6.2		2.1	0.5 U	1.2	0.5 U	0.88	0.94	1 U	0.5 J
N-BUTYLBENZENE		24		NA	NA	NA	NA	NA	NA	1 U	NA
N-PROPYLBENZENE		24		NA	NA	NA	NA	NA	NA	1 U	NA
M+P-XYLENES		21		NA	NA	NA	NA	NA	NA	NA	NA
O-XYLENE		21		NA	NA	NA	NA	NA	NA	1 U	NA
P-XYLENE		21		NA	NA	NA	NA	NA	NA	1 U	NA
TOTAL XYLENES		21		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
SEC-BUTYLBENZENE		24		NA	NA	NA	NA	NA	NA	1 U	NA
STYRENE	100	160		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
TETRACHLOROETHENE	5	0.1		***270***	***16***	***46***	***46***	0.1 U	0.1 UJ	0.1 U	0.1 U
TOLUENE	1000	72		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
TRICHLOROETHENE	5	0.028	0.73	***7.2***	***1.9 J***	***1.6***	***0.42 J***	0.1 U	0.1 UJ	0.1 U	***0.64***
VINYL CHLORIDE	2	0.02		***2.5***	0.1 UJ	***0.71***	0.2 UJ	0.1 U	0.1 UJ	0.1 U	0.1 U

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW21D-1006	B81-GW-MW23B-1006	B81-GW-MW32B-1006	B81-GW-MW38B-1006	B81-GW-MW39B-1006	B81-GW-MW40B-1006-AVG	B81-GW-MW41B-0906	B81-GW-MW42B-1006
LOCATION ID				B81-MW-21D	B81-MW-23B	B81-MW-32B	B81-MW-38B	B81-MW-39B	B81-MW-40B	B81-MW-41B	B81-MW-42B
TOP DEPTH				20.5	23	21.5	19	19	20	18.5	17
BOTTOM DEPTH				30.5	33	31.5	29	22	30	28.5	30
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/06/06	10/11/06	10/17/06	10/13/06	10/16/06	10/16/06	09/27/06	10/17/06
VOLATILE ORGANIC COMPOUNDS (UG/L) (cont.)											
TOTAL CHLORINATED ETHENES				299.7 J	19.6 J	54.61	47.92 J	0.2 U	0.2 UJ	0.32 U	0.64
TOTAL CHLORINATED VOCS				560.276 J	25.32 J	147.61	100.92 J	0.35 U	0.35 UJ	0.62 U	0.64
BTEX				2.7	0.17 J	0.42 U	0.39 J	0.4 U	0.4 UJ	0.78 U	0.4 U
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)											
1,1-BIPHENYL		30		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-DIOXANE		6.1		1 UJ	***8 J***	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	2 J
2-METHYLNAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
2-METHYLPHENOL		180		0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ
ACENAPHTHENE		36		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		1 U	1 U	1 U	1 U	1 U	1 U	2	1 U
CAPROLACTAM		1800		43 J	52 J	25 U	10 UJ	10 UJ	29 U	81 J	38 U
FLUORENE		24		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
NAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
N-NITROSODIPHENYLAMINE		13.72		1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PHENANTHRENE		180		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PHENOL		1100		0.1 J	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ
LOW MOLECULAR WEIGHT PAHS				0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL PAHS			0.0775	0.1 U	0.1 U	0.1 U	0.1 U	0.1 UJ	0.1 UJ	0.1 U	0.1 U
PESTICIDES/PCBS (UG/L)											
DIELDRIN		0.0042		0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
ENDOSULFAN I		22		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.011	0.01 U
ENDOSULFAN SULFATE		22		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
ENDRIN KETONE		1.1		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
HEPTACHLOR EPOXIDE	0.2	0.0074		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
METALS (UG/L)											
ALUMINUM		3600	15341.35	88.9 J	39.5 J	32 U	60.4	32 U	32 U	2420	32 U
ANTIMONY	6	1.5		0.056 U	0.056 U	0.056 U	0.056 UJ	0.056 U	0.0855 UJ	0.172 UJ	0.056 U
ARSENIC	10	0.045		0.696 UJ	0.484 UJ	***0.177 J***	0.329 UJ	0.1 U	***0.0825 J***	***0.612 J***	0.1 U
BARIUM	2000	260	181.32	20	29 U	97.2	19.2	41.7	44.7	30	30.5
BERYLLIUM	4	7.3	0.77	0.0877 J	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.282 J	0.043 U
CADMIUM	5	1.8		0.094 U	0.094 U	0.094 U	0.094 U	0.094 U	0.094 U	0.106 J	0.094 U
CALCIUM			19187.09	27500	19500	18600	14700 J	26700	25600	18500	17200

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW21D-1006	B81-GW-MW23B-1006	B81-GW-MW32B-1006	B81-GW-MW38B-1006	B81-GW-MW39B-1006	B81-GW-MW40B-1006-AVG	B81-GW-MW41B-0906	B81-GW-MW42B-1006
LOCATION ID				B81-MW-21D	B81-MW-23B	B81-MW-32B	B81-MW-38B	B81-MW-39B	B81-MW-40B	B81-MW-41B	B81-MW-42B
TOP DEPTH				20.5	23	21.5	19	19	20	18.5	17
BOTTOM DEPTH				30.5	33	31.5	29	22	30	28.5	30
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/06/06	10/11/06	10/17/06	10/13/06	10/16/06	10/16/06	09/27/06	10/17/06
METALS (UG/L) (cont.)											
CHROMIUM	100	11	18.1	0.12 U	0.12 U	0.539 UJ	0.12 U	0.902 UJ	0.836 UJ	1.51 U	0.715 UJ
COBALT		73	8.5	0.959 J	0.341 UJ	0.353 J	2.2 J	0.194 UJ	0.566 UJ	0.74 J	1.94 J
COPPER	1300	150	13.5	1.03 UJ	2.03 J	0.798 J	2.6 J	3.24	2.81	4.02 J	1.71 J
IRON		1100	44137.52	210	141 UJ	144 J	123	101 J	177 J	***1760 J***	134 J
LEAD	15	15		0.249 J	0.192 UJ	0.107 J	0.232 UJ	0.075 U	0.127 J	2.05	0.075 U
MAGNESIUM			14205.47	13300	9840 J	6860	8050	8640	8900	6610	6300
MANGANESE		88	2680.63	***766***	***859***	***1830***	***98.4***	14.9	37.4	***282***	54
MERCURY		1.1		0.018 UJ	0.0327 UJ	0.018 U	0.018 UJ	0.018 U	0.018 U	0.026 UJ	0.018 U
NICKEL		73		3.11 J	1.96 J	1.8 UJ	2.48 J	2.06 UJ	2.48 UJ	5.19 J	1.64 UJ
POTASSIUM			6177.62	1380 J	2360 J	1840	1830	1070	1300	2580	1390
SELENIUM	50	18		0.325 UJ	0.292 J	0.11 U	0.823 UJ	0.428 UJ	0.266 UJ	0.578 UJ	0.197 UJ
SODIUM			47342.14	20900	16600	13900	21700	44200	41900	24400	42000
VANADIUM		3.6	22.6	1.23 J	0.358 J	0.175 J	0.291 J	0.117 J	0.198 J	1.6 J	0.195 J
ZINC		1100	51.7	4.96 UJ	7.7 UJ	5.92 J	7.37 J	8.21 J	8.04 J	19.7 J	3.43 J
CYANIDE	200	73		11 U	3.1 UJ	3.7 UJ	2.3 UJ	1.2 U	3.35 UJ	3.6 J	3.8 UJ
DISSOLVED METALS (UG/L)											
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	NA	NA	36.2 J
ARSENIC	10	0.045		NA	NA	NA	NA	NA	NA	NA	***0.154 J***
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	NA	NA	30
CALCIUM			19187.09	NA	NA	NA	NA	NA	NA	NA	16500
COBALT		73	8.5	NA	NA	NA	NA	NA	NA	NA	3.3 J
COPPER	1300	150	13.5	NA	NA	NA	NA	NA	NA	NA	1 J
IRON		1100	44137.52	NA	NA	NA	NA	NA	NA	NA	547 J
LEAD	15	15		NA	NA	NA	NA	NA	NA	NA	0.153 J
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	NA	NA	7580
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	NA	NA	***124***
NICKEL		73		NA	NA	NA	NA	NA	NA	NA	2.65 J
POTASSIUM			6177.62	NA	NA	NA	NA	NA	NA	NA	1950
SODIUM			47342.14	NA	NA	NA	NA	NA	NA	NA	38600
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	NA	NA	0.4 J
ZINC		1100	51.7	NA	NA	NA	NA	NA	NA	NA	5.07 J

TABLE 4-7
SUMMARY OF ANALYTICAL DATA[1] - SHALLOW BEDROCK GROUNDWATER (17 TO <45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW21D-1006	B81-GW-MW23B-1006	B81-GW-MW32B-1006	B81-GW-MW38B-1006	B81-GW-MW39B-1006	B81-GW-MW40B-1006-AVG	B81-GW-MW41B-0906	B81-GW-MW42B-1006
LOCATION ID				B81-MW-21D	B81-MW-23B	B81-MW-32B	B81-MW-38B	B81-MW-39B	B81-MW-40B	B81-MW-41B	B81-MW-42B
TOP DEPTH				20.5	23	21.5	19	19	20	18.5	17
BOTTOM DEPTH				30.5	33	31.5	29	22	30	28.5	30
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/06/06	10/11/06	10/17/06	10/13/06	10/16/06	10/16/06	09/27/06	10/17/06
MISCELLANEOUS PARAMETERS (MG/L)											
AMMONIA-N				NA	NA	NA	NA	0.2 U	0.2 U	0.2 U	NA
CHLORIDE	250			NA	NA	NA	NA	87 J	6 UJ	15	NA
NITRATE	10	1		NA	NA	NA	NA	0.81	0.82	NA	NA
NITRATE-N	10			NA	NA	NA	NA	NA	NA	0.13 U	NA
SULFATE	250			NA	NA	NA	NA	16	16.5	51 J	NA
TOTAL ORGANIC CARBON				NA	NA	NA	NA	1 U	1 U	1.8	NA
VOLATILE GASES (UG/L)											
METHANE				NA	NA	NA	NA	14 U	14 U	14 U	NA
FIELD (MG/L)											
FERROUS IRON				NA	NA	NA	NA	0.05	0.03 U	0.66	NA

Notes:

1) This table contains the detect and non-detect results for all parameters detected in at least one sample in this media subgroup.
Complete results for all parameters are presented in Appendix F.

PRG - EPA Region IX PRGs for tap water (EPA. 2004) (human health risk based values). The PRG values presented represent a cancer risk level of 10-6 and a hazard quotient of 0.1.

MCL - The lower of the U.S. EPA Maximum Contaminant Level (MCL) for drinking water and the Massachusetts MCL (MMCL).

BKG - NAS South Weymouth Background Value (Stone & Webster, 2002)

Black Background/White print - Primary Criteria Exceeded

Bold Italics (black or gray background) - Secondary Criteria Exceeded

Gray Background - Detected

B or JB - Possible Field Blank Contamination

U - Not Detected

UJ - Detection Limit Approximate

J - Quantitation Limit Approximate

R - Rejected

TABLE 4-8
SUMMARY OF ANALYTICAL DATA[1] - DEEP BEDROCK GROUNDWATER (>=45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW3D-0906	B81-GW-MW3D2-1006	B81-GW-MW8D-1006	B81-GW-MW9D2-0906	B81-GW-MW10D2-1006	B81-GW-MW21D2-1006	B81-GW-MW22D2-1006	B81-GW-MW23D-1006
LOCATION ID				B81-MW-03D	B81-MW-03D2	B81-MW-08D	B81-MW-09D2	B81-MW-10D2	B81-MW-21D2	B81-MW-22D2	B81-MW-23D
TOP DEPTH				50	110	80	60	49	49	62	60
BOTTOM DEPTH				60	120	90	70	58.83	58.7	72	70
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/22/06	10/10/06	10/04/06	09/28/06	10/05/06	10/06/06	10/10/06	10/04/06
VOLATILE ORGANIC COMPOUNDS (UG/L)											
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		NA	0.5 U	0.5 U	NA	0.67	200	0.5 U	0.5 U
1,2-DICHLOROETHANE	5	0.12		0.1 U	0.1 UJ	0.1 U	0.1 U	0.1 U	0.5 U	0.1 U	***0.13***
ACETONE		550		5 UJ	5 U	5 UJ	5 U	5 UJ	26	5 U	5 UJ
BENZENE	5	0.35		***0.45***	0.1 UJ	0.1 U	0.14	0.1 U	***2***	0.1 U	0.1 U
CARBON DISULFIDE		100		0.1 U	0.1 UJ	0.1 U	0.1 U	0.1 U	0.5 U	0.1 U	0.1 U
CARBON TETRACHLORIDE	5	0.17		0.1 U	***0.33 J***	0.1 U	0.1 U	0.1 U	0.5 U	0.1 U	0.1 U
CIS-1,2-DICHLOROETHENE	70	6.1		***27***	0.5 U	0.45 J	2	0.5 U	***15 J***	0.5 U	0.5 UJ
TOTAL 1,2-DICHLOROETHENE	5	6.1		***27***	0.5 U	0.45 J	2	0.5 U	***15 J***	0.5 U	0.5 UJ
CYCLOHEXANE		1000		NA	0.5 U	0.5 U	NA	0.5 U	0.43 J	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE		39		1 U	7.7	0.5 U	1 U	0.98	33	0.5 U	0.5 U
METHYL TERT-BUTYL ETHER		6.2		1 U	0.5 U	0.5 U	1 U	0.5 U	4	0.5 U	0.5 U
TETRACHLOROETHENE	5	0.1		***2800***	***0.55 J***	***15***	***12***	***0.51***	***220***	0.1 U	***0.2***
TRICHLOROETHENE	5	0.028	0.73	***180***	0.1 UJ	***1.2 J***	***0.82***	0.1 U	***5***	0.1 U	0.1 U
TRICHLOROFLUOROMETHANE		130		1 U	0.96	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	2	0.02		***0.15***	0.1 UJ	0.1 U	0.1 U	0.1 U	***2.6***	0.1 U	0.1 U
TOTAL CHLORINATED ETHENES				3007.15	0.55 J	16.65 J	14.82	0.51	242.6 J	0.2 U	0.7 J
TOTAL CHLORINATED VOCS				3007.15	9.54 J	16.65 J	14.82	2.16 J	475.6 J	0.33 U	0.83 J
BTEX				0.45	0.4 UJ	0.4 U	0.14	0.4 U	2	0.4 U	0.4 U
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)											
1,4-DIOXANE		6.1		1 UJ	***7 J***	1 UJ	1 UJ	1 UJ	1 UJ	3 J	1 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		1 U	1 U	1 U	1 U	1	1 U	1 U	2
CAPROLACTAM		1800		69 J	10 UJ	100 J	110 J	460 J	180 J	6 J	210 J
DI-N-BUTYL PHTHALATE		360	3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
NAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U	0.33	0.1 U	0.1 U	0.1 U	0.1 U
PHENOL		1100		0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ
LOW MOLECULAR WEIGHT PAHS				0.1 U	0.1 U	0.1 U	0.33	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL PAHS			0.0775	0.1 U	0.1 U	0.1 U	0.33	0.1 U	0.1 UJ	0.1 U	0.1 U
PESTICIDES/PCBS (UG/L)											
BETA-BHC		0.037		0.01 U	0.01 U	0.01 U	0.013 J	0.01 U	0.01 U	0.01 U	0.01 U
HEPTACHLOR EPOXIDE	0.2	0.0074		***0.026 J***	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U

TABLE 4-8
SUMMARY OF ANALYTICAL DATA[1] - DEEP BEDROCK GROUNDWATER (>=45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW3D-0906	B81-GW-MW3D2-1006	B81-GW-MW8D-1006	B81-GW-MW9D2-0906	B81-GW-MW10D2-1006	B81-GW-MW21D2-1006	B81-GW-MW22D2-1006	B81-GW-MW23D-1006
LOCATION ID				B81-MW-03D	B81-MW-03D2	B81-MW-08D	B81-MW-09D2	B81-MW-10D2	B81-MW-21D2	B81-MW-22D2	B81-MW-23D
TOP DEPTH				50	110	80	60	49	49	62	60
BOTTOM DEPTH				60	120	90	70	58.83	58.7	72	70
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/22/06	10/10/06	10/04/06	09/28/06	10/05/06	10/06/06	10/10/06	10/04/06
METALS (UG/L)											
ALUMINUM		3600	15341.35	156	262	NA	1020 J	214 J	836 J	41.2 J	253 J
ARSENIC	10	0.045		0.162 UJ	***0.569 J***	NA	0.288 UJ	0.292 UJ	***2.2***	0.331 UJ	***5.28***
BARIUM	2000	260	181.32	28.3	10.2 U	NA	64.4	40.1	56.2	112	25 J
BERYLLIUM	4	7.3	0.77	0.043 U	0.043 U	NA	0.118 UJ	0.043 U	0.0804 J	0.043 U	0.043 U
CADMIUM	5	1.8		0.094 U	0.094 U	NA	0.094 U	0.155 J	0.134 J	0.094 U	0.094 U
CALCIUM			19187.09	17700	10300	NA	13400	8940	32000	18600 J	12800
CHROMIUM	100	11	18.1	0.907 UJ	0.349 J	NA	0.891 J	1.84	0.687 J	0.12 U	1.22 UJ
COBALT		73	8.5	0.275 UJ	0.245 UJ	NA	1.82 J	0.197 UJ	1.54 J	0.138 UJ	0.138 UJ
COPPER	1300	150	13.5	0.638 J	1.3 J	NA	2.84	4.79 UJ	9.82 UJ	1.52 J	2.28 J
IRON		1100	44137.52	595	653 J	NA	***1880 J***	297	1030	569	182 J
LEAD	15	15		0.633 J	1.77 J	NA	2.03	1.35	3.44	0.857 J	1.5 J
MAGNESIUM			14205.47	5700	1090 J	NA	2190	905	4700	1850	499 J
MANGANESE		88	2680.63	***1380***	***248***	NA	***772***	86.5	***824***	***471***	12 J
NICKEL		73		1.41 J	1.03 J	NA	2.27 J	23.9	6.58 J	1.11 UJ	1.09 UJ
POTASSIUM			6177.62	1940 J	1480 J	NA	1760 J	1070 J	5070 J	1100	4330
SELENIUM	50	18		0.429 UJ	0.351 J	NA	0.216 UJ	0.136 UJ	0.469 UJ	0.11 U	0.373 UJ
SILVER		18		0.085 U	0.085 U	NA	0.085 U	0.109 J	0.574 J	0.085 U	0.085 U
SODIUM			47342.14	13900	16300	NA	7620	4790	16400	18500	30800 J
THALLIUM	2	0.24		0.044 U	0.044 U	NA	0.044 U	0.044 U	0.0457 J	0.044 U	0.044 U
VANADIUM		3.6	22.6	0.187 J	0.992 J	NA	2.14 J	0.377 J	1.37 J	0.191 J	2.17
ZINC		1100	51.7	10.8 U	36.5 U	NA	23.6	36.4	33.5	8.62 J	41.3 J
CYANIDE	200	73		3.6 UJ	2.9 UJ	NA	1.8 UJ	1.2 UJ	9.2 UJ	15	1.2 UJ
DISSOLVED METALS (UG/L)											
ALUMINUM		3600	15341.35	NA	NA	NA	NA	NA	43.9 J	NA	NA
ANTIMONY	6	1.5		NA	NA	NA	NA	NA	0.447 UJ	NA	NA
ARSENIC	10	0.045		NA	NA	NA	NA	NA	***1.83***	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	NA	33.5	NA	NA
CALCIUM			19187.09	NA	NA	NA	NA	NA	27800	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	NA	NA	0.169 J	NA	NA
COBALT		73	8.5	NA	NA	NA	NA	NA	1.38 J	NA	NA
IRON		1100	44137.52	NA	NA	NA	NA	NA	428	NA	NA
LEAD	15	15		NA	NA	NA	NA	NA	0.391 J	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	NA	NA	4500	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	NA	***720***	NA	NA

TABLE 4-8
SUMMARY OF ANALYTICAL DATA[1] - DEEP BEDROCK GROUNDWATER (>=45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW3D-0906	B81-GW-MW3D2-1006	B81-GW-MW8D-1006	B81-GW-MW9D2-0906	B81-GW-MW10D2-1006	B81-GW-MW21D2-1006	B81-GW-MW22D2-1006	B81-GW-MW23D-1006
LOCATION ID				B81-MW-03D	B81-MW-03D2	B81-MW-08D	B81-MW-09D2	B81-MW-10D2	B81-MW-21D2	B81-MW-22D2	B81-MW-23D
TOP DEPTH				50	110	80	60	49	49	62	60
BOTTOM DEPTH				60	120	90	70	58.83	58.7	72	70
SAMPLE DATE	**MCL**	**PRG**	**BKG**	09/22/06	10/10/06	10/04/06	09/28/06	10/05/06	10/06/06	10/10/06	10/04/06
DISSOLVED METALS (UG/L) (cont.)											
NICKEL		73		NA	NA	NA	NA	NA	6.39 J	NA	NA
POTASSIUM			6177.62	NA	NA	NA	NA	NA	4920 J	NA	NA
SODIUM			47342.14	NA	NA	NA	NA	NA	16600	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	NA	0.877 J	NA	NA
ZINC		1100	51.7	NA	NA	NA	NA	NA	26.6	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)											
AMMONIA-N				NA	NA	NA	0.2 U	NA	NA	NA	NA
CHLORIDE	250			NA	NA	NA	6.4	NA	NA	NA	NA
NITRATE-N	10			NA	NA	NA	0.13 U	NA	NA	NA	NA
SULFATE	250			NA	NA	NA	21 J	NA	NA	NA	NA
TOTAL ORGANIC CARBON				NA	NA	NA	1.1	NA	NA	NA	NA
VOLATILE GASES (UG/L)											
METHANE				NA	NA	NA	39	NA	NA	NA	NA

TABLE 4-8
SUMMARY OF ANALYTICAL DATA[1] - DEEP BEDROCK GROUNDWATER (>=45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW24D-1006	B81-GW-MW25D-1006	B81-GW-MW26D-1006	B81-GW-MW27D-0906	B81-GW-MW31D-1006-AVG	B81-GW-MW32D-1006	B81-GW-MW33D-1006	B81-GW-MW34D-1006-AVG
LOCATION ID				B81-MW-24D	B81-MW-25D	B81-MW-26D	B81-MW-27D	B81-MW-31D	B81-MW-32D	B81-MW-33D	B81-MW-34D
TOP DEPTH				60	70	60	50	70	60	50	70
BOTTOM DEPTH				70	80	70	60	80	70	60	80
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/03/06	10/10/06	10/06/06	09/29/06	10/13/06	10/11/06	10/12/06	10/10/06
VOLATILE ORGANIC COMPOUNDS (UG/L)											
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		2	0.5 U	0.5 U	NA	0.5 U	0.5 U	10	0.525
1,2-DICHLOROETHANE	5	0.12		0.1 U	***0.18 J***	***0.14***	0.1 U	0.1 U	0.1 U	0.1 U	0.1 UJ
ACETONE		550		5 UJ	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U
BENZENE	5	0.35		0.16	0.1 U	0.1 U	0.34	0.1 U	0.1 U	***1***	0.1 UJ
CARBON DISULFIDE		100		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 UJ
CARBON TETRACHLORIDE	5	0.17		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 UJ
CIS-1,2-DICHLOROETHENE	70	6.1		0.38 J	1.6	0.5 U	1 U	0.5 U	0.5 U	2.4	0.29 J
TOTAL 1,2-DICHLOROETHENE	5	6.1		0.38 J	1.6	0.5 U	1 U	0.5 U	0.5 U	2.4	0.29 J
CYCLOHEXANE		1000		0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE		39		0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	18	0.5 U
METHYL TERT-BUTYL ETHER		6.2		0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	1.3	0.5 U
TETRACHLOROETHENE	5	0.1		***3.3***	***0.67 J***	***0.49***	***0.32***	0.1 U	***0.12 J***	***4.1***	***16***
TRICHLOROETHENE	5	0.028	0.73	***0.36***	***0.32 J***	0.1 U	0.1 U	0.1 U	0.1 U	***0.39 J***	***1.35 J***
TRICHLOROFLUOROMETHANE		130		0.5 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	2	0.02		***0.17***	0.1 U	0.1 U	0.1 U	0.1 U	***0.21 J***	***1.4***	0.1 UJ
TOTAL CHLORINATED ETHENES				4.21 J	2.59 J	0.49	0.32	0.2 U	0.33 J	8.29 J	17.64 J
TOTAL CHLORINATED VOCS				6.21 J	2.77 J	0.63	0.32	0.35 U	0.33 J	36.29 J	18.165 J
BTEX				0.16	0.4 U	0.4 U	0.34	0.4 U	0.4 U	1	0.4 UJ
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)											
1,4-DIOXANE		6.1		1 UJ	2 J	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		2	2	1	1 U	1 U	1 U	1 U	0.75
CAPROLACTAM		1800		90 J	10 UJ	120 J	35 J	10 UJ	41 J	79 J	7.5 J
DI-N-BUTYL PHTHALATE		360	3	1 U	1 U	1 U	1 U	0.75 B	1 U	1 U	1 U
NAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PHENOL		1100		0.1 UJ	0.25 J	0.1 UJ	0.1 UJ	1.45 UJ	0.1 UJ	0.1 UJ	0.1 UJ
LOW MOLECULAR WEIGHT PAHS				0.1 U	0.1 U	0.1 U	0.1 UJ	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL PAHS			0.0775	0.1 U	0.1 U	0.1 U	0.69 UJ	0.1 UJ	0.1 U	0.1 U	0.1 U
PESTICIDES/PCBS (UG/L)											
BETA-BHC		0.037		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
HEPTACHLOR EPOXIDE	0.2	0.0074		0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U

TABLE 4-8
SUMMARY OF ANALYTICAL DATA[1] - DEEP BEDROCK GROUNDWATER (>=45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW24D-1006	B81-GW-MW25D-1006	B81-GW-MW26D-1006	B81-GW-MW27D-0906	B81-GW-MW31D-1006-AVG	B81-GW-MW32D-1006	B81-GW-MW33D-1006	B81-GW-MW34D-1006-AVG
LOCATION ID				B81-MW-24D	B81-MW-25D	B81-MW-26D	B81-MW-27D	B81-MW-31D	B81-MW-32D	B81-MW-33D	B81-MW-34D
TOP DEPTH				60	70	60	50	70	60	50	70
BOTTOM DEPTH				70	80	70	60	80	70	60	80
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/03/06	10/10/06	10/06/06	09/29/06	10/13/06	10/11/06	10/12/06	10/10/06
METALS (UG/L)											
ALUMINUM		3600	15341.35	314 J	254	467 J	1590 J	32 U	32 U	32 U	91
ARSENIC	10	0.045		***0.507 J***	0.14 UJ	0.654 UJ	***1.63***	***0.63 J***	***0.731 J***	0.194 UJ	0.152 UJ
BARIUM	2000	260	181.32	29.4 J	21.1 U	16.9	207	136	137	132	107
BERYLLIUM	4	7.3	0.77	0.043 U	0.615 J	0.135 J	1.4 J	0.043 U	0.043 U	0.043 U	0.0348 J
CADMIUM	5	1.8		0.172 J	0.355 J	0.094 U	0.203 J	0.094 U	0.094 U	0.094 U	0.094 U
CALCIUM			19187.09	13800	25000	5660	23800	14500	29800	24200	19600 J
CHROMIUM	100	11	18.1	1.98 UJ	0.12 U	1.89	0.12 UJ	0.12 U	0.12 U	0.12 U	0.12 U
COBALT		73	8.5	0.741 J	4.14 J	0.252 UJ	2.35 J	0.23 UJ	0.116 UJ	0.204 UJ	0.263 UJ
COPPER	1300	150	13.5	7.74 J	1.72 J	2.73 UJ	3.34	0.582 J	0.568 J	0.52 UJ	0.683 J
IRON		1100	44137.52	457 J	272 J	***2090***	***3970 J***	184 UJ	133 UJ	588 J	350
LEAD	15	15		***18.5 J***	0.296 UJ	2.82	***18.7***	0.152 UJ	0.177 UJ	0.0921 UJ	0.952 J
MAGNESIUM			14205.47	1570 J	2830 J	562	5050	1590 J	3960 J	5170 J	8930
MANGANESE		88	2680.63	***158 J***	***1640***	52.2	***1420***	***586***	***316***	***722***	***1180***
NICKEL		73		3.17 J	8.37 J	1.21 UJ	5.23 J	0.562 UJ	0.847 UJ	0.744 UJ	1.34 UJ
POTASSIUM			6177.62	2430	4250 J	2150 J	2130 J	1090 J	1480 J	1580 J	1310
SELENIUM	50	18		0.797 UJ	1.43 J	0.11 U	0.57 UJ	0.0885 J	0.11 U	0.11 U	0.132 UJ
SILVER		18		0.085 U	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U
SODIUM			47342.14	15200 J	28400	15100	27300	23000	11000	11500	13000
THALLIUM	2	0.24		0.044 U	0.044 U	0.044 U	0.0709 J	0.044 U	0.044 U	0.044 U	0.044 U
VANADIUM		3.6	22.6	1.1 J	0.125 J	***4.37***	3.12 J	0.0544 J	0.305 J	0.0492 J	0.108 J
ZINC		1100	51.7	171 J	67.9	29	71.6	7.02 UJ	9.51 UJ	13.2 U	21.2 J
CYANIDE	200	73		1.2 UJ	3.6 UJ	1.2 U	1.2 U	2.15 UJ	5.6 UJ	5.1 UJ	16
DISSOLVED METALS (UG/L)											
ALUMINUM		3600	15341.35	NA	NA	NA	40 J	NA	NA	NA	NA
ANTIMONY	6	1.5		NA	NA	NA	0.229 J	NA	NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA	0.235 UJ	NA	NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA	44.1	NA	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA	13200	NA	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	0.12 UJ	NA	NA	NA	NA
COBALT		73	8.5	NA	NA	NA	2.17 J	NA	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA	246 J	NA	NA	NA	NA
LEAD	15	15		NA	NA	NA	0.0806 UJ	NA	NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA	3350	NA	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	***830***	NA	NA	NA	NA

TABLE 4-8
SUMMARY OF ANALYTICAL DATA[1] - DEEP BEDROCK GROUNDWATER (>=45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW24D-1006	B81-GW-MW25D-1006	B81-GW-MW26D-1006	B81-GW-MW27D-0906	B81-GW-MW31D-1006-AVG	B81-GW-MW32D-1006	B81-GW-MW33D-1006	B81-GW-MW34D-1006-AVG
LOCATION ID				B81-MW-24D	B81-MW-25D	B81-MW-26D	B81-MW-27D	B81-MW-31D	B81-MW-32D	B81-MW-33D	B81-MW-34D
TOP DEPTH				60	70	60	50	70	60	50	70
BOTTOM DEPTH				70	80	70	60	80	70	60	80
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/03/06	10/10/06	10/06/06	09/29/06	10/13/06	10/11/06	10/12/06	10/10/06
DISSOLVED METALS (UG/L) (cont.)											
NICKEL		73		NA	NA	NA	1.21 UJ	NA	NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA	1030 J	NA	NA	NA	NA
SODIUM			47342.14	NA	NA	NA	22700	NA	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	0.049 U	NA	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA	6.74 UJ	NA	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)											
AMMONIA-N				0.29	NA	NA	NA	NA	NA	NA	NA
CHLORIDE	250			3.5	NA	NA	NA	NA	NA	NA	NA
NITRATE-N	10			0.52 J	NA	NA	NA	NA	NA	NA	NA
SULFATE	250			13 U	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON				2.3	NA	NA	NA	NA	NA	NA	NA
VOLATILE GASES (UG/L)											
METHANE				14 U	NA	NA	NA	NA	NA	NA	NA

TABLE 4-8
SUMMARY OF ANALYTICAL DATA[1] - DEEP BEDROCK GROUNDWATER (>=45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW35D-1006	B81-GW-MW36D-1006	B81-GW-MW37D-1006
LOCATION ID				B81-MW-35D	B81-MW-36D	B81-MW-37D
TOP DEPTH				80	100	80
BOTTOM DEPTH				90	110	90
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/09/06	10/09/06	10/11/06
VOLATILE ORGANIC COMPOUNDS (UG/L)						
1,1,2-TRICHLOROTRIFLUOROETHANE		5900		0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	5	0.12		0.2 UJ	0.1 U	***2.1 J***
ACETONE		550		5 U	5 U	5 U
BENZENE	5	0.35		0.2 UJ	0.1 U	0.15 J
CARBON DISULFIDE		100		0.2 UJ	0.1 U	0.24 J
CARBON TETRACHLORIDE	5	0.17		0.2 UJ	0.1 U	0.1 U
CIS-1,2-DICHLOROETHENE	70	6.1		1.1	0.5 U	***8.8***
TOTAL 1,2-DICHLOROETHENE	5	6.1		1.1	0.5 U	***8.8***
CYCLOHEXANE		1000		0.5 U	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE		39		0.5 U	0.5 U	0.5 U
METHYL TERT-BUTYL ETHER		6.2		0.5 U	0.5 U	4
TETRACHLOROETHENE	5	0.1		***49***	0.1 U	***0.36 J***
TRICHLOROETHENE	5	0.028	0.73	***7 J***	0.1 U	***0.17 J***
TRICHLOROFLUOROMETHANE		130		0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	2	0.02		0.2 UJ	0.1 U	***1.1 J***
TOTAL CHLORINATED ETHENES				57.1 J	0.2 U	10.43 J
TOTAL CHLORINATED VOCS				57.1 J	0.33 U	12.53 J
BTEX				0.42 UJ	0.4 U	0.15 J
SEMIVOLATILE ORGANIC COMPOUNDS (UG/L)						
1,4-DIOXANE		6.1		1 UJ	1 UJ	1 UJ
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		1 U	1	1 U
CAPROLACTAM		1800		10 UJ	2 J	98 J
DI-N-BUTYL PHTHALATE		360	3	1 U	1 U	1 U
NAPHTHALENE		0.62		0.1 U	0.1 U	0.1 U
PHENOL		1100		0.1 UJ	0.1 UJ	0.1 UJ
LOW MOLECULAR WEIGHT PAHS				0.1 U	0.1 U	0.1 U
TOTAL PAHS			0.0775	0.1 U	0.1 U	0.1 U
PESTICIDES/PCBS (UG/L)						
BETA-BHC		0.037		0.01 U	0.01 U	0.01 U
HEPTACHLOR EPOXIDE	0.2	0.0074		0.01 U	0.01 U	0.01 U

TABLE 4-8
SUMMARY OF ANALYTICAL DATA[1] - DEEP BEDROCK GROUNDWATER (>=45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW35D-1006	B81-GW-MW36D-1006	B81-GW-MW37D-1006
LOCATION ID				B81-MW-35D	B81-MW-36D	B81-MW-37D
TOP DEPTH				80	100	80
BOTTOM DEPTH				90	110	90
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/09/06	10/09/06	10/11/06
METALS (UG/L)						
ALUMINUM		3600	15341.35	75.8	37.3 J	62
ARSENIC	10	0.045		0.361 UJ	0.616 UJ	***3.94***
BARIUM	2000	260	181.32	44.2	52.7	72.5
BERYLLIUM	4	7.3	0.77	0.043 U	0.043 U	0.0668 J
CADMIUM	5	1.8		0.094 U	0.094 U	0.094 U
CALCIUM			19187.09	14300 J	18700 J	19700
CHROMIUM	100	11	18.1	0.367 J	0.12 U	0.12 U
COBALT		73	8.5	0.256 UJ	0.305 UJ	0.726 UJ
COPPER	1300	150	13.5	0.967 J	0.52 UJ	1.69 J
IRON		1100	44137.52	429	783	***1970 J***
LEAD	15	15		0.46 UJ	0.254 UJ	0.245 UJ
MAGNESIUM			14205.47	2780	2900	3460 J
MANGANESE		88	2680.63	***378***	***430***	***1050***
NICKEL		73		1.6 J	0.9 UJ	2.73 UJ
POTASSIUM			6177.62	1810	1600	1930 J
SELENIUM	50	18		0.117 UJ	0.11 U	0.18 J
SILVER		18		0.085 U	0.085 U	0.085 U
SODIUM			47342.14	18100	9000	73000
THALLIUM	2	0.24		0.044 U	0.044 U	0.044 U
VANADIUM		3.6	22.6	0.155 J	0.0614 J	0.202 J
ZINC		1100	51.7	17.2 J	13.9 J	23.2 U
CYANIDE	200	73		9.1 UJ	1.2 U	2.5 UJ
DISSOLVED METALS (UG/L)						
ALUMINUM		3600	15341.35	NA	NA	NA
ANTIMONY	6	1.5		NA	NA	NA
ARSENIC	10	0.045		NA	NA	NA
BARIUM	2000	260	181.32	NA	NA	NA
CALCIUM			19187.09	NA	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA
COBALT		73	8.5	NA	NA	NA
IRON		1100	44137.52	NA	NA	NA
LEAD	15	15		NA	NA	NA
MAGNESIUM			14205.47	NA	NA	NA
MANGANESE		88	2680.63	NA	NA	NA

TABLE 4-8
SUMMARY OF ANALYTICAL DATA[1] - DEEP BEDROCK GROUNDWATER (>=45 FT)
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW35D-1006	B81-GW-MW36D-1006	B81-GW-MW37D-1006
LOCATION ID				B81-MW-35D	B81-MW-36D	B81-MW-37D
TOP DEPTH				80	100	80
BOTTOM DEPTH				90	110	90
SAMPLE DATE	**MCL**	**PRG**	**BKG**	10/09/06	10/09/06	10/11/06
DISSOLVED METALS (UG/L) (cont.)						
NICKEL		73		NA	NA	NA
POTASSIUM			6177.62	NA	NA	NA
SODIUM			47342.14	NA	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA
ZINC		1100	51.7	NA	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)						
AMMONIA-N				NA	NA	NA
CHLORIDE	250			NA	NA	NA
NITRATE-N	10			NA	NA	NA
SULFATE	250			NA	NA	NA
TOTAL ORGANIC CARBON				NA	NA	NA
VOLATILE GASES (UG/L)						
METHANE				NA	NA	NA

Notes:

1) This table contains the detect and non-detect results for all parameters detected in at least one sample in this media subgroup. Complete results for all parameters are presented in Appendix F.
PRG - EPA Region IX PRGs for tap water (EPA. 2004) (human health risk based values). The PRG values presented represent a cancer risk level of 10-6 and a hazard quotient of 0.1.
MCL - The lower of the U.S. EPA Maximum Contaminant Level (MCL) for drinking water and the Massachusetts MCL (MMCL).
BKG - NAS South Weymouth Background Value (Stone & Webster, 2002)
Black Background/White print - Primary Criteria Exceeded
Bold Italics (black or gray background) - Secondary Criteria Exceeded
Gray Background - Detected
B or JB - Possible Field Blank Contamination
U - Not Detected
UJ - Detection Limit Approximate
J - Quantitation Limit Approximate
R - Rejected

TABLE 4-5A
SUMMARY OF ANALYTICAL DETAILS[1] - WATER TABLE INTERVAL GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID	MCL	PRG	BKG	B81-GW-MW8S-1109-AVG	B81-GW-MW20S-1109	B81-GW-MW21S-1109	B81-GW-MW38S-1109	B81-GW-MW42S-1109	B81-GW-MW43S-1109	B81-GW-MW44S-1109	B81-GW-MW45S-1209	B81-GW-MW46S-1109
LOCATION ID				B81-MW-08S	B81-MW-20S	B81-MW-21S	B81-MW-38S	B81-MW-42S	B81-MW-43S	B81-MW-44S	B81-MW-45S	B81-MW-46S
TOP DEPTH				4.0	2.6	4.7	3.0	4.0		3.0	3.0	4.0
BOTTOM DEPTH				13.0	12.6	14.7	8.0	9.0		13.0	13.0	14.0
SAMPLE DATE				11/18/09	11/17/09	11/19/09	11/12/09	11/05/09	11/24/09	11/25/09	12/14/09	11/25/09
VOLATILES (UG/L)												
ACETONE		550		2 U	2 U	2 U	2 U	2 U	2 U	3 J	2 UJ	2 U
BENZENE	5	0.35		0.0074 UJ	0.020 UJ	0.017 UJ	0.018 UJ	0.0072 U	0.0092 UJ	0.081	0.019 J	0.011 UJ
BROMODICHLOROMETHANE	80	0.18		0.016 U	0.016 UJ	0.016 U	0.016 U	0.016 U	0.13	***0.25***	0.082	0.17
BTEX				0.177 UJ	12 J	0.179 UJ	0.18 UJ	0.177 U	0.177 UJ	0.081	0.019 J	0.178 UJ
CHLOROFORM	80	0.17	3.2	0.050 U	0.050 UJ	0.050 U	0.050 U	0.050 U	***0.96***	***2***	***2***	***0.84***
CIS-1,2-DICHLOROETHENE	70	6.1		0.6 UJ	***32***	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	1.0 J
CYCLOHEXANE		1000		0.3 U	0.7 J	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 UJ	0.3 U
ETHYLBENZENE	700	130		0.2 U	3	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ISOPROPYLBENZENE		66		0.2 U	2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
M+P-XYLENES		21		0.6 U	5	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
O-XYLENE		21		0.2 U	4	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TETRACHLOROETHENE	5	0.1		0.048 UJ	***19***	***10***	***2***	0.011 U	***0.66 J***	***0.80***	0.086 UJ	0.097 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		0.4 UJ	***32***	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	1 J
TOTAL CHLORINATED ETHENES				0.096 J	56 J	10.2	2.08	0.126 U	0.66 J	0.812 J	0.038 J	1.02 J
TOTAL XYLENES	10000	21		0.2 U	9	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRICHLOROETHENE	5	0.028	0.73	***0.096***	***5***	***0.22***	***0.080***	0.0082 U	0.040 UJ	0.0082 U	***0.038 J***	0.075 U
VINYL CHLORIDE	2	0.02		0.0100 U	***0.035 J***	0.0100 U	0.0100 U	0.0100 U	0.0100 U	0.012 J	0.0100 U	0.019 J
VOLATILE GASES (UG/L)												
ETHENE				0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	0.96 J
METHANE				18	220	1.1 J	18	2.0 J	1.2 J	96	12	17
SEMIVOLATILES (UG/L)												
2-METHYLNAPHTHALENE		0.62		0.08 U	0.3	0.08 UJ	0.07 U	0.07 U	0.07 U	0.08 U	0.07 U	0.07 U
BENZO(A)ANTHRACENE		0.092	0.0475	0.05 U	0.05 U	0.05 U	0.04 U	0.04 U	0.04 U	***0.2 J***	0.04 U	0.04 U
HIGH MOLECULAR WEIGHT PAHS				0.062 UJ	0.063 UJ	0.062 UJ	0.057 UJ	0.057 U	0.057 UJ	0.2 J	0.057 U	0.057 U
LOW MOLECULAR WEIGHT PAHS				0.0586 U	1.1	0.0586 UJ	0.0557 U	0.0557 U	0.0557 U	0.0571 U	0.0557 U	0.0557 U
NAPHTHALENE		0.62		0.06 U	***0.8***	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
TOTAL PAHS			0.0775	0.0606 UJ	1.1 J	0.0606 UJ	0.0565 UJ	0.0565 U	0.0565 UJ	0.2 J	0.0565 U	0.0565 U
PESTICIDES/PCBS (UG/L)												
4,4'-DDD		0.28		0.0017 U	0.0017 U	0.0018 U	0.0041 J	0.0017 U	0.0017 U	0.0018 UJ	0.0017 U	0.0018 U
4,4'-DDE		0.2		0.00095 U	0.00092 U	0.00096 U	0.00093 U	0.00095 U	0.00092 U	0.00096 UJ	0.0057 J	0.00096 U
ALPHA-CHLORDANE	2	0.19		0.011 J	0.0014 U	0.0015 U	0.0014 U	0.0015 U	0.0014 U	0.0015 UJ	0.0015 U	0.0015 U
DELTA-BHC		0.011		0.0025 UJ	0.0024 UJ	0.0025 U	0.0025 UJ	0.0025 U	0.0024 U	0.0025 UJ	0.0055 J	0.0025 U
ENDRIN KETONE		1.1		0.0066 J	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 UJ	0.0015 U	0.0015 U
METALS (UG/L)												
ALUMINUM		3600	15341.4	43.3 UJ	1040	257 J	22.2 UJ	NA	28.3 UJ	320	NA	127 UJ
ARSENIC	10	0.045		***3.6 J***	***3.0 J***	***2.3 J***	***6.5***	NA	***2.2 J***	***2.9 J***	NA	***3.1 J***
BARIUM	2000	260	181.32	7.8	11.5	2.9	2.4	NA	12.9	16.5	NA	24.2
CALCIUM			19187.1	6460	11100	7620	4480	NA	3690	8160	NA	16200
CHROMIUM	100	11	18.1	2.6 J	3.6 J	2.4 UJ	4.2 J	NA	3.2 U	3.1 U	NA	3.9 U
COBALT		73	8.5	0.10 U	0.34 UJ	0.13 UJ	0.10 U	NA	0.14 UJ	1.2	NA	0.62 UJ
COPPER	1300	150	13.5	0.49 J	5.2	0.79 UJ	0.35 U	NA	1.3 U	1.3 U	NA	1.3 U
IRON		1100	44137.5	22.50 U	978	239 U	22.50 U	NA	22.50 U	481	NA	117 U

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-5A
SUMMARY OF ANALYTICAL DETAILS[1] - WATER TABLE INTERVAL GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW8S-1109-AVG	B81-GW-MW20S-1109	B81-GW-MW21S-1109	B81-GW-MW38S-1109	B81-GW-MW42S-1109	B81-GW-MW43S-1109	B81-GW-MW44S-1109	B81-GW-MW45S-1209	B81-GW-MW46S-1109
LOCATION ID				B81-MW-08S	B81-MW-20S	B81-MW-21S	B81-MW-38S	B81-MW-42S	B81-MW-43S	B81-MW-44S	B81-MW-45S	B81-MW-46S
TOP DEPTH				4.0	2.6	4.7	3.0	4.0		3.0	3.0	4.0
BOTTOM DEPTH				13.0	12.6	14.7	8.0	9.0		13.0	13.0	14.0
SAMPLE DATE	**MCL**	**PRG**	**BKG**	11/18/09	11/17/09	11/19/09	11/12/09	11/05/09	11/24/09	11/25/09	12/14/09	11/25/09
LEAD	15	15		0.14 UJ	1.5	0.18 J	0.05 U	NA	0.05 U	0.24 J	NA	0.14 J
MAGNESIUM			14205.5	1770	907	2380	2070	NA	954	2460	NA	7200
MANGANESE		88	2680.63	***91.2***	16.3	12.5	1.6	NA	***173***	***810***	NA	***726***
MERCURY	2	1.1		0.02 U	0.02 U	0.02 U	0.02 U	NA	0.02 U	0.02 J	NA	0.02 U
NICKEL		73		0.76 J	5.6 J	0.51 J	0.22 UJ	NA	0.41 J	1.5	NA	1.6
POTASSIUM			6177.62	836 J	752 J	727 UJ	440 J	NA	886 J	1620	NA	2680
SODIUM			47342.1	11600	4980	7780	5420	NA	11100	30400	NA	19600
VANADIUM		3.6	22.6	2.3 J	***3.7 J***	2.1 UJ	***5.8***	NA	2.5 UJ	3.2 UJ	NA	2.7 UJ
ZINC		1100	51.7	7.1 J	42.0 J	4.5 J	3.55 UJ	NA	3.55 U	4.3 J	NA	3.55 U
DISSOLVED METALS (UG/L)												
ARSENIC	10	0.045		NA	NA	NA	NA	2.6 UJ	NA	NA	***3.8 J***	NA
BARIUM	2000	260	181.32	NA	NA	NA	NA	5.1	NA	NA	13.9	NA
CALCIUM			19187.1	NA	NA	NA	NA	12400	NA	NA	6140	NA
CHROMIUM	100	11	18.1	NA	NA	NA	NA	2.4 J	NA	NA	3.8 U	NA
COBALT		73	8.5	NA	NA	NA	NA	0.12 UJ	NA	NA	1.0	NA
COPPER	1300	150	13.5	NA	NA	NA	NA	2.2 U	NA	NA	1.3	NA
LEAD	15	15		NA	NA	NA	NA	0.36 UJ	NA	NA	0.07 J	NA
MAGNESIUM			14205.5	NA	NA	NA	NA	940	NA	NA	1740	NA
MANGANESE		88	2680.63	NA	NA	NA	NA	1.8 U	NA	NA	***1100***	NA
POTASSIUM			6177.62	NA	NA	NA	NA	1150	NA	NA	2890	NA
SODIUM			47342.1	NA	NA	NA	NA	6530	NA	NA	28500	NA
VANADIUM		3.6	22.6	NA	NA	NA	NA	2.0 J	NA	NA	3.0 UJ	NA
MISCELLANEOUS PARAMETERS (MG/L)												
AMMONIA-N				0.10 U	0.10 U	0.10 U	0.10 U	0.042 J	0.10 U	0.16	0.14	0.10 U
CHLORIDE				4.1	11.	4.2	4.1	7.8	7.3	8.8	9.8	6.5
FERROUS IRON				0.03 U	0.23 J	0.07	0.03 U	0.03 U	0.03 U	0.14	0.03 U	0.1
NITRATE-N	10			0.050 U	0.050 U	0.60	0.32	1.4	0.060	0.050 U	0.050 U	0.091
NITRITE-N	1			0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.031 J	0.050 U
ORTHOPHOSPHATE-P				0.034 J	0.048 J	0.053	0.038 J	0.015 J	0.037 J	0.050 U	0.041 J	0.050 U
SULFATE				26.	6.7	9.7	7.8	5.1	9.8	14.	21.	14.
TOTAL ORGANIC CARBON				2.6	2.1	0.66 J	0.67 J	5.0	0.65 J	4.4	6.6	3.6

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-6A
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID	MCL	PRG	BKG	B81-GW-MW23S-1109	B81-GW-MW32S-1109-	B81-GW-MW38I-1109-	B81-GW-MW39I-1109	B81-GW-MW42I-1109	B81-GW-MW43I-1109	B81-GW-MW47I-1109
LOCATION ID				B81-MW-23S	B81-MW-32S	B81-MW-38I	B81-MW-39I	B81-MW-42I	B81-MW-43I	B81-MW-47I
TOP DEPTH				9.0	9.0	10.0	11.0	11.0	11.0	6.0
BOTTOM DEPTH				14.0	19.0	15.0	16.0	16.0	16.0	16.0
SAMPLE DATE				11/19/09	11/12/09	11/04/09	11/04/09	11/05/09	11/23/09	11/25/09
VOLATILES (UG/L)										
1,1,2-TRICHLOROETHANE	5	0.2		0.10 U	0.10 UJ	***0.26 J***	0.10 U	0.10 U	0.10 U	0.10 U
1,2,4-TRICHLOROBENZENE	70	0.72		0.4 U	***0.80 J***	0.40 U	0.4 U	0.4 U	0.4 U	0.4 U
BENZENE	5	0.35		0.060 U	***3***	***0.95 J***	0.0072 U	0.0072 U	0.0072 U	0.010 UJ
BROMODICHLOROMETHANE	80	0.18		0.016 U	0.016 UJ	0.016 U	0.016 U	***0.28***	0.016 U	0.041 J
BTEX				0.19 U	3	0.95 J	0.177 U	0.177 U	0.177 U	0.178 UJ
CHLORODIBROMOMETHANE	80	0.13		0.018 U	0.018 UJ	0.018 U	0.018 U	0.045 J	0.018 U	0.018 UJ
CHLOROFORM	80	0.17	3.2	0.050 U	0.071 J	0.05 U	***0.22***	***0.9 J***	0.12 J	***0.20***
CIS-1,2-DICHLOROETHENE	70	6.1		0.2 J	***62***	***7***	0.2 U	0.2 U	0.2 U	0.2 U
CYCLOHEXANE		1000		0.3 U	3	0.40 J	0.3 U	0.3 U	0.3 U	0.3 U
DICHLORODIFLUOROMETHANE		39		0.2 UJ	0.20 U	0.30 J	0.2 U	0.2 U	0.2 UJ	0.2 U
ISOPROPYLBENZENE		66		0.2 U	0.50 J	0.20 U	0.2 U	0.2 U	0.2 U	0.2 U
METHYL CYCLOHEXANE		520		0.3 U	3	0.30 U	0.3 U	0.3 U	0.3 U	0.3 U
METHYL TERT-BUTYL ETHER		6.2		0.6 U	0.65	0.60 U	0.6 U	0.6 U	0.6 U	0.6 U
TETRACHLOROETHENE	5	0.1		***2***	***250***	***98.5***	0.011 U	0.023 U	0.020 UJ	***0.92***
TOTAL 1,2-DICHLOROETHENE	5	6.1		0.2 J	***62***	***7***	0.2 U	0.2 U	0.2 U	0.2 U
TOTAL CHLORINATED ETHENES				2.45 J	341 J	107 J	0.126 U	1	0.128 UJ	1.57
TRICHLOROETHENE	5	0.028	0.73	***0.25***	***28***	***1 J***	0.0082 U	***1***	0.0082 U	***0.65***
VINYL CHLORIDE	2	0.02		0.0100 U	***1.445 J***	***0.325***	0.0100 U	0.0100 U	0.0100 U	0.0100 U
VOLATILE GASES (UG/L)										
METHANE				13	950	740	1.5 J	2.0 J	1.8 J	94
SEMIVOLATILES (UG/L)										
2,4,6-TRICHLOROPHENOL		0.36		0.1 U	0.10 U	0.10 U	0.1 U	0.1 U	0.2 J	0.1 U
BENZO(A)ANTHRACENE		0.092	0.0475	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	***0.1 J***	0.04 U
HIGH MOLECULAR WEIGHT PAHS				0.057 UJ	0.057 UJ	0.057 U	0.057 U	0.057 U	0.1 J	0.057 U
LOW MOLECULAR WEIGHT PAHS				0.0557 UJ	0.065 J	0.08 J	0.0557 U	0.0557 U	0.0557 U	0.0557 U
NAPHTHALENE		0.62		0.06 U	0.065 J	0.08 J	0.06 U	0.06 U	0.06 U	0.06 U
TOTAL PAHS			0.0775	0.0565 UJ	0.065 J	0.08 J	0.0565 U	0.0565 U	0.1 J	0.0565 U

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-6A
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID	MCL	PRG	BKG	B81-GW-MW23S-1109	B81-GW-MW32S-1109-	B81-GW-MW38I-1109-	B81-GW-MW39I-1109	B81-GW-MW42I-1109	B81-GW-MW43I-1109	B81-GW-MW47I-1109
LOCATION ID				B81-MW-23S	B81-MW-32S	B81-MW-38I	B81-MW-39I	B81-MW-42I	B81-MW-43I	B81-MW-47I
TOP DEPTH				9.0	9.0	10.0	11.0	11.0	11.0	6.0
BOTTOM DEPTH				14.0	19.0	15.0	16.0	16.0	16.0	16.0
SAMPLE DATE				11/19/09	11/12/09	11/04/09	11/04/09	11/05/09	11/23/09	11/25/09
PESTICIDES/PCBS (UG/L)										
4,4'-DDE		0.2		0.00092 U	0.004533 J	0.00228 J	0.0074 J	0.00092 U	0.00092 U	0.00093 U
4,4'-DDT		0.2		0.0017 U	0.004875 J	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.011 J
ALDRIN		0.004		0.0014 U	0.0014 UJ	0.0014 U	0.0014 U	0.0014 U	0.0014 U	***0.0057 J***
BETA-BHC		0.037		0.0012 U	0.0012 UJ	0.0028 J	0.0012 U	0.0012 U	0.0012 U	0.0012 U
DELTA-BHC		0.011		0.0024 U	0.002875 J	0.0024 U	0.0024 U	0.0024 U	0.0024 U	0.0025 U
ENDOSULFAN II		22		0.0011 U	0.0011 UJ	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U
GAMMA-CHLORDANE	2	0.015		0.0011 U	0.00115 UJ	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0080 J
METALS (UG/L)										
ALUMINUM		3600	15341.35	772	207 J	35.7 UJ	39.3 UJ	53.9 UJ	42.5 UJ	25.4 UJ
ARSENIC	10	0.045		***1.9 J***	***4.05 J***	2.15 UJ	1.50 U	3.0 UJ	***1.7 J***	***3.1 J***
BARIUM	2000	260	181.32	8.5	9.65	8.65	20.8	14.8	9.5	13.6
BERYLLIUM	4	7.3	0.77	0.08 UJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
CALCIUM			19187.09	11000	22500	12650	13300	12400	16400	16600
CHROMIUM	100	11	18.1	3.6 U	3.6 J	1.85 UJ	2.3 UJ	2.5 J	2.2 UJ	2.5 UJ
COBALT		73	8.5	0.50 UJ	0.485 UJ	0.17 UJ	0.48 UJ	0.12 UJ	0.10 U	0.80 J
COPPER	1300	150	13.5	2.0 U	0.69 J	0.74 UJ	0.65 UJ	0.91 UJ	0.70 UJ	0.85 UJ
IRON		1100	44137.52	790	307	76.1 UJ	47.2 UJ	63.0 UJ	41.6 UJ	24.3 UJ
LEAD	15	15		0.97 J	0.285 J	0.535 UJ	0.82 UJ	0.38 UJ	0.05 U	0.10 J
MAGNESIUM			14205.47	4080	13150	7735	4720	4920	6680	5550
MANGANESE		88	2680.63	24.8	***343***	15.05	2.3	2.5	25.8	***1620***
NICKEL		73		1.7	10.2 J	0.46 UJ	0.55 UJ	0.58 UJ	0.63 J	0.73 J
POTASSIUM			6177.62	2800	1320	938 J	768 J	1000	1120	1780
SILVER		18		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
SODIUM			47342.14	15000	21050	12400	18000	31600	17100	25500
VANADIUM		3.6	22.6	4.4 UJ	3.45 J	1.4 J	1.3 J	2.2 J	1.7 UJ	2.3 UJ
ZINC		1100	51.7	9.2 J	61.15 J	3.55 U	3.55 U	3.55 U	59.3	3.55 U
MISCELLANEOUS PARAMETERS (MG/L)										

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-6A
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW23S-1109	B81-GW-MW32S-1109-	B81-GW-MW38I-1109-	B81-GW-MW39I-1109	B81-GW-MW42I-1109	B81-GW-MW43I-1109	B81-GW-MW47I-1109
LOCATION ID				B81-MW-23S	B81-MW-32S	B81-MW-38I	B81-MW-39I	B81-MW-42I	B81-MW-43I	B81-MW-47I
TOP DEPTH				9.0	9.0	10.0	11.0	11.0	11.0	6.0
BOTTOM DEPTH				14.0	19.0	15.0	16.0	16.0	16.0	16.0
SAMPLE DATE	**MCL**	**PRG**	**BKG**	11/19/09	11/12/09	11/04/09	11/04/09	11/05/09	11/23/09	11/25/09
AMMONIA-N				0.10 U	0.10 U	0.0485 J	0.043 J	0.038 J	0.10 U	0.10 U
CHLORIDE				4.9	7.25	6.8	36.	46.	40.	34.
FERROUS IRON				0.4	0.125	0.03	0.03 U	0.03 U	0.16 J	0.05
NITRATE-N	10			0.093	0.0415 J	0.05 U	0.32	0.66	0.29	0.40
NITRITE-N	1			0.012 J	0.05 U	0.05 U	0.050 U	0.050 U	0.050 U	0.050 U
ORTHOPHOSPHATE-P				0.090	0.016 J	0.0325 J	0.030 J	0.024 J	0.022 J	0.050 U
SULFATE				16.	20	12.5	13.	15.	17.	11.
SULFIDE				1.0 U	1 U	1.6 J	1.0 UJ	0.90 J	1.0	1.0 U
TOTAL ORGANIC CARBON				1.5	1.95	1.3	1.2	1.1	0.76 J	1.4

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-6A
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID	MCL	PRG	BKG	B81-GW-MW48I-1109	B81-GW-MW49I-1109
LOCATION ID				B81-MW-48I	B81-MW-49I
TOP DEPTH				9.5	8.5
BOTTOM DEPTH				19.5	18.5
SAMPLE DATE				11/23/09	11/23/09
VOLATILES (UG/L)					
1,1,2-TRICHLOROETHANE	5	0.2		0.10 U	0.10 U
1,2,4-TRICHLOROBENZENE	70	0.72		0.4 U	0.4 U
BENZENE	5	0.35		0.0072 U	0.0072 U
BROMODICHLOROMETHANE	80	0.18		***0.19***	0.073
BTEX				0.177 U	0.177 U
CHLORODIBROMOMETHANE	80	0.13		0.018 U	0.018 U
CHLOROFORM	80	0.17	3.2	***1***	***0.85***
CIS-1,2-DICHLOROETHENE	70	6.1		0.2 U	0.2 U
CYCLOHEXANE		1000		0.3 U	0.3 U
DICHLORODIFLUOROMETHANE		39		0.2 UJ	0.2 UJ
ISOPROPYLBENZENE		66		0.2 U	0.2 U
METHYL CYCLOHEXANE		520		0.3 U	0.3 U
METHYL TERT-BUTYL ETHER		6.2		0.6 U	0.6 U
TETRACHLOROETHENE	5	0.1		***2***	0.045 UJ
TOTAL 1,2-DICHLOROETHENE	5	6.1		0.2 U	0.2 U
TOTAL CHLORINATED ETHENES				2.32	0.137 UJ
TRICHLOROETHENE	5	0.028	0.73	***0.32***	0.028 UJ
VINYL CHLORIDE	2	0.02		0.0100 U	0.0100 U
VOLATILE GASES (UG/L)					
METHANE				2.0 J	1.6 J
SEMIVOLATILES (UG/L)					
2,4,6-TRICHLOROPHENOL		0.36		0.2 J	0.1 U
BENZO(A)ANTHRACENE		0.092	0.0475	***0.1 J***	0.04 U
HIGH MOLECULAR WEIGHT PAHS				0.1 J	0.057 UJ
LOW MOLECULAR WEIGHT PAHS				0.0557 U	0.0557 U
NAPHTHALENE		0.62		0.06 U	0.06 U
TOTAL PAHS			0.0775	0.1 J	0.0565 UJ

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-6A
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID	MCL	PRG	BKG	B81-GW-MW48I-1109	B81-GW-MW49I-1109
LOCATION ID				B81-MW-48I	B81-MW-49I
TOP DEPTH				9.5	8.5
BOTTOM DEPTH				19.5	18.5
SAMPLE DATE				11/23/09	11/23/09
PESTICIDES/PCBS (UG/L)					
4,4'-DDE		0.2		0.00093 U	0.00093 U
4,4'-DDT		0.2		0.0017 U	0.0017 U
ALDRIN		0.004		0.0014 U	0.0014 U
BETA-BHC		0.037		0.0012 U	0.0012 U
DELTA-BHC		0.011		0.0025 U	0.0025 U
ENDOSULFAN II		22		0.0033 J	0.0011 U
GAMMA-CHLORDANE	2	0.015		0.0011 U	0.0011 U
METALS (UG/L)					
ALUMINUM		3600	15341.35	158 UJ	2720
ARSENIC	10	0.045		***2.0 J***	***3.2 J***
BARIUM	2000	260	181.32	19.6	30.7
BERYLLIUM	4	7.3	0.77	0.05 U	0.30 J
CALCIUM			19187.09	13200	5880
CHROMIUM	100	11	18.1	2.4 UJ	5.8
COBALT		73	8.5	0.47 UJ	1.9
COPPER	1300	150	13.5	1.2 U	16.9
IRON		1100	44137.52	160 U	***3320***
LEAD	15	15		0.11 J	2.3
MAGNESIUM			14205.47	6460	1480
MANGANESE		88	2680.63	***315***	***244***
NICKEL		73		0.94 J	2.3
POTASSIUM			6177.62	1710	1600
SILVER		18		0.05 U	0.06 J
SODIUM			47342.14	25600	14200
VANADIUM		3.6	22.6	2.5 UJ	***8.6***
ZINC		1100	51.7	3.55 U	9.9 J
MISCELLANEOUS PARAMETERS (MG/L)					

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-6A
SUMMARY OF ANALYTICAL DATA[1] - DEEP OVERBURDEN GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW48I-1109	B81-GW-MW49I-1109
LOCATION ID				B81-MW-48I	B81-MW-49I
TOP DEPTH				9.5	8.5
BOTTOM DEPTH				19.5	18.5
SAMPLE DATE	**MCL**	**PRG**	**BKG**	11/23/09	11/23/09
AMMONIA-N				0.10 U	0.10 U
CHLORIDE				28.	8.8
FERROUS IRON				0.03 U	0.36
NITRATE-N	10			0.97	0.30
NITRITE-N	1			0.050 U	0.050 U
ORTHOPHOSPHATE-P				0.018 J	0.049 J
SULFATE				17.	9.5
SULFIDE				1.0 U	1.0 U
TOTAL ORGANIC CARBON				1.9	1.5

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-7A
SUMMARY OF ANALYTICAL DETAILS[1] - SHALLOW BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-BR07-1109-AVG	B81-GW-MW21D-1109	B81-GW-MW34B-1109	B81-GW-MW38B-1109	B81-GW-MW39B-1109
LOCATION ID				B81-BR-07	B81-MW-21D	B81-MW-34B	B81-MW-38B	B81-MW-39B
TOP DEPTH				22.0	20.5	31.0	19.0	19.0
BOTTOM DEPTH				55.0	30.5	41.0	29.0	22.0
SAMPLE DATE	MCL	PRG	BKG	11/24/09	11/13/09	11/02/09	11/06/09	11/18/09
VOLATILES (UG/L)								
1,1-DICHLOROETHENE	7	34		1 J	0.4 U	0.4 U	0.4 U	0.4 U
2-BUTANONE		700		7 U	1 U	1 U	1 U	1 U
ACETONE		550		12 U	2 U	2 U	2 U	2 U
BENZENE	5	0.35		***3 J***	***0.41 J***	0.029 J	0.24	0.0072 U
BROMODICHLOROMETHANE	80	0.18		0.016 UJ	0.016 U	0.016 UJ	0.016 U	0.016 U
BTEX				3.3 J	0.41 J	0.029 J	0.24	0.177 U
CHLORODIBROMOMETHANE	80	0.13		0.018 UJ	0.018 U	0.018 UJ	0.018 U	0.018 U
CHLOROFORM	80	0.17	3.2	0.05 UJ	0.050 U	***0.55 J***	0.050 U	0.088 J
CIS-1,2-DICHLOROETHENE	70	6.1		***9 J***	***12***	1	2	0.2 U
DICHLORODIFLUOROMETHANE		39		0.40 J	0.2 U	0.2 U	0.2 U	0.2 U
TETRACHLOROETHENE	5	0.1		***11000***	***57***	***80***	***67***	0.011 U
TOLUENE	1000	72		0.30 J	0.3 U	0.3 U	0.3 U	0.3 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		***9.4 J***	***12***	1	2	0.2 U
TOTAL CHLORINATED ETHENES				11100 J	72.2	88 J	69.4	0.126 U
TRANS-1,2-DICHLOROETHENE	100	12		0.40 J	0.2 U	0.2 U	0.2 U	0.2 U
TRICHLOROETHENE	5	0.028	0.73	***120***	***3***	***7***	***0.38***	0.0082 U
VINYL CHLORIDE	2	0.02		***1.5 J***	***0.22***	***0.024 J***	***0.060***	0.0100 U
VOLATILE GASES (UG/L)								
METHANE				255	99	24	17	0.79 J
SEMIVOLATILES (UG/L)								
2,4,6-TRICHLOROPHENOL		0.36		0.10 U	0.1 U	0.2 J	0.1 U	0.1 U
BENZALDEHYDE		360		0.90 UJ	1.0 UJ	0.9 UJ	0.9 UJ	1.0 UJ
BENZO(A)ANTHRACENE		0.092	0.0475	0.04 U	0.05 U	0.04 U	0.04 U	0.05 U
BENZO(B)FLUORANTHENE		0.092		0.08 U	0.09 U	0.08 U	0.09 U	0.09 U
CAPROLACTAM		1800		0.40 U	0.4 U	0.4 U	3 J	0.4 U
DIBENZO(A,H)ANTHRACENE		0.0092	0.03	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U
HIGH MOLECULAR WEIGHT PAHS				0.057 U	0.061 UJ	0.057 U	0.059 U	0.061 UJ

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-7A
SUMMARY OF ANALYTICAL DETAILS[1] - SHALLOW BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-BR07-1109-AVG	B81-GW-MW21D-1109	B81-GW-MW34B-1109	B81-GW-MW38B-1109	B81-GW-MW39B-1109
LOCATION ID				B81-BR-07	B81-MW-21D	B81-MW-34B	B81-MW-38B	B81-MW-39B
TOP DEPTH				22.0	20.5	31.0	19.0	19.0
BOTTOM DEPTH				55.0	30.5	41.0	29.0	22.0
SAMPLE DATE	**MCL**	**PRG**	**BKG**	11/24/09	11/13/09	11/02/09	11/06/09	11/18/09
INDENO(1,2,3-CD)PYRENE		0.092		0.05 U	0.05 U	0.05 U	0.05 U	0.05 UJ
PENTACHLOROPHENOL	1	0.56		0.30 UJ	0.3 UJ	0.3 UJ	0.3 UJ	0.3 U
TOTAL PAHS			0.0775	0.0565 U	0.0594 UJ	0.0565 U	0.0582 U	0.0594 UJ
PESTICIDES/PCBS (UG/L)								
GAMMA-BHC (LINDANE)	0.2	0.052	0.0092	0.00145 U	0.0014 UJ	0.0022 J	0.0014 U	0.0014 U
METALS (UG/L)								
ALUMINUM		3600	15341.4	83.7 UJ	85.9 UJ	293 J	***4910 J***	18.7 UJ
ARSENIC	10	0.045		***3.3 J***	***3.7 J***	1.8 UJ	3.2 UJ	***2.4 J***
BARIUM	2000	260	181.32	126	15.7	183	42.7	28.5
BERYLLIUM	4	7.3	0.77	0.05 U	0.05 U	0.08 J	0.37 J	0.05 U
CALCIUM			19187.1	29300	17300	33900	11800	19100
CHROMIUM	100	11	18.1	2.5 UJ	4.0 J	1.5 UJ	4.2	2.9 J
COBALT		73	8.5	0.105 UJ	0.59 UJ	0.80 J	3.3	0.10 U
COPPER	1300	150	13.5	1.55 U	0.80 J	1.4 U	7.5	0.84 J
IRON		1100	44137.5	***2620***	136 U	***1580***	***2850***	49.3 UJ
LEAD	15	15		0.665 J	0.16 UJ	0.74 UJ	4.5	0.08 UJ
MAGNESIUM			14205.5	4480	9590	14100	8250	7730
MANGANESE		88	2680.63	***312***	***250***	***2470***	***117***	2.1
NICKEL		73		0.79 J	2.4 J	1.7 U	4.6	0.50 UJ
POTASSIUM			6177.62	2155	1080	6040	1450	963 J
SODIUM			47342.1	13100	22800	36000	15700	31100
VANADIUM		3.6	22.6	2.45 UJ	***5.9***	0.86 J	***5.8***	2.4 J
ZINC		1100	51.7	3.55 U	4.2 J	3.7 J	30.3	3.55 UJ
MISCELLANEOUS PARAMETERS (MG/L)								
AMMONIA-N				0.055 J	0.10 U	0.092 J	0.039 J	0.10 U
CHLORIDE				9.4	4.4	56.	12.	62.
FERROUS IRON				0.185	0.05	1.6	0.67	0.03 U
NITRATE-N	10			0.05 U	0.10	0.050 U	0.050 U	0.63

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-7A
SUMMARY OF ANALYTICAL DETAILS[1] - SHALLOW BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-BR07-1109-AVG	B81-GW-MW21D-1109	B81-GW-MW34B-1109	B81-GW-MW38B-1109	B81-GW-MW39B-1109
LOCATION ID				B81-BR-07	B81-MW-21D	B81-MW-34B	B81-MW-38B	B81-MW-39B
TOP DEPTH				22.0	20.5	31.0	19.0	19.0
BOTTOM DEPTH				55.0	30.5	41.0	29.0	22.0
SAMPLE DATE	**MCL**	**PRG**	**BKG**	11/24/09	11/13/09	11/02/09	11/06/09	11/18/09
NITRITE-N	1			0.05 U	0.050 U	0.050 U	0.015 J	0.050 U
ORTHOPHOSPHATE-P				0.031 J	0.53 J	0.035 J	0.023 J	0.036 J
SULFATE				25	23.	37.	21.	15.
SULFIDE				1 U	1.0 U	1.0 J	1.4 J	1.0 U
TOTAL ORGANIC CARBON				2.05	2.4	2.6	1.0	0.58 J

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-7A
SUMMARY OF ANALYTICAL DETAILS[1] - SHALLOW BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW40B2-3133	B81-GW-MW42B-1109	B81-GW-MW42B2-3437	B81-GW-MW42B2-0110	B81-GW-MW43B-0210
LOCATION ID				B81-MW-40B2	B81-MW-42B	B81-MW-42B2	B81-MW-42B2	B81-MW-43B
TOP DEPTH				31.0	17.0	34.0	35.6	36.1
BOTTOM DEPTH				33.0	30.0	37.0	50.1	51.1
SAMPLE DATE	MCL	PRG	BKG	12/30/09	11/09/09	12/30/09	01/29/10	02/02/10
VOLATILES (UG/L)								
1,1-DICHLOROETHENE	7	34		0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
2-BUTANONE		700		3 J	1 U	4 J	1 U	1 U
ACETONE		550		20	2 U	21	2 U	2 U
BENZENE	5	0.35		0.029 J	0.0072 U	0.0072 UJ	0.012 J	0.0072 U
BROMODICHLOROMETHANE	80	0.18		0.016 U	***0.33***	0.016 UJ	0.060 J	0.042 J
BTEX				0.429 J	0.177 U	0.177 UJ	0.012 J	0.177 U
CHLORODIBROMOMETHANE	80	0.13		0.018 U	0.054	0.018 UJ	0.018 U	0.018 U
CHLOROFORM	80	0.17	3.2	0.097 J	***1***	***0.24 J***	***0.19***	0.11 J
CIS-1,2-DICHLOROETHENE	70	6.1		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
DICHLORODIFLUOROMETHANE		39		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TETRACHLOROETHENE	5	0.1		0.020 UJ	0.021 UJ	0.025 UJ	0.056	0.011 U
TOLUENE	1000	72		0.4 J	0.3 U	0.3 U	0.3 U	0.3 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TOTAL CHLORINATED ETHENES				0.1 J	1 J	0.33 J	1.06	0.056 J
TRANS-1,2-DICHLOROETHENE	100	12		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRICHLOROETHENE	5	0.028	0.73	***0.10***	***1***	***0.33 J***	***1***	***0.056 J***
VINYL CHLORIDE	2	0.02		0.0100 UJ	0.0100 U	0.0100 UJ	0.0100 U	0.0100 U
VOLATILE GASES (UG/L)								
METHANE				NA	1.5 J	NA	0.88 J	1.2 J
SEMIVOLATILES (UG/L)								
2,4,6-TRICHLOROPHENOL		0.36		NA	0.1 U	NA	0.2 J	0.1 UJ
BENZALDEHYDE		360		NA	0.9 UJ	NA	0.9 UJ	0.9 UJ
BENZO(A)ANTHRACENE		0.092	0.0475	NA	0.04 U	NA	0.04 U	0.04 U
BENZO(B)FLUORANTHENE		0.092		NA	0.08 U	NA	***0.1 J***	0.08 UJ
CAPROLACTAM		1800		NA	0.4 UJ	NA	0.4 UJ	0.4 UJ
DIBENZO(A,H)ANTHRACENE		0.0092	0.03	NA	0.07 UJ	NA	***0.10 J***	0.07 UJ
HIGH MOLECULAR WEIGHT PAHS				NA	0.057 UJ	NA	0.4 J	0.057 UJ

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-7A
SUMMARY OF ANALYTICAL DETAILS[1] - SHALLOW BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW40B2-3133	B81-GW-MW42B-1109	B81-GW-MW42B2-3437	B81-GW-MW42B2-0110	B81-GW-MW43B-0210
LOCATION ID				B81-MW-40B2	B81-MW-42B	B81-MW-42B2	B81-MW-42B2	B81-MW-43B
TOP DEPTH				31.0	17.0	34.0	35.6	36.1
BOTTOM DEPTH				33.0	30.0	37.0	50.1	51.1
SAMPLE DATE	**MCL**	**PRG**	**BKG**	12/30/09	11/09/09	12/30/09	01/29/10	02/02/10
INDENO(1,2,3-CD)PYRENE		0.092		NA	0.05 UJ	NA	***0.2 J***	0.05 UJ
PENTACHLOROPHENOL	1	0.56		NA	0.3 UJ	NA	0.3 UJ	0.3 UJ
TOTAL PAHS			0.0775	NA	0.0565 UJ	NA	0.4 J	0.0565 UJ
PESTICIDES/PCBS (UG/L)								
GAMMA-BHC (LINDANE)	0.2	0.052	0.0092	NA	0.0014 U	NA	0.0014 U	0.0014 U
METALS (UG/L)								
ALUMINUM		3600	15341.4	NA	61.4 UJ	NA	201 J	55.7 UJ
ARSENIC	10	0.045		NA	1.50 U	NA	1.50 U	1.50 U
BARIUM	2000	260	181.32	NA	19.1	NA	59.9	39.6
BERYLLIUM	4	7.3	0.77	NA	0.05 U	NA	0.06 J	0.05 U
CALCIUM			19187.1	NA	11800	NA	11600	42200
CHROMIUM	100	11	18.1	NA	2.0 J	NA	1.3 UJ	1.6 UJ
COBALT		73	8.5	NA	0.10 U	NA	0.23 UJ	0.10 U
COPPER	1300	150	13.5	NA	0.38 J	NA	0.76 UJ	0.87 UJ
IRON		1100	44137.5	NA	63.8 UJ	NA	307	102 U
LEAD	15	15		NA	0.18 UJ	NA	0.63 UJ	0.36 UJ
MAGNESIUM			14205.5	NA	5280	NA	3500	5840
MANGANESE		88	2680.63	NA	1.5	NA	***318***	20.0 U
NICKEL		73		NA	0.45 UJ	NA	1.6	7.7
POTASSIUM			6177.62	NA	988 J	NA	1840	4000
SODIUM			47342.1	NA	31400	NA	38600	12600
VANADIUM		3.6	22.6	NA	0.77 J	NA	1.2 J	0.81 J
ZINC		1100	51.7	NA	3.55 UJ	NA	3.55 U	18.5
MISCELLANEOUS PARAMETERS (MG/L)								
AMMONIA-N				NA	0.065 J	NA	0.10 U	0.040 J
CHLORIDE				NA	43.	NA	38.	27.
FERROUS IRON				NA	0.03	NA	0.03 U	0.03 U
NITRATE-N	10			NA	0.70	NA	0.63	0.035 J

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-7A
SUMMARY OF ANALYTICAL DETAILS[1] - SHALLOW BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW40B2-3133	B81-GW-MW42B-1109	B81-GW-MW42B2-3437	B81-GW-MW42B2-0110	B81-GW-MW43B-0210
LOCATION ID				B81-MW-40B2	B81-MW-42B	B81-MW-42B2	B81-MW-42B2	B81-MW-43B
TOP DEPTH				31.0	17.0	34.0	35.6	36.1
BOTTOM DEPTH				33.0	30.0	37.0	50.1	51.1
SAMPLE DATE	**MCL**	**PRG**	**BKG**	12/30/09	11/09/09	12/30/09	01/29/10	02/02/10
NITRITE-N	1			NA	0.050 U	NA	0.050 U	0.050 U
ORTHOPHOSPHATE-P				NA	0.051 J	NA	0.020 J	0.093
SULFATE				NA	16.	NA	19.	25.
SULFIDE				NA	1.0 U	NA	1.0 U	1.0 U
TOTAL ORGANIC CARBON				NA	0.72 J	NA	1.6	2.8

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-7A
SUMMARY OF ANALYTICAL DETAILS[1] - SHALLOW BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID	MCL	PRG	BKG	B81-GW-MW50B-0210-AVG	B81-GW-MW50B2-2528-[illegible]	B81-GW-MW51B-1109
LOCATION ID				B81-MW-50B	B81-MW-50B2	B81-MW-51B
TOP DEPTH				25.3	25.0	20.0
BOTTOM DEPTH				35.6	28.0	30.0
SAMPLE DATE				02/02/10	12/30/09	11/03/09
VOLATILES (UG/L)						
1,1-DICHLOROETHENE	7	34		0.4 U	0.40 U	0.4 U
2-BUTANONE		700		1 U	3 J	1 U
ACETONE		550		2 U	20	2 U
BENZENE	5	0.35		0.0072 U	0.0056 J	0.0072 U
BROMODICHLOROMETHANE	80	0.18		0.016 U	0.016 UJ	0.054
BTEX				0.177 U	0.306 J	0.177 U
CHLORODIBROMOMETHANE	80	0.13		0.018 U	0.018 UJ	0.018 U
CHLOROFORM	80	0.17	3.2	0.05 U	0.076 J	***0.26***
CIS-1,2-DICHLOROETHENE	70	6.1		0.2 U	0.20 U	0.2 U
DICHLORODIFLUOROMETHANE		39		0.2 U	0.20 U	0.2 U
TETRACHLOROETHENE	5	0.1		***0.835***	***0.215 J***	0.011 U
TOLUENE	1000	72		0.3 U	0.30 J	0.3 U
TOTAL 1,2-DICHLOROETHENE	5	6.1		0.2 U	0.2 U	0.2 U
TOTAL CHLORINATED ETHENES				0.87 J	0.314 J	1
TRANS-1,2-DICHLOROETHENE	100	12		0.2 U	0.20 U	0.2 U
TRICHLOROETHENE	5	0.028	0.73	***0.035 J***	***0.0995 J***	***1***
VINYL CHLORIDE	2	0.02		0.01 U	0.01 UJ	0.0100 U
VOLATILE GASES (UG/L)						
METHANE				2.25 J	NA	1.1 J
SEMIVOLATILES (UG/L)						
2,4,6-TRICHLOROPHENOL		0.36		0.1 UJ	NA	0.1 U
BENZALDEHYDE		360		0.75 J	NA	0.9 UJ
BENZO(A)ANTHRACENE		0.092	0.0475	0.0375 J	NA	0.04 U
BENZO(B)FLUORANTHENE		0.092		***0.122 J***	NA	0.08 U
CAPROLACTAM		1800		0.4 UJ	NA	0.4 UJ
DIBENZO(A,H)ANTHRACENE		0.0092	0.03	***0.145 J***	NA	0.07 U
HIGH MOLECULAR WEIGHT PAHS				0.27 J	NA	0.057 UJ

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-7A
SUMMARY OF ANALYTICAL DETAILS[1] - SHALLOW BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW50B-0210-AVG	B81-GW-MW50B2-2528-[illegible]	B81-GW-MW51B-1109
LOCATION ID				B81-MW-50B	B81-MW-50B2	B81-MW-51B
TOP DEPTH				25.3	25.0	20.0
BOTTOM DEPTH				35.6	28.0	30.0
SAMPLE DATE	MCL	PRG	BKG	02/02/10	12/30/09	11/03/09
INDENO(1,2,3-CD)PYRENE		0.092		0.3 UJ	NA	0.05 U
PENTACHLOROPHENOL	1	0.56		0.325 J	NA	0.3 UJ
TOTAL PAHS			0.0775	0.27 J	NA	0.0565 UJ
PESTICIDES/PCBS (UG/L)						
GAMMA-BHC (LINDANE)	0.2	0.052	0.0092	0.0022 J	NA	0.0014 U
METALS (UG/L)						
ALUMINUM		3600	15341.4	50.2 UJ	NA	436 J
ARSENIC	10	0.045		1.5 U	NA	2.2 UJ
BARIUM	2000	260	181.32	212	NA	20.1
BERYLLIUM	4	7.3	0.77	0.05 U	NA	0.10 J
CALCIUM			19187.1	33700	NA	11900
CHROMIUM	100	11	18.1	1.35 UJ	NA	1.9 UJ
COBALT		73	8.5	0.4 J	NA	6.6
COPPER	1300	150	13.5	1.4	NA	6.1
IRON		1100	44137.5	796	NA	222 U
LEAD	15	15		0.32 UJ	NA	0.68 UJ
MAGNESIUM			14205.5	20800	NA	4280
MANGANESE		88	2680.63	***3180***	NA	26.6
NICKEL		73		1.2 U	NA	1.3 U
POTASSIUM			6177.62	2320	NA	1120
SODIUM			47342.1	22000	NA	30000
VANADIUM		3.6	22.6	0.7 U	NA	1.8 J
ZINC		1100	51.7	16.4	NA	9.3 J
MISCELLANEOUS PARAMETERS (MG/L)						
AMMONIA-N				0.1	NA	0.053 J
CHLORIDE				56	NA	38.
FERROUS IRON				0.38	NA	0.62
NITRATE-N	10			0.05 U	NA	0.68

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-7A
SUMMARY OF ANALYTICAL DETAILS[1] - SHALLOW BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW50B-0210-AVG	B81-GW-MW50B2-2528-	B81-GW-MW51B-1109
LOCATION ID				B81-MW-50B	B81-MW-50B2	B81-MW-51B
TOP DEPTH				25.3	25.0	20.0
BOTTOM DEPTH				35.6	28.0	30.0
SAMPLE DATE	**MCL**	**PRG**	**BKG**	02/02/10	12/30/09	11/03/09
NITRITE-N	1			0.05 U	NA	0.050 U
ORTHOPHOSPHATE-P				0.02 J	NA	0.043 J
SULFATE				38.5	NA	17.
SULFIDE				1 U	NA	1.0 UJ
TOTAL ORGANIC CARBON				1.7	NA	1.4

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-8A
SUMMARY OF ANALYTICAL DETAILS[1] - DEEP BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW3D-1109	B81-GW-MW21D2-1109	B81-GW-MW33D-1109	B81-GW-MW34D-1109	B81-GW-MW35D-1109	B81-GW-MW40B2-5658
LOCATION ID				B81-MW-03D	B81-MW-21D2	B81-MW-33D	B81-MW-34D	B81-MW-35D	B81-MW-40B2
TOP DEPTH				50.0	49.0	50.0	70.0	80.0	56.0
BOTTOM DEPTH				60.0	59.0	60.0	80.0	90.0	58.0
SAMPLE DATE	MCL	PRG	BKG	11/19/09	11/12/09	11/17/09	11/03/09	11/13/09	12/30/09
VOLATILES (UG/L)									
1,1-DICHLOROETHENE	7	34		1.0 J	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
2-BUTANONE		700		1 U	1 U	1 U	1 U	1 U	3 J
ACETONE		550		2 U	2 U	2 U	2 U	2 J	22
BENZENE	5	0.35		0.18 J	***0.54 J***	***1***	0.0072 U	0.028 UJ	0.022 J
BROMODICHLOROMETHANE	80	0.18		0.016 UJ	0.016 UJ	0.016 UJ	0.016 U	0.016 UJ	0.016 U
BTEX				0.18 J	0.54 J	1	0.177 U	0.182 UJ	0.022 J
CHLORODIBROMOMETHANE	80	0.13		0.018 UJ	0.018 UJ	0.018 UJ	0.018 U	0.018 UJ	0.018 U
CHLOROFORM	80	0.17	3.2	0.050 UJ	0.050 UJ	0.050 UJ	0.050 U	0.050 UJ	0.10
CIS-1,2-DICHLOROETHENE	70	6.1		***26***	***15***	***10***	0.3 J	6	0.2 U
CYCLOHEXANE		1000		0.3 U	0.3 U	0.3 J	0.3 U	0.3 U	0.3 U
DICHLORODIFLUOROMETHANE		39		0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
METHYL TERT-BUTYL ETHER		6.2		0.6 U	4	1	0.6 U	0.6 U	0.6 U
TETRACHLOROETHENE	5	0.1		***1600***	***80***	***28***	***12***	***290 J***	0.016 UJ
TOTAL 1,2-DICHLOROETHENE	5	6.1		***26***	***15***	***10***	0.3 J	6	0.2 U
TOTAL CHLORINATED ETHENES				1820 J	102	41 J	13.3 J	331 J	0.14 J
TRICHLOROETHENE	5	0.028	0.73	***190***	***3***	***2***	***1***	***35***	***0.14***
VINYL CHLORIDE	2	0.02		***0.089 J***	***4***	***1 J***	0.0100 U	***0.054 J***	0.0100 U
VOLATILE GASES (UG/L)									
ETHENE				0.69 U	0.69 U	0.69 U	0.69 U	0.69 U	NA
METHANE				9.8 J	44	220	61	37	NA
SEMIVOLATILES (UG/L)									
2,4,6-TRICHLOROPHENOL		0.36		0.1 UJ	0.1 U	0.1 U	0.1 U	0.1 U	NA
BENZO(A)ANTHRACENE		0.092	0.0475	0.04 U	0.04 U	***0.2 J***	0.04 U	***0.2 J***	NA
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		2 U	2 U	2 U	2 U	2 U	NA
HIGH MOLECULAR WEIGHT PAHS				0.059 UJ	0.057 UJ	0.2 J	0.057 U	0.2 J	NA
INDENO(1,2,3-CD)PYRENE		0.092		0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 U	NA
LOW MOLECULAR WEIGHT PAHS				0.0571 UJ	0.0557 U	0.0557 U	0.0557 U	0.0557 U	NA

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-8A
SUMMARY OF ANALYTICAL DETAILS[1] - DEEP BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW3D-1109	B81-GW-MW21D2-1109	B81-GW-MW33D-1109	B81-GW-MW34D-1109	B81-GW-MW35D-1109	B81-GW-MW40B2-5658
LOCATION ID				B81-MW-03D	B81-MW-21D2	B81-MW-33D	B81-MW-34D	B81-MW-35D	B81-MW-40B2
TOP DEPTH				50.0	49.0	50.0	70.0	80.0	56.0
BOTTOM DEPTH				60.0	59.0	60.0	80.0	90.0	58.0
SAMPLE DATE	MCL	PRG	BKG	11/19/09	11/12/09	11/17/09	11/03/09	11/13/09	12/30/09
PHENANTHRENE		180		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	NA
TOTAL PAHS			0.0775	0.0582 UJ	0.0565 UJ	0.2 J	0.0565 U	0.2 J	NA
PESTICIDES/PCBS (UG/L)									
4,4'-DDD		0.28		0.0017 U	0.0042 J	0.0017 U	0.0017 U	0.0017 U	NA
GAMMA-BHC (LINDANE)	0.2	0.052	0.0092	0.0014 U	0.0041 J	0.0014 U	0.0014 U	0.0014 U	NA
HEPTACHLOR	0.4	0.015		0.0015 U	0.0015 U	0.0068 J	0.0015 U	0.0067 J	NA
METALS (UG/L)									
ALUMINUM		3600	15341.4	182 UJ	124 J	86.8 UJ	NA	217 J	NA
ARSENIC	10	0.045		1.50 U	***6.2***	***3.5 J***	NA	***3.8 J***	NA
BARIUM	2000	260	181.32	54.4	33.4	133	NA	77.0	NA
CADMIUM	5	1.8		0.06 J	0.13 UJ	0.07 UJ	NA	0.05 U	NA
CALCIUM			19187.1	18600	27300	27300	NA	18700	NA
CHROMIUM	100	11	18.1	1.4 UJ	3.4 J	2.8 J	NA	3.2 J	NA
COBALT		73	8.5	0.26 UJ	1.2	0.35 UJ	NA	0.18 UJ	NA
COPPER	1300	150	13.5	1.2 U	3.0	0.36 J	NA	0.35 U	NA
IRON		1100	44137.5	228 U	585	503	NA	386 U	NA
LEAD	15	15		0.46 J	0.62 J	0.27 J	NA	0.32 J	NA
MAGNESIUM			14205.5	7020	9950	6680	NA	4830	NA
MANGANESE		88	2680.63	***2240***	***1500***	***956***	NA	***782***	NA
NICKEL		73		1.1	3.3 J	0.61 UJ	NA	0.85 J	NA
POTASSIUM			6177.62	1850	2920	1560	NA	1390	NA
SODIUM			47342.1	14500	25000	12300	NA	12200	NA
VANADIUM		3.6	22.6	0.70 U	3.4 J	1.9 J	NA	3.4 J	NA
ZINC		1100	51.7	20.2	17.4 J	13.4 J	NA	7.4 J	NA
DISSOLVED METALS (UG/L)									
ALUMINUM		3600	15341.4	NA	NA	NA	***4450 J***	NA	NA
ANTIMONY	6	1.5		NA	NA	NA	0.37 UJ	NA	NA
ARSENIC	10	0.045		NA	NA	NA	2.2 UJ	NA	NA

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-8A
SUMMARY OF ANALYTICAL DETAILS[1] - DEEP BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW3D-1109	B81-GW-MW21D2-1109	B81-GW-MW33D-1109	B81-GW-MW34D-1109	B81-GW-MW35D-1109	B81-GW-MW40B2-5658
LOCATION ID				B81-MW-03D	B81-MW-21D2	B81-MW-33D	B81-MW-34D	B81-MW-35D	B81-MW-40B2
TOP DEPTH				50.0	49.0	50.0	70.0	80.0	56.0
BOTTOM DEPTH				60.0	59.0	60.0	80.0	90.0	58.0
SAMPLE DATE	**MCL**	**PRG**	**BKG**	11/19/09	11/12/09	11/17/09	11/03/09	11/13/09	12/30/09
BARIUM	2000	260	181.32	NA	NA	NA	118	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA	NA	0.44 J	NA	NA
CALCIUM			19187.1	NA	NA	NA	17200	NA	NA
CHROMIUM	100	11	18.1	NA	NA	NA	3.2	NA	NA
COPPER	1300	150	13.5	NA	NA	NA	7.1	NA	NA
IRON		1100	44137.5	NA	NA	NA	***2660***	NA	NA
LEAD	15	15		NA	NA	NA	***16.6***	NA	NA
MAGNESIUM			14205.5	NA	NA	NA	8160	NA	NA
MANGANESE		88	2680.63	NA	NA	NA	***961***	NA	NA
NICKEL		73		NA	NA	NA	1.8	NA	NA
POTASSIUM			6177.62	NA	NA	NA	1680	NA	NA
SODIUM			47342.1	NA	NA	NA	11300	NA	NA
VANADIUM		3.6	22.6	NA	NA	NA	3.6 J	NA	NA
ZINC		1100	51.7	NA	NA	NA	29.9	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)									
AMMONIA-N				0.10 U	0.083 J	0.10 U	0.065 J	0.10 U	NA
CHLORIDE				11.	8.9	12.	12.	11.	NA
FERROUS IRON				0.05	1.06	0.3	0.42	0.15	NA
NITRITE-N	1			0.050 U	0.050 U	0.050 U	0.13	0.050 U	NA
ORTHOPHOSPHATE-P				0.10	0.43 J	0.34 J	0.023 J	0.20 J	NA
SULFATE				24.	60.	20.	24.	19.	NA
SULFIDE				1.0 U	1.0 U	1.0 U	1.5 J	1.0 U	NA
TOTAL ORGANIC CARBON				4.1	4.1	3.9	0.99 J	3.4	NA
MISCELLANEOUS PARAMETERS (UG/L)									
CYANIDE	200	73		10. U	10. U	10. U	10. U	10. U	NA

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-8A
SUMMARY OF ANALYTICAL DETAILS[1] - DEEP BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW40B2-7678	B81-GW-MW40B2-0210	B81-GW-MW42B2-4649	B81-GW-MW43B2-0110	B81-GW-MW47B2-0210-AVG	B81-GW-MW47B1-0210
LOCATION ID				B81-MW-40B2	B81-MW-40B2	B81-MW-42B2	B81-MW-43B2	B81-MW-472B2	B81-MW-47B1
TOP DEPTH				76.0	50.5	46.0	84.1	67.5	50.5
BOTTOM DEPTH				78.0	60.5	49.0	99.1	77.5	60.5
SAMPLE DATE	MCL	PRG	BKG	12/30/09	02/03/10	12/30/09	01/28/10	02/04/10	02/03/10
VOLATILES (UG/L)									
1,1-DICHLOROETHENE	7	34		0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
2-BUTANONE		700		3 J	1 U	3 J	1 U	1 U	1 U
ACETONE		550		22	3 J	22	2 U	2 U	2 U
BENZENE	5	0.35		0.038 J	0.0072 U	0.0091 J	0.013 J	0.037 J	0.28 J
BROMODICHLOROMETHANE	80	0.18		0.016 U	0.016 U	0.085 J	***2***	0.016 U	0.016 U
BTEX				0.038 J	0.177 U	0.0091 J	0.013 J	0.037 J	0.28 J
CHLORODIBROMOMETHANE	80	0.13		0.018 U	0.018 U	0.018 UJ	***0.33 J***	0.018 U	0.018 U
CHLOROFORM	80	0.17	3.2	0.095 J	0.050 U	***0.67 J***	***11***	***0.65 J***	0.12
CIS-1,2-DICHLOROETHENE	70	6.1		0.2 U	0.2 U	0.4 J	0.2 U	0.2 U	0.2 U
CYCLOHEXANE		1000		0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
DICHLORODIFLUOROMETHANE		39		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.4 J
METHYL TERT-BUTYL ETHER		6.2		0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
TETRACHLOROETHENE	5	0.1		0.011 U	0.025 J	***0.34 J***	***0.28***	***0.54 J***	***0.11***
TOTAL 1,2-DICHLOROETHENE	5	6.1		0.2 U	0.2 U	0.4 J	0.2 U	0.2 U	0.2 U
TOTAL CHLORINATED ETHENES				0.12 J	0.135 J	2.74 J	0.45	0.748 J	0.452 J
TRICHLOROETHENE	5	0.028	0.73	***0.12***	***0.11***	***2***	***0.17***	***0.088 J***	***0.042 J***
VINYL CHLORIDE	2	0.02		0.0100 UJ	0.0100 U	0.0100 UJ	0.0100 U	***0.12 J***	***0.30***
VOLATILE GASES (UG/L)									
ETHENE				NA	1.5 J	NA	0.69 U	0.69 U	0.69 U
METHANE				NA	0.88 J	NA	0.92 J	3.3 J	18
SEMIVOLATILES (UG/L)									
2,4,6-TRICHLOROPHENOL		0.36		NA	0.2 J	NA	0.1 U	0.1 UJ	0.1 UJ
BENZO(A)ANTHRACENE		0.092	0.0475	NA	0.05 U	NA	0.05 U	0.05 UJ	0.05 U
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		NA	2 U	NA	2 J	2 U	2 U
HIGH MOLECULAR WEIGHT PAHS				NA	0.063 UJ	NA	0.2 J	0.068 UJ	0.063 UJ
INDENO(1,2,3-CD)PYRENE		0.092		NA	0.05 UJ	NA	***0.2 J***	0.06 UJ	0.05 UJ
LOW MOLECULAR WEIGHT PAHS				NA	0.0614 UJ	NA	0.0586 U	0.2 J	0.0629 UJ

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-8A
SUMMARY OF ANALYTICAL DETAILS[1] - DEEP BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW40B2-7678	B81-GW-MW40B2-0210	B81-GW-MW42B2-4649	B81-GW-MW43B2-0110	B81-GW-MW47B2-0210-AVG	B81-GW-MW47B1-0210
LOCATION ID				B81-MW-40B2	B81-MW-40B2	B81-MW-42B2	B81-MW-43B2	B81-MW-472B2	B81-MW-47B1
TOP DEPTH				76.0	50.5	46.0	84.1	67.5	50.5
BOTTOM DEPTH				78.0	60.5	49.0	99.1	77.5	60.5
SAMPLE DATE	**MCL**	**PRG**	**BKG**	12/30/09	02/03/10	12/30/09	01/28/10	02/04/10	02/03/10
PHENANTHRENE		180		NA	0.05 U	NA	0.05 U	0.2 J	0.05 U
TOTAL PAHS			0.0775	NA	0.0624 UJ	NA	0.2 J	0.2 J	0.0629 UJ
PESTICIDES/PCBS (UG/L)									
4,4'-DDD		0.28		NA	0.0019 U	NA	0.0018 UJ	0.0019 U	0.0019 U
GAMMA-BHC (LINDANE)	0.2	0.052	0.0092	NA	0.0015 U	NA	0.0014 UJ	0.0015 U	0.0015 U
HEPTACHLOR	0.4	0.015		NA	0.0017 U	NA	0.0016 UJ	0.0017 U	0.0017 U
METALS (UG/L)									
ALUMINUM		3600	15341.4	NA	NA	NA	NA	226 J	75.8 UJ
ARSENIC	10	0.045		NA	NA	NA	NA	***2.8 J***	1.50 U
BARIUM	2000	260	181.32	NA	NA	NA	NA	73.6	98.1
CADMIUM	5	1.8		NA	NA	NA	NA	0.05 U	0.05 U
CALCIUM			19187.1	NA	NA	NA	NA	26700	30000
CHROMIUM	100	11	18.1	NA	NA	NA	NA	1.5 UJ	1.6 UJ
COBALT		73	8.5	NA	NA	NA	NA	0.12 UJ	0.10 U
COPPER	1300	150	13.5	NA	NA	NA	NA	0.88 UJ	0.44 UJ
IRON		1100	44137.5	NA	NA	NA	NA	128 U	70.1 UJ
LEAD	15	15		NA	NA	NA	NA	0.30 UJ	0.20 UJ
MAGNESIUM			14205.5	NA	NA	NA	NA	3020	3510
MANGANESE		88	2680.63	NA	NA	NA	NA	***172***	***216***
NICKEL		73		NA	NA	NA	NA	0.77 UJ	0.54 UJ
POTASSIUM			6177.62	NA	NA	NA	NA	2190	1750
SODIUM			47342.1	NA	NA	NA	NA	23400	16800
VANADIUM		3.6	22.6	NA	NA	NA	NA	1.6 J	0.99 J
ZINC		1100	51.7	NA	NA	NA	NA	3.55 U	3.55 U
DISSOLVED METALS (UG/L)									
ALUMINUM		3600	15341.4	NA	58.0 UJ	NA	192 J	NA	NA
ANTIMONY	6	1.5		NA	0.65 J	NA	0.37 UJ	NA	NA
ARSENIC	10	0.045		NA	***1.8 J***	NA	***5.3***	NA	NA

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-8A
SUMMARY OF ANALYTICAL DETAILS[1] - DEEP BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW40B2-7678	B81-GW-MW40B2-0210	B81-GW-MW42B2-4649	B81-GW-MW43B2-0110	B81-GW-MW47B2-0210-AVG	B81-GW-MW47B1-0210
LOCATION ID				B81-MW-40B2	B81-MW-40B2	B81-MW-42B2	B81-MW-43B2	B81-MW-472B2	B81-MW-47B1
TOP DEPTH				76.0	50.5	46.0	84.1	67.5	50.5
BOTTOM DEPTH				78.0	60.5	49.0	99.1	77.5	60.5
SAMPLE DATE	**MCL**	**PRG**	**BKG**	12/30/09	02/03/10	12/30/09	01/28/10	02/04/10	02/03/10
BARIUM	2000	260	181.32	NA	45.8	NA	6.3	NA	NA
BERYLLIUM	4	7.3	0.77	NA	0.05 U	NA	0.05 U	NA	NA
CALCIUM			19187.1	NA	36500	NA	20300	NA	NA
CHROMIUM	100	11	18.1	NA	1.6 UJ	NA	2.4 UJ	NA	NA
COPPER	1300	150	13.5	NA	1.5	NA	2.6	NA	NA
IRON		1100	44137.5	NA	70.5 UJ	NA	49.7 UJ	NA	NA
LEAD	15	15		NA	0.27 UJ	NA	0.55 UJ	NA	NA
MAGNESIUM			14205.5	NA	5250	NA	1480	NA	NA
MANGANESE		88	2680.63	NA	***348***	NA	1.0 U	NA	NA
NICKEL		73		NA	0.92 UJ	NA	0.81 UJ	NA	NA
POTASSIUM			6177.62	NA	1810	NA	7580	NA	NA
SODIUM			47342.1	NA	21900	NA	65200	NA	NA
VANADIUM		3.6	22.6	NA	0.70 U	NA	***7.2***	NA	NA
ZINC		1100	51.7	NA	15.0	NA	3.55 U	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)									
AMMONIA-N				NA	0.10 U	NA	0.10 U	0.041 J	0.033 J
CHLORIDE				NA	40.	NA	36.	18.	15.
FERROUS IRON				NA	0.71	NA	0.48	0.23 J	0.03 U
NITRITE-N	1			NA	0.0037 J	NA	0.091	0.050 U	0.050 U
ORTHOPHOSPHATE-P				NA	0.050 U	NA	0.38	0.77 J	0.042 J
SULFATE				NA	25.	NA	90.	21.	18.
SULFIDE				NA	1.0 U	NA	1.0 U	1.0 U	1.0 U
TOTAL ORGANIC CARBON				NA	1.8	NA	3.8	1.5	1.1
MISCELLANEOUS PARAMETERS (UG/L)									
CYANIDE	200	73		NA	10. UJ	NA	10. UJ	7.5 J	10. UJ

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-8A
SUMMARY OF ANALYTICAL DETAILS[1] - DEEP BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW47BB2-1209	B81-GW-MW50B2-6164
LOCATION ID				B81-MW-47B	B81-MW-50B2
TOP DEPTH					61.0
BOTTOM DEPTH					64.0
SAMPLE DATE	MCL	PRG	BKG	12/15/09	12/30/09
VOLATILES (UG/L)					
1,1-DICHLOROETHENE	7	34		0.4 UJ	0.4 U
2-BUTANONE		700		1 U	3 J
ACETONE		550		2 UJ	20
BENZENE	5	0.35		0.046 J	0.012 J
BROMODICHLOROMETHANE	80	0.18		***0.78 J***	0.016 U
BTEX				0.046 J	0.012 J
CHLORODIBROMOMETHANE	80	0.13		0.018 U	0.018 U
CHLOROFORM	80	0.17	3.2	***6***	0.098 J
CIS-1,2-DICHLOROETHENE	70	6.1		2	0.2 U
CYCLOHEXANE		1000		0.3 UJ	0.3 U
DICHLORODIFLUOROMETHANE		39		0.2 UJ	0.2 U
METHYL TERT-BUTYL ETHER		6.2		0.6 U	0.6 U
TETRACHLOROETHENE	5	0.1		***12***	***0.13***
TOTAL 1,2-DICHLOROETHENE	5	6.1		2	0.2 U
TOTAL CHLORINATED ETHENES				14.8 J	0.228
TRICHLOROETHENE	5	0.028	0.73	***0.74 J***	***0.098***
VINYL CHLORIDE	2	0.02		***0.089 J***	0.0100 U
VOLATILE GASES (UG/L)					
ETHENE				NA	NA
METHANE				NA	NA
SEMIVOLATILES (UG/L)					
2,4,6-TRICHLOROPHENOL		0.36		NA	NA
BENZO(A)ANTHRACENE		0.092	0.0475	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8		NA	NA
HIGH MOLECULAR WEIGHT PAHS				NA	NA
INDENO(1,2,3-CD)PYRENE		0.092		NA	NA
LOW MOLECULAR WEIGHT PAHS				NA	NA

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-8A
SUMMARY OF ANALYTICAL DETAILS[1] - DEEP BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW47BB2-1209	B81-GW-MW50B2-6164
LOCATION ID				B81-MW-47B	B81-MW-50B2
TOP DEPTH					61.0
BOTTOM DEPTH					64.0
SAMPLE DATE	MCL	PRG	BKG	12/15/09	12/30/09
PHENANTHRENE		180		NA	NA
TOTAL PAHS			0.0775	NA	NA
PESTICIDES/PCBS (UG/L)					
4,4'-DDD		0.28		NA	NA
GAMMA-BHC (LINDANE)	0.2	0.052	0.0092	NA	NA
HEPTACHLOR	0.4	0.015		NA	NA
METALS (UG/L)					
ALUMINUM		3600	15341.4	NA	NA
ARSENIC	10	0.045		NA	NA
BARIUM	2000	260	181.32	NA	NA
CADMIUM	5	1.8		NA	NA
CALCIUM			19187.1	NA	NA
CHROMIUM	100	11	18.1	NA	NA
COBALT		73	8.5	NA	NA
COPPER	1300	150	13.5	NA	NA
IRON		1100	44137.5	NA	NA
LEAD	15	15		NA	NA
MAGNESIUM			14205.5	NA	NA
MANGANESE		88	2680.63	NA	NA
NICKEL		73		NA	NA
POTASSIUM			6177.62	NA	NA
SODIUM			47342.1	NA	NA
VANADIUM		3.6	22.6	NA	NA
ZINC		1100	51.7	NA	NA
DISSOLVED METALS (UG/L)					
ALUMINUM		3600	15341.4	NA	NA
ANTIMONY	6	1.5		NA	NA
ARSENIC	10	0.045		NA	NA

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-8A
SUMMARY OF ANALYTICAL DETAILS[1] - DEEP BEDROCK GROUNDWATER - 2009-2010
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

SAMPLE ID				B81-GW-MW47BB2-1209	B81-GW-MW50B2-6164
LOCATION ID				B81-MW-47B	B81-MW-50B2
TOP DEPTH					61.0
BOTTOM DEPTH					64.0
SAMPLE DATE	MCL	PRG	BKG	12/15/09	12/30/09
BARIUM	2000	260	181.32	NA	NA
BERYLLIUM	4	7.3	0.77	NA	NA
CALCIUM			19187.1	NA	NA
CHROMIUM	100	11	18.1	NA	NA
COPPER	1300	150	13.5	NA	NA
IRON		1100	44137.5	NA	NA
LEAD	15	15		NA	NA
MAGNESIUM			14205.5	NA	NA
MANGANESE		88	2680.63	NA	NA
NICKEL		73		NA	NA
POTASSIUM			6177.62	NA	NA
SODIUM			47342.1	NA	NA
VANADIUM		3.6	22.6	NA	NA
ZINC		1100	51.7	NA	NA
MISCELLANEOUS PARAMETERS (MG/L)					
AMMONIA-N				NA	NA
CHLORIDE				NA	NA
FERROUS IRON				NA	NA
NITRITE-N	1			NA	NA
ORTHOPHOSPHATE-P				NA	NA
SULFATE				NA	NA
SULFIDE				NA	NA
TOTAL ORGANIC CARBON				NA	NA
MISCELLANEOUS PARAMETERS (UG/L)					
CYANIDE	200	73		NA	NA

DARK SHADING-MIN OF MCL, MMCL EXCEEDED; BOLD/ITALIC-PRG EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

TABLE 4-9
SUMMARY OF ANALYTICAL DATA - SOIL GAS
BUILDING 81 SITE
FORMER NAS SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

SAMPLE ID		B81-SG-GP01-1109	B81-SS-GP02-1109	B81-SS-GP02-1109-D	B81-SS-GP02-1109-AVG	B81-SG-GP03-1109	B81-SS-GP04-1109	B81-SG-GP05-1109	B81-SS-GP06-1109	B81-SS-GP07-1109	B81-SG-GP08-1109
LOCATION ID		B81-SG-GP01	B81-SS-GP02	B81-SS-GP02	B81-SS-GP02	B81-SG-GP03	B81-SS-GP04	B81-SG-GP05	B81-SS-GP06	B81-SS-GP07	B81-SG-GP08
SAMPLE DATE		11/20/09	11/11/09	11/11/09	11/11/09	11/17/09	11/10/09	11/17/09	11/06/09	11/06/09	11/16/09
TOP DEPTH (FT)		3.5	0.8	0.8	0.8	3.5	0.6	3.5	0.5	0.6	3.5
BOTTOM DEPTH (FT)		3.5	0.8	0.8	0.8	3.5	0.6	3.5	0.5	0.6	3.5
SACODE				DUPLICATE	AVERAGE						
CRITERIA	EPARSLx10										
VOLATILES (PPBV)											
1,1,2-TRICHLOROTRIFLUOROETHANE	40000	1.5	1.6 J	2.4 J	2 J	4.3 U	22 U	1.1 U	1.2 U	1.8	1.1 U
1,1-DICHLOROETHANE	3.7	1.1 U	1.1 U	1.1 U	1.1 U	4.3 U	22 U	1.1 U	1.2 U	1.7	1.1 U
BENZENE	0.97	5.6	1.1 U	1.1 U	1.1 U	4.3 U	22 U	2.0	1.2 U	1.1 U	2.3
BTEX		59.6	1.1	1.1	1.1	4.3 U	22 U	3.7	1.2 U	1.1 U	25.9
ETHYLBENZENE	2.2	1.1 U	1.1 U	1.1 U	1.1 U	4.3 U	22 U	1.1 U	1.2 U	1.1 U	4.8
M+P-XYLENES		1.1 U	1.1	1.1	1.1	4.3 U	22 U	1.1 U	1.2 U	1.1 U	14
O-XYLENE	1700	1.1 U	1.1 U	1.1 U	1.1 U	4.3 U	22 U	1.1 U	1.2 U	1.1 U	2.8
TETRACHLOROETHENE	0.6	73	96 J	140 J	118 J	1700	4600	42	290	58	17
TOLUENE	14000	54	1.1 U	1.1 U	1.1 U	4.3 U	22 U	1.7	1.2 U	1.1 U	2.0
TOTAL CHLORINATED ETHENES		73	96 J	140 J	118 J	1700	4600	42	290	58	17
TOTAL XYLENES	230	1.1 U	1.1	1.1	1.1	4.3 U	22 U	1.1 U	1.2 U	1.1 U	16.8

DARK SHADING-RSL EXCEEDED; LIGHT SHADING-DETECTED;
U-NOT DETECTED; J-QUANTITATION APPROXIMATE; R-REJECTED; NA-NOT ANALYZED

APPENDIX B

PRG CALCULATIONS

PRELIMINARY REMEDIATION GOALS
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Receptor: Recreational User
Exposure Pathways: Vapor Intrusion
Exposure Scenario: Reasonable Maximum Exposure

Chemical	USEPA RSL[1] (ug/L)	MassDEP GW-3 Values[2] (ug/L)	Target Cancer Risk Level[3]		Hazard Index = 1[3] (ug/L)
			10^{-6} (ug/L)	10^{-5} (ug/L)	
Groundwater					
Benzene	0.39	10,000	77	770	6,400
cis-1,2-Dichloroethene[4]	28	50,000	NA	NA	NA
Naphthalene	0.14	20,000	370	3,700	13,000
Tetrachloroethene	9.7	30,000	910	9,100	3,400
Toluene	860	40,000	NA	NA	980,000
Trichloroethene[5]	0.44	5,000	64	640	260
Vinyl chloride	0.015	50,000	9.6	96	3,000

1 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012. [Cancer benchmark value = 1E-06, Hazard index = 1.0]. The RSL for tap water is presented.
2 - Source: Table 1 (310 CMR 40.0974(2)) in Massachusetts Contingency Plan 310 CMR 40, MassDEP.
3 - An exposure frequency of 39 days per year was assumed for the recreational user. This is the adult recreational user exposure frequency (reasonable maximum exposure scenario) used in the HHRA for soil exposure. An average depth to groundwater of 183 cm was assumed for PRG calculation.
4 - No PRGs are calculated for cis-1,2-dichloroethene because no inhalation toxicity criteria are available for this compound.
5 - Trichloroethene = 1/(1/Mutagenic + 1/Non-mutagenic)
= 1/(1/143 + 1/117)
= 64

cm = centimeter
HHRA = Human Health Risk Assessment
MassDEP = Massachusetts Department of Environmental Protection
PRG = Preliminary Remediation Goal
RSL = Regional Screening Level
ug/L = Micrograms per liter
USEPA = United States Environmental Protection Agency

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
71432		Benzene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	30	39	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	5.89E+01	1.79E+03	7.8E-06	3.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,102	2.97E-03	1.27E-01	1.76E-04	1.42E-02	0.00E+00	0.00E+00	5.69E-04	4.14E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.27E+02	0.10	8.33E+01	1.42E-02	4.00E+02	3.99E+63	2.88E-04	3.65E-02	7.8E-06	3.0E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
7.67E+01	6.41E+03	7.67E+01	1.79E+06	7.67E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
	Soil Properties Lookup Table									
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
91203		Naphthalene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	30	39	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
5.90E-02	7.50E-06	4.82E-04	25	10,373	491.14	748.40	2.00E+03	3.10E+01	3.4E-05	3.0E-03

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	12,892	1.79E-04	7.64E-03	1.76E-04	9.54E-03	0.00E+00	0.00E+00	4.50E-04	3.13E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	7.64E+00	0.10	8.33E+01	9.54E-03	4.00E+02	7.21E+94	2.31E-04	1.76E-03	3.4E-05	3.0E-03

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
3.65E+02	1.33E+04	3.65E+02	3.10E+04	3.65E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	2.0E-06	1.0E-02		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184		Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	30	39	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.20E-02	8.20E-06	1.84E-02	25	8,288	394.40	620.20	1.55E+02	2.00E+02	2.6E-07	4.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	9,533	8.81E-03	3.77E-01	1.76E-04	1.16E-02	0.00E+00	0.00E+00	4.63E-04	3.37E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	3.77E+02	0.10	8.33E+01	1.16E-02	4.00E+02	5.42E+77	2.45E-04	9.23E-02	2.6E-07	4.0E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
9.10E+02	3.38E+03	9.10E+02	2.00E+05	9.10E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	2.6E-07	4.0E-02		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108883		Toluene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	30	39	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.70E-02	8.60E-06	6.62E-03	25	7,930	383.78	591.79	1.82E+02	5.26E+02	0.0E+00	5.0E+00

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	9,133	3.28E-03	1.40E-01	1.76E-04	1.41E-02	0.00E+00	0.00E+00	5.62E-04	4.09E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.40E+02	0.10	8.33E+01	1.41E-02	4.00E+02	2.15E+64	2.85E-04	3.99E-02	NA	5.0E+00

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	9.77E+05	9.77E+05	5.26E+05	NOC

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.
NOC = NOT OF CONCERN. The groundwater conc. at or above the solubility limit is not of concern for this pathway.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	2.0E-06	1.0E-02		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	76	39	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.0E-06	0.0E+00

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
2.40E+09	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,532	5.33E-03	2.28E-01	1.76E-04	1.28E-02	0.00E+00	0.00E+00	5.09E-04	3.71E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.28E+02	0.10	8.33E+01	1.28E-02	4.00E+02	7.02E+70	2.64E-04	6.01E-02	1.0E-06	NA

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
1.43E+02	NA	1.43E+02	1.47E+06	1.43E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	1.0E-06	0.0E+00		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	30	39	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	3.1E-06	2.0E-03

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,532	5.33E-03	2.28E-01	1.76E-04	1.28E-02	0.00E+00	0.00E+00	5.09E-04	3.71E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.28E+02	0.10	8.33E+01	1.28E-02	4.00E+02	7.02E+70	2.64E-04	6.01E-02	3.1E-06	2.0E-03

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
1.17E+02	2.59E+02	1.17E+02	1.47E+06	1.17E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	3.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75014		Vinyl chloride (chloroethene)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	30	39	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	1.86E+01	8.80E+03	8.8E-06	1.0E-01

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	4,978	1.84E-02	7.85E-01	1.76E-04	1.71E-02	0.00E+00	0.00E+00	6.80E-04	4.96E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	7.85E+02	0.10	8.33E+01	1.71E-02	4.00E+02	6.32E+52	3.29E-04	2.58E-01	8.8E-06	1.0E-01

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
9.61E+00	3.02E+03	9.61E+00	8.80E+06	9.61E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	2.0E-06	1.0E-02		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

PRELIMINARY REMEDIATION GOALS
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Receptor: Industrial/Commercial Worker
Exposure Pathways: Vapor Intrusion
Exposure Scenario: Reasonable Maximum Exposure

Chemical	USEPA RSL[1] (ug/L)	MassDEP GW-3 Values[2] (ug/L)	Target Cancer Risk Level[3]		Hazard Index = 1[3] (ug/L)
			10^{-6} (ug/L)	10^{-5} (ug/L)	
Groundwater					
Benzene	0.39	10,000	14	140	1,200
cis-1,2-Dichloroethene[4]	28	50,000	NA	NA	NA
Naphthalene	0.14	20,000	68	680	2,500
Tetrachloroethene	9.7	30,000	170	1,700	630
Toluene	860	40,000	NA	NA	180,000
Trichloroethene	0.44	5,000	17	170	49
Vinyl chloride	0.015	50,000	1.8	18	570

1 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012. [Cancer benchmark value = 1E-06, Hazard index = 1.0]. The RSL for tap water is presented.
2 - Source: Table 1 (310 CMR 40.0974(2)) in Massachusetts Contingency Plan 310 CMR 40, MassDEP.
3 - An average depth to groundwater of 183 cm was assumed for PRG calculation.
4 - No PRGs are calculated for cis-1,2-dichloroethene because no inhalation toxicity criteria are available for this compound.

cm = centimeter
MassDEP = Massachusetts Department of Environmental Protection
PRG = Preliminary Remediation Goal
RSL = Regional Screening Level
ug/L = Micrograms per liter
USEPA = United States Environmental Protection Agency

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
71432		Benzene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	5.89E+01	1.79E+03	7.8E-06	3.0E-02

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,102	2.97E-03	1.27E-01	1.76E-04	1.42E-02	0.00E+00	0.00E+00	5.69E-04	4.14E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.27E+02	0.10	8.33E+01	1.42E-02	4.00E+02	3.99E+63	2.88E-04	3.65E-02	7.8E-06	3.0E-02

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
1.44E+01	1.20E+03	1.44E+01	1.79E+06	1.44E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
	Soil Properties Lookup Table									
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	2.6E-07	4.0E-02		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
91203		Naphthalene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
5.90E-02	7.50E-06	4.82E-04	25	10,373	491.14	748.40	2.00E+03	3.10E+01	3.4E-05	3.0E-03

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	12,892	1.79E-04	7.64E-03	1.76E-04	9.54E-03	0.00E+00	0.00E+00	4.50E-04	3.13E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	7.64E+00	0.10	8.33E+01	9.54E-03	4.00E+02	7.21E+94	2.31E-04	1.76E-03	3.4E-05	3.0E-03

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
6.83E+01	2.49E+03	6.83E+01	3.10E+04	6.83E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	2.0E-06	1.0E-02		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184		Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.20E-02	8.20E-06	1.84E-02	25	8,288	394.40	620.20	1.55E+02	2.00E+02	2.6E-07	4.0E-02

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	9,533	8.81E-03	3.77E-01	1.76E-04	1.16E-02	0.00E+00	0.00E+00	4.63E-04	3.37E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	3.77E+02	0.10	8.33E+01	1.16E-02	4.00E+02	5.42E+77	2.45E-04	9.23E-02	2.6E-07	4.0E-02

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
1.70E+02	6.33E+02	1.70E+02	2.00E+05	1.70E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	2.0E-06	1.0E-02		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	2.6E-07	4.0E-02		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108883		Toluene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.70E-02	8.60E-06	6.62E-03	25	7,930	383.78	591.79	1.82E+02	5.26E+02	0.0E+00	5.0E+00

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	9,133	3.28E-03	1.40E-01	1.76E-04	1.41E-02	0.00E+00	0.00E+00	5.62E-04	4.09E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.40E+02	0.10	8.33E+01	1.41E-02	4.00E+02	2.15E+64	2.85E-04	3.99E-02	NA	5.0E+00

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	1.83E+05	1.83E+05	5.26E+05	1.83E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	2.6E-07	4.0E-02		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	4.1E-06	2.0E-03

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	8,532	5.33E-03	2.28E-01	1.76E-04	1.28E-02	0.00E+00	0.00E+00	5.09E-04	3.71E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.28E+02	0.10	8.33E+01	1.28E-02	4.00E+02	7.02E+70	2.64E-04	6.01E-02	4.1E-06	2.0E-03

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
1.66E+01	4.86E+01	1.66E+01	1.47E+06	1.66E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
	Soil Properties Lookup Table									
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	2.6E-07	4.0E-02		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75014		Vinyl chloride (chloroethene)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	1.86E+01	8.80E+03	8.8E-06	1.0E-01

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.92E+04	1.06E+06	3.77E-04	15	4,978	1.84E-02	7.85E-01	1.76E-04	1.71E-02	0.00E+00	0.00E+00	6.80E-04	4.96E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	7.85E+02	0.10	8.33E+01	1.71E-02	4.00E+02	6.32E+52	3.29E-04	2.58E-01	8.8E-06	1.0E-01

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
1.80E+00	5.66E+02	1.80E+00	8.80E+06	1.80E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane	1.16E+02	3.20E-02	8.90E-06	1.23E+03	6.00E-03	1.47E-04	25	469	692		6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	2.6E-07	4.0E-02		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

PRELIMINARY REMEDIATION GOALS
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Receptor: Residents
Exposure Pathways: Vapor Intrusion
Exposure Scenario: Reasonable Maximum Exposure

Chemical	USEPA RSL[1] (ug/L)	MassDEP GW-3 Values[2] (ug/L)	Target Cancer Risk Level[3]		Hazard Index = 1[3] (ug/L)
			10^{-6} (ug/L)	10^{-5} (ug/L)	
Groundwater					
Benzene[4]	0.39	10,000	2.1	21	210
cis-1,2-Dichloroethene[5]	28	50,000	NA	NA	NA
Naphthalene	0.14	20,000	10	100	440
Tetrachloroethene	9.7	30,000	25	250	110
Toluene[4]	860	40,000	NA	NA	32,000
Trichloroethene[4][6]	0.44	5,000	1.8	18	8.5
Vinyl chloride[4]	0.015	50,000	0.26	2.6	99

1 - USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, May, 2012. [Cancer benchmark value = 1E-06, Hazard index = 1.0]. The RSL for tap water is presented.
2 - Source: Table 1 (310 CMR 40.0974(2)) in Massachusetts Contingency Plan 310 CMR 40, MassDEP.
3 - An average depth to groundwater of 183 cm was assumed for PRG calculation.
4 - Contaminant of interest.
5 - No PRGs are calculated for cis-1,2-dichloroethene because no inhalation toxicity criteria are available for this compound.
6 - Trichloroethene = 1/(1/Mutagenic + 1/Non-mutagenic)
= 1/(1/3.91 + 1/3.2)
= 1.8

cm = centimeter
MassDEP = Massachusetts Department of Environmental Protection
PRG = Preliminary Remediation Goal
RSL = Regional Screening Level
ug/L = Micrograms per liter
USEPA = United States Environmental Protection Agency

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
71432		Benzene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	5.89E+01	1.79E+03	7.8E-06	3.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,102	2.97E-03	1.27E-01	1.76E-04	1.42E-02	0.00E+00	0.00E+00	5.69E-04	4.14E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.27E+02	0.10	8.33E+01	1.42E-02	4.00E+02	3.99E+63	1.17E-03	1.49E-01	7.8E-06	3.0E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
2.09E+00	2.10E+02	2.09E+00	1.79E+06	2.09E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
	Soil Properties Lookup Table									
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane											6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
91203		Naphthalene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
5.90E-02	7.50E-06	4.82E-04	25	10,373	491.14	748.40	2.00E+03	3.10E+01	3.4E-05	3.0E-03

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	12,892	1.79E-04	7.64E-03	1.76E-04	9.54E-03	0.00E+00	0.00E+00	4.50E-04	3.13E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	7.64E+00	0.10	8.33E+01	9.54E-03	4.00E+02	7.21E+94	9.42E-04	7.19E-03	3.4E-05	3.0E-03

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
9.95E+00	4.35E+02	9.95E+00	3.10E+04	9.95E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	2.0E-06	1.0E-02		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane											6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184		Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.20E-02	8.20E-06	1.84E-02	25	8,288	394.40	620.20	1.55E+02	2.00E+02	2.6E-07	4.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	9,533	8.81E-03	3.77E-01	1.76E-04	1.16E-02	0.00E+00	0.00E+00	4.63E-04	3.37E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	3.77E+02	0.10	8.33E+01	1.16E-02	4.00E+02	5.42E+77	1.00E-03	3.77E-01	2.6E-07	4.0E-02

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
2.48E+01	1.11E+02	2.48E+01	2.00E+05	2.48E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane											6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	2.6E-07	4.0E-02		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108883		Toluene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
8.70E-02	8.60E-06	6.62E-03	25	7,930	383.78	591.79	1.82E+02	5.26E+02	0.0E+00	5.0E+00

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	9,133	3.28E-03	1.40E-01	1.76E-04	1.41E-02	0.00E+00	0.00E+00	5.62E-04	4.09E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.40E+02	0.10	8.33E+01	1.41E-02	4.00E+02	2.15E+64	1.16E-03	1.63E-01	NA	5.0E+00

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	3.20E+04	3.20E+04	5.26E+05	3.20E+04

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane											6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

Reset to

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Looku)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	76	350	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.0E-06	0.0E+00

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
2.40E+09	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,532	5.33E-03	2.28E-01	1.76E-04	1.28E-02	0.00E+00	0.00E+00	5.09E-04	3.71E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.28E+02	0.10	8.33E+01	1.28E-02	4.00E+02	7.02E+70	1.08E-03	2.45E-01	1.0E-06	NA

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
3.91E+00	NA	3.91E+00	1.47E+06	3.91E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	1.0E-06	0.0E+00		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane											6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

DATA ENTRY SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	3.1E-06	2.0E-03

END

DATA ENTRY SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	8,532	5.33E-03	2.28E-01	1.76E-04	1.28E-02	0.00E+00	0.00E+00	5.09E-04	3.71E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.28E+02	0.10	8.33E+01	1.28E-02	4.00E+02	7.02E+70	1.08E-03	2.45E-01	3.1E-06	2.0E-03

END

DATA ENTRY SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
3.20E+00	8.50E+00	3.20E+00	1.47E+06	3.20E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	3.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane											6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75014		Vinyl chloride (chloroethene)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
12	15	183	183	0	0	A	S	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	S	1.66	0.375	0.054	S	1.66	0.375	0.054

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	1.86E+01	8.80E+03	8.8E-06	1.0E-01

END

CHEMICAL PROPERTIES SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	168	0.321	0.321	0.321	0.003	9.96E-08	0.998	9.94E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.69E+04	1.06E+06	3.77E-04	15	4,978	1.84E-02	7.85E-01	1.76E-04	1.71E-02	0.00E+00	0.00E+00	6.80E-04	4.96E-03	168

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	7.85E+02	0.10	8.33E+01	1.71E-02	4.00E+02	6.32E+52	1.34E-03	1.05E+00	8.8E-06	1.0E-01

END

CHEMICAL PROPERTIES SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
2.62E-01	9.90E+01	2.62E-01	8.80E+06	2.62E-01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

VLOOKUP TABLES

Soil Properties Lookup Table

SCS Soil Type	K_s (cm/h)	α_1 (1/cm)	N (unitless)	M (unitless)	n (cm^3/cm^3)	θ_r (cm^3/cm^3)	Mean Grain Diameter (cm)	Bulk Density (g/cm^3)	θ_w (cm^3/cm^3)	SCS Soil Name
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

Chemical Properties Lookup Table

CAS No.	Chemical	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's law constant H' (unitless)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	URF extrapolated (X)	RfC extrapolated (X)
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	1.9E-01		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01		X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04		X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01		X
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	9.8E-02		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	6.22E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Methyl chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.0E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	1.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroetha	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03		
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	0.0E+00		
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X

91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	3.4E-05	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	8.15E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		
95578	2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02		X
95636	1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	7.0E-03		
96128	1,2-Dibromo-3-chloropropane											6.0E-03	2.0E-04		
96184	1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X	
96333	Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01		X
97632	Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01		X
98066	tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01		X
98828	Isopropylbenzene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01		
98862	Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01		X
98953	Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03		
100414	Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	2.5E-06	1.0E+00		
100425	Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00		
100447	Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X	
100527	Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01		X
103651	n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01		X
104518	n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01		X
106423	p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	7.0E-01		
106467	1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01		
106934	1,2-Dibromoethane (ethylene dib	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04		
106990	1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03		
107028	Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05		
107062	1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	2.4E+00		
107131	Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03		
108054	Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01		
108101	Methylisobutylketone (4-methyl-2	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00		
108383	m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01		
108678	1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03		
108872	Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00		
108883	Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	5.0E+00		
108907	Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	5.0E-02		
109693	1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00		X
110009	Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03		X
110543	Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01		
111444	Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00		
115297	Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02		X
118741	Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03		X
120821	1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03		
123739	Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X	
124481	Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X	X
126987	Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04		
126998	2-Chloro-1,3-butadiene (chloropr	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03		
127184	Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	2.7E-01		
129000	Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14370	0.0E+00	1.1E-01		X
132649	Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66400	0.0E+00	1.4E-02		X
135988	sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88730	0.0E+00	1.4E-01		X
141786	Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7633.66	0.0E+00	3.2E+00		X
156592	cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7192	0.0E+00	0.0E+00		
156605	trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6717	0.0E+00	6.0E-02		
205992	Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17000	2.1E-04	0.0E+00	X	
218019	Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16455	2.1E-06	0.0E+00	X	
309002	Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15000	4.9E-03	1.1E-04		X
319846	alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15000	1.8E-03	0.0E+00		
541731	1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9230.18	0.0E+00	1.1E-01		X
542756	1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7900	4.0E-06	2.0E-02		
630206	1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01		X
1634044	MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6677.66	0.0E+00	3.0E+00		
7439976	Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14127	0.0E+00	3.0E-04		

CALCULATION OF RISK-BASED PRELIMINARY CLEANUP LEVELS (PAGE 1 OF 3)

SITE NAME: BUILDING 81
LOCATION: NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS
EXPOSURE SCENARIO: CONSTRUCTION WORKERS
MEDIA: GROUNDWATER
DATE: JULY 26, 2012

THIS SPREADSHEET CALCULATES RISK-BASED CLEANUP GOALS FOR EXPOSURES TO GROUNDWATER THROUGH INCDIENTAL INGESTION, DERMAL CONTACT, AND INHALATION.

RELEVANT EQUATION:

Carcinogens

$$PRG_{GW} = \frac{TCR}{Intake_{oral} \cdot CSF_{oral} \cdot CF + Intake_{derm} \cdot CSF_{derm} \cdot CF + Intake_{inh} \cdot IUR}$$

NonCarcinogens

$$PRG_{GW} = \frac{THI}{\left[\left(\frac{Intake_{oral}}{RfD_{oral}}\right) + \left(\frac{Intake_{derm}}{RfD_{derm}}\right) + \left(\frac{Intake_{inh}}{RfC}\right)\right] \cdot CF}$$

$$Intake_{oral} = \frac{IR \times EF \times ED}{BW \times AT}$$

$$Intake_{derm} = \frac{DA_{Event} \times EV \times ED \times EF \times SA}{BW \times AT}$$

$$Intake_{inh} = \frac{VF \times ET \times EF \times ED}{AT \times 24\ hr/day}$$

For Inorganics DAevent = Kp x CF2 x tevent

For Organics

$$\text{If } tevent \le t^*, \text{ then}: DAevent = 2 \times FA \times Kp \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If } tevent > t^*, \text{ then}: DAevent = FA \times Kp \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

WHERE:

TCR = :	1.0E-06	Target Cancer Risk
THI = :	1	Target Hazard Index
IR = :	0.01	Incidental ingestion rate of groundwater (L/day)
SA = :	5,749	Skin surface available for contact (cm^2)
CF = :	0.001	Conversion Factor (mg/ug or L/cm^3)
DAevent = :		Chemical specific absorbed dose per event (mg/cm^2-event)
EV = :	1	Event frequency (events/days)
ET = :	8	Exposure time (hours/day)
EF = :	10	Exposure frequency (days/year)
ED = :	1	Exposure duration (years)
BW = :	70	Body weight (kg)
ATc = :	25,550	Averaging time for carcinogenic exposures (days)
ATn = :	365	Averaging time for noncarcinogenic exposures (days)
Kp =:		Chemical specific permeability coefficient (cm/hr)
tevent = :	2	duration of event (hr/event)
tau = :		Chemical specific lag time (hr)
t* = :		Chemical specific time it takes to reach steady state (hr)
B = :		Chemical specific dimensionless constant
VF = :		Chemical specific volatilization factor (L/m3) (See Page 3)
CSF_{oral} = :		oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfD_{oral} = :		oral noncarcinogenic reference dose (mg/kg/day)
CSF_{derm} = :		dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfD_{derm} = :		dermal noncarcinogenic reference dose (mg/kg/day)
IUR = :		inhalation unit risk ($(ug/m^3)^{-1}$)
RfC = :		inhalation reference concentration (mg/m^3)

CALCULATION OF RISK-BASED PRELIMINARY CLEANUP LEVELS (PAGE 2 OF 3)

SITE NAME: BUILDING 81
LOCATION: NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS
EXPOSURE SCENARIO: CONSTRUCTION WORKERS
MEDIA: GROUNDWATER
DATE: JULY 26, 2012

CHEMICAL	Organic or Inorganic	Estimated Kp (cm/hr)	FA	tau-event (hr)	B	t* (hr)	DAevent (L/cm^2 - event)
2-Methylnaphthalene	Organic	8.94E-02	1.00E+00	6.57E-01	4.10E-01	1.58E+00	2.88E-04
Benzene	Organic	1.49E-02	1.00E+00	2.92E-01	5.05E-02	7.00E-01	3.74E-05
cis-1,2-Dichloroethene	Organic	1.09E-02	1.00E+00	3.66E-01	4.12E-02	8.80E-01	2.92E-05
Naphthalene	Organic	4.66E-02	1.00E+00	5.58E-01	2.03E-01	1.34E+00	1.40E-04
Tetrachloroethene	Organic	3.34E-02	1.00E+00	9.06E-01	1.66E-01	2.18E+00	1.24E-04
Toluene	Organic	3.11E-02	1.00E+00	3.50E-01	1.15E-01	8.39E-01	8.00E-05
Trichloroethene	Organic	1.16E-02	1.00E+00	5.81E-01	5.13E-02	1.39E+00	3.64E-05
Vinyl chloride	Organic	5.60E-03	1.00E+00	2.39E-01	1.70E-02	5.73E-01	1.37E-05

CHEMICAL	VF (L/m3)	Cancer Slope Factor			Reference Dose		
		Oral $(mg/kg/day)^{-1}$	Dermal $(mg/kg/day)^{-1}$	Inhalation $(ug/m^3)^{-1}$	Oral (mg/kg/day)	Dermal (mg/kg/day)	Inhalation (mg/m^3)
2-Methylnaphthalene	8.43E+00	NA	NA	NA	4.0E-03	4.0E-03	NA
Benzene	1.25E+01	5.5E-02	5.5E-02	7.8E-06	4.0E-03	4.0E-03	3.0E-02
cis-1,2-Dichloroethene	1.11E+01	NA	NA	NA	2.0E-03	2.0E-03	NA
Naphthalene	8.71E+00	NA	NA	3.4E-05	2.0E-02	2.0E-02	3.0E-03
Tetrachloroethene	8.62E+00	2.1E-03	2.1E-03	2.6E-07	6.0E-03	6.0E-03	4.0E-02
Toluene	1.15E+01	NA	NA	NA	8.0E-02	8.0E-02	5.0E+00
Trichloroethene	9.66E+00	4.6E-02	4.6E-02	4.1E-06	5.0E-04	5.0E-04	2.0E-03
Vinyl chloride	1.41E+01	7.2E-01	7.2E-01	4.4E-06	3.0E-03	3.0E-03	1.0E-01

CHEMICAL	Carcinogenic Intakes			Noncarcinogenic Intakes		
	Oral (L/kg/day)	Dermal (L/kg/day)	Inhalation (L/m^3)	Oral (L/kg/day)	Dermal (L/kg/day)	Inhalation (L/m^3)
2-Methylnaphthalene	5.591E-08	9.27E-06	1.10E-03	3.91E-06	6.49E-04	7.70E-02
Benzene	5.591E-08	1.20E-06	1.63E-03	3.91E-06	8.42E-05	1.14E-01
cis-1,2-Dichloroethene	5.591E-08	9.38E-07	1.45E-03	3.91E-06	6.57E-05	1.02E-01
Naphthalene	5.591E-08	4.49E-06	1.14E-03	3.91E-06	3.15E-04	7.96E-02
Tetrachloroethene	5.591E-08	4.00E-06	1.12E-03	3.91E-06	2.80E-04	7.87E-02
Toluene	5.591E-08	2.57E-06	1.50E-03	3.91E-06	1.80E-04	1.05E-01
Trichloroethene	5.591E-08	1.17E-06	1.26E-03	3.91E-06	8.18E-05	8.82E-02
Vinyl chloride	5.591E-08	4.41E-07	1.83E-03	3.91E-06	3.09E-05	1.28E-01

CHEMICAL	Groundwater Concentration		Risk-Based[(1)] Cleanup Level (ug/L)
	Carcinogenic (ug/L)	Noncarcinogenic (ug/L)	
2-Methylnaphthalene	NA	6129	6129
Benzene	78.4	262	78.4
cis-1,2-Dichloroethene	NA	28733	28733
Naphthalene	25.9	37.7	25.9
Tetrachloroethene	3323	496	496
Toluene	NA	42923	42923
Trichloroethene	191	22.6	22.6
Vinyl chloride	119	772	119

Notes:
(1) - Risked-based cleanup level is the lower of the carcinogenic and noncarcinogenic groundwater concentration.

CALCULATION OF RISK-BASED PRELIMINARY CLEANUP LEVELS (PAGE 3 OF 3)

SITE NAME: BUILDING 81
LOCATION: NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS
EXPOSURE SCENARIO: CONSTRUCTION WORKERS
MEDIA: GROUNDWATER
DATE: JULY 26, 2012

CALCULATION OF VOLATILIZATION FACTOR FOR CONSTRUCTION WORKERS EXPOSED TO GROUNDWATER
SOURCE: VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY (http://www.deq.state.va.us/vrprisk/raguide.html)
Table 3.8 Exposure-point concentrations (inhalation) for construction/utility workers in a trench: Groundwater less than 15 feet deep

For Mass-Transfer Coefficients			For Emission Flux and Concentration in Trench			Trench dimensions		
Kg,H2O	0.833	cm/s	CF1	1.00E-03	L/cm3	Length	**8**	ft
MWH2O	18		CF2	1.00E+04	cm2/m2		2.44	m
Kg,O2	0.002	cm/s	CF3	3600	s/hr	Width	**6**	ft
MWO2	32		F	**1**			1.83	m
T	**77**	F	ACH	2	hr-1	Depth	**6**	ft
T	298	K					1.83	m
R	8.20E-05	atm-m3/mol-K				Width/Depth	1.00	

	CAS No.	Molecular Weight MWi g/mol	Henry's Law Constant Hi atm-m3/mol	Gas-Phase Mass Transfer Coefficient KiG cm/s	Liquid-Phase Mass Transfer Coefficient KiL cm/s	Overall Mass Transfer Coefficient Ki cm/s	Concentration of Contaminant in Groundwater Cgw ug/L	Volatilization Factor VF L/m3	Concentration of Contaminant in Trench Ctrench ug/m3
Volatile Organic Compounds (VOCs)									
2-Methylnaphthalene	91-57-6	142.20	5.18E-04	4.17E-01	9.49E-04	8.57E-04	1.00E+00	8.43E+00	8.43E+00
Benzene	71-43-2	78.11	5.55E-03	5.09E-01	1.28E-03	1.27E-03	1.00E+00	1.25E+01	1.25E+01
cis-1,2-Dichloroethene	156-59-2	96.94	4.08E-03	4.74E-01	1.15E-03	1.13E-03	1.00E+00	1.11E+01	1.11E+01
Naphthalene	91-20-3	128.18	4.40E-04	4.32E-01	9.99E-04	8.85E-04	1.00E+00	8.71E+00	8.71E+00
Tetrachloroethene	127-18-4	165.83	1.77E-02	3.96E-01	8.79E-04	8.76E-04	1.00E+00	8.62E+00	8.62E+00
Toluene	108-88-3	92.14	6.64E-03	4.82E-01	1.18E-03	1.17E-03	1.00E+00	1.15E+01	1.15E+01
Trichloroethene	79-01-6	131.39	9.85E-03	4.28E-01	9.87E-04	9.81E-04	1.00E+00	9.66E+00	9.66E+00
Vinyl chloride	75-01-4	62.50	2.78E-02	5.49E-01	1.43E-03	1.43E-03	1.00E+00	1.41E+01	1.41E+01

APPENDIX C

CONTAMINANT MASS AND VOLUME CALCULATIONS

NAS South Weymouth
Building 81
COC Mass Calculations - PCE Plumes (5, 100, and 1,000 ug/L)
12/13/2012

foc	0.002
bulk density, lb/ft3 (overburden)	110
bulk density, lb/ft3 (bedrock)	162

							Aqueous		Contaminant Sorbed				
Zone Thickness (ft)	Location	Area within 1,000 ug/L PCE Plume (ft^2)	Total Volume in Place (ft^3)	Volume of Soil Fines (ft^3)	n	Volume in Water (gallons)	Average Concentration (ug/L)	Contaminant (lb)	Koc (L/kg)	Kd (L/kg)	Cs (ug/kg)	Soil mass (lb)	Amount Sorbed (lb)
22	Shallow Bedrock 1,000 ug/L PCE Plume	600	13,200	1,056	0.02	2,000	11,000	0.18	263	0.526	5,786	171,325	0.99
20	Deep Bedrock 1,000 ug/L PCE Plume	400	8,000	640	0.02	1,000	1,600	0.013	263	0.526	842	103,834	0.087
22	Shallow Bedrock 5 ug/L TCE Plume	600	13,200	1,056	0.02	2,000	120	0.0020	107	0.214	25.68	171,325	0.0044
20	Deep Bedrock 10 ug/L TCE Plume	400	8,000	640	0.02	1,000	190	0.0016	107	0.214	40.66	103,834	0.0042
							Total	**0.20**				**Total**	**1.09**

							Aqueous		Contaminant Sorbed				
Zone Thickness (ft)	Location	Area between 100 and 1,000 ug/L PCE Plume (ft^2)	Total Volume in Place (ft^3)	Volume of Soil Fines (ft^3)	n	Volume in Water (gallons)	Average Concentration (ug/L)	Contaminant (lb)	Koc (L/kg)	Kd (L/kg)	Cs (ug/kg)	Soil mass (lb)	Amount Sorbed (lb)
22	Shallow Bedrock 100 ug/L PCE Plume	7,700	169,400	13,552	0.02	25,000	313	0.065	263	0.526	164	2,198,676	0.36
20	Deep Bedrock 100 ug/L PCE Plume	5,500	110,000	8,800	0.02	16,000	290	0.039	263	0.526	153	1,427,712	0.22
22	Shallow Bedrock 5 ug/L TCE Plume	5,800	127,600	10,208	0.02	19,000	19	0.0030	107	0.214	4.0446	1,656,146	0.0067
20	Deep Bedrock 10 ug/L TCE Plume	4,400	88,000	7,040	0.02	13,000	35	0.0038	107	0.214	7.49	1,142,170	0.0086
22	Shallow Bedrock 70 ug/L cis-1,2-DCE Plume	300	6,600	528	0.02	1,000	125	0.0010	45	0.09	11.25	85,663	0.00096
22	Shallow Bedrock 2 ug/L VC Plume	1,700	37,400	2,992	0.02	6,000	10	0.00048	3	0.006	0.057	485,422	0.000028
22	Shallow Bedrock 5 ug/L Benzene Plume	300	6,600	528	0.02	1,000	8	0.00007	95	0.19	1.5067	85,663	0.00013
							Total	**0.11**				**Total**	**0.60**

Zone Thickness (ft)	Location	Area within 100 ug/L PCE Plume (ft^2)	Total Volume in Place (ft^3)	n	Volume in Water (gallons)	Aqueous: Average Concentration (ug/L)	Aqueous: Contaminant (lb)	Contaminant Sorbed: Koc (L/kg)	Contaminant Sorbed: Kd (L/kg)	Contaminant Sorbed: Cs (ug/kg)	Contaminant Sorbed: Soil mass (lb)	Contaminant Sorbed: Amount Sorbed (lb)
11	Overburden 100 ug/L PCE Plume	11,400	125,400	0.32	300,000	227	0.57	263	0.526	119	13,794,000	1.65
11	Overburden 5 ug/L TCE Plume	8,800	96,800	0.32	232,000	14	0.028	107	0.214	3.0602	10,648,000	0.033
11	Overburden 70 ug/L cis-1,2-DCE Plume	400	4,400	0.32	11,000	100	0.0092	45	0.09	9	484,000	0.0044
11	Overburden 2 ug/L VC Plume	6,000	66,000	0.32	158,000	7.1	0.0093	3.0	0.006	4.23E-02	7,260,000	0.00031
11	Overburden 5 ug/L Benzene Plume	5,800	63,800	0.32	153,000	7	0.0089	95	0.19	1.3205	7,018,000	0.0093
						Total	**0.62**				**Total**	**1.69**

Zone Thickness (ft)	Location	Area between 5 and 100 ug/L PCE Plume (ft^2)[1]	Total Volume in Place (ft^3)	Volume of Soil Fines (ft^3)	n	Volume in Water (gallons)	Aqueous: Average Concentration (ug/L)	Contaminant Sorbed: Contaminant (lb)	Contaminant Sorbed: Koc (L/kg)	Contaminant Sorbed: Kd (L/kg)	Contaminant Sorbed: Cs (ug/kg)	Contaminant Sorbed: Soil mass (lb)	Contaminant Sorbed: Amount Sorbed (lb)
11	Overburden 5 ug/L PCE Plume	16,400	180,400	---	0.32	432,000	52	0.19	665	1.33	69	19,844,000	1.37
22	Shallow Bedrock 5 ug/L PCE Plume	24,800	545,600	43,648	0.02	82,000	49	0.033	665	1.33	65	7,081,452	0.46
20	Deep Bedrock 5 ug/L PCE Plume	10,700	214,000	17,120	0.02	32,000	6.3	0.0017	665	1.33	8	2,777,549	0.023
22	Shallow Bedrock 5 ug/L TCE Plume	2,900	63,800	5,104	0.02	10,000	7	0.00058	160	0.32	2.24	828,073	0.0019
20	Deep Bedrock 10 ug/L TCE Plume	400	8,000	640	0.02	1,000	5	0.000042	160	0.32	1.6	103,834	0.00017
20	Deep Bedrock 2 ug/L VC Plume	700	14,000	1,120	0.02	2,000	4	0.000067	8.2	0.0164	0.0656	181,709	0.000012
							Total	**0.22**				**Total**	**1.86**

1) Deep bedrock TCE calculations were based on the 10 ug/L contour line
2) Toluene not included in mass estimates; no exceedances of the MCL in groundwater

Cs = Concentrations in dry soil (sorbed phase), ug/kg
Cw = concentration in water, ug/L
foc = fraction organic carbon
n = porosity
Koc = partition coefficient, L/kg
Kd = partition coefficient; L/kg
ρs = soil true density, lb/ft3
ρbs = soil bulk density, lb/ft3

ρw = density of water, lb/ft3
Cs = Kd x Cw
Koc x foc = Kd
Kd = Cs/ Cw
Kd * Cw = Cs
Koc x foc = Kd
n = Volume void (Vv)/Volume total (Vt)
n = 1-(ρbs/ρs)

Vs = Volume of soil fines
Vw = Volume of water
Vs = 0.08Vt

APPENDIX D

CONCEPTUAL DESIGN CALCULATIONS

CLIENT: SOUTH WEYMOUTH		JOB NUMBER: 112G02073 - FS.DF.B81
SUBJECT: BUILDING 81 SITE FS - CONCEPTUAL DESIGN CALCULATION SHEET		
BASED ON:		DRAWING NUMBER:
BY: JWL Date: 12/27/2012	CAH Date: 1/8/2013	APPROVED BY: DATE:

PURPOSE:

The purpose of this calculation is to determine the volumes, areas, and quantities of materials associated with the remedial action alternatives presented in the Building 81 Site FS. These material and volume quantities are presented within the FS text and are used to support the cost estimates provided in Appendix D.

DISCUSSION:

The volume, area, and quantity calculations presented below are based on the descriptions of the alternatives presented in Section 4.0 of the text and FS Figures 4-1, 4-3, and 4-4.

CALCULATIONS:

Alternative G-1: No Action

Five year reviews are required under this alternative. No other quantity calculations are needed.

Alternative G-2: Bio-barriers, MNA, and LUCs

Component 1: Bio-barriers in the overburden and bedrock east of Shea Memorial Drive

See Figure 4-1 for the locations of the overburden and bedrock barriers.

Assume the bio-barrier will be installed by injecting a commercially available emulsified oil product into the subsurface via injection wells.

The attached table summarizes the inputs used for the barriers in the deep overburden, shallow bedrock, and deep bedrock. The spreadsheet output tables are included. Quantities were calculated on a spreadsheet based on the output of the barrier calculations.

The barriers were estimated using the ESTCP Emulsified Oil Substrate design tool spreadsheets. Inputs to the spreadsheets were obtained from the RI ,when possible. In cases where measurements were unavailable, a value was selected from the middle of the typical range. A barrier design was prepared for the deep overburden, shallow bedrock, and deep bedrock.

Well spacing is 15 feet.

Replenishment

It is assumed that the bio-barriers will be replenished every 5 years by injection of the same amount of emulsified oil product based on groundwater monitoring results. The replenishment quantity was estimated based on 5-year substrate usage. A 30-year period is assumed.

Component 2: MNA

Assume 12 existing wells will be monitored at the following frequency:

Year 1: Quarterly
Years 2 & 3: Semi-annually
Years 4 - 30: Annually

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BY: JWL Date: 12/27/2012	CAH Date: 1/8/2013	APPROVED BY: DATE:

Analytes include VOCs, chlorinated PAHs, arsenic, cadmium, manganese, and natural attenuation parameters

Component 3: LUCs

Assume 4 warning signs will need to be installed in addition to administrative LUCs.

Five Year Reviews

Five year reviews are also required under this alternative.

Alternative G-3: Enhanced In-situ Bioremediation, Bio-barriers, MNA, and LUCs

Component 1: Enhanced In-situ Bioremediation in the Overburden and Bedrock Source Zones near the Former Tank Grave

See Fig 4-3 for the locations of the Target Treatment Zones (TTZs) in overburden, shallow and deep bedrock. These zones are encompassed by the 1,000 ug/L PCE contour.

Assume the a commercially available emulsified oil product will be injected into the subsurface via injection wells in the TTZs to stimulate biodegradation of chlorinated solvents.

Assume the source zones will be treated by injecting a commercially available emulsified oil product into the subsurface via injection wells.

The attached table summarizes the inputs used for the source zone treatment in the deep overburden, shallow bedrock, and deep bedrock. The spreadsheet output tables are included. Quantities were calculated on a spreadsheet based on the output of the source zone treatment calculations.

The source zone treatment was estimated using the ESTCP Emulsified Oil Substrate design tool spreadsheets. Inputs to the spreadsheets were obtained from the RI when possible. In cases where measurements were unavailable, a value was selected from the middle of the typical range. A source zone treatment design was prepared for the deep overburden, shallow bedrock, and deep bedrock.

Well spacing is 10 feet.

Replenishment

It is assumed that the TTZs will be replenished only once after 5 years by injecting half the amount of emulsified oil product initially applied at 50% of the injection points based on groundwater monitoring results.

Component 2: Bio-barriers in the overburden and bedrock east of Shea Memorial Drive

Identical to Component 1 of Alternative G-2.

Component 3: MNA

Identical to Component 2 of Alternative G-2.

CLIENT: SOUTH WEYMOUTH		JOB NUMBER: 112G02073 - FS.DF.B81
SUBJECT: BUILDING 81 SITE FS - CONCEPTUAL DESIGN CALCULATION SHEET		
BASED ON:		DRAWING NUMBER:
BY: JWL Date: 12/27/2012	CAH Date: 1/8/2013	APPROVED BY: DATE:

Component 4: LUCs

Identical to Component 3 of Alternative G-2.

Five Year Reviews

Five year reviews are required under this alternative.

Alternative G-4: In-situ Chemical Oxidation, Bio-barriers, MNA, and LUCs

Component 1: In-situ Chemical Oxidation in the Overburden and Bedrock Source Zones near the Former Tank Grave

See Fig 4-3 for the locations of the TTZs in overburden, shallow and deep bedrock.

TTZ in Deep Overburden (adjacent to well I-12)

Assume a NaMnO4 solution will be injected to the overburden TTZ to destroy the PCE.

Assume the TTZ dimension is

Length =	20	ft	perpendicular to GW
Width =	20	ft	parallel to GW flow
Area =	400	sf	

Assume the ROI of each injection well is

ROI = 5 ft

The number of injection wells needed in the deep overburden TTZ is

# of injection wells = 4

Average Well Depth = 18 ft

Total Well Depth = 72 ft

Assume the amount of 40% NaMnO4 solution required for the treatment is:

Mass of 40% NaMnO4 solution = 778 lb — Geocleanse's quote recommended 778 lb of 40% NaMnO4 solution (see Attachment B), assuming the permanganate natural oxidant demand (PNOD) is 2 g/kg soil

Density of the 40% NaMnO4 solution is:

ρ = 11.52 lb/gal

Volume of the 40% NaMnO4 solution is:

V(40%) = 67.5 gal — s.g. = 1.39

Assume the NaMnO4 will be diluted by 1:10 in volume and injected as a solution at a concentration of 5.3%

Dilution ratio = 10

CLIENT:	SOUTH WEYMOUTH	JOB NUMBER:	112G02073 - FS.DF.B81
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BASED ON:		DRAWING NUMBER:	
BY: JWL Date: 12/27/2012	CAH Date: 1/8/2013	APPROVED BY:	DATE:

Total volume of injection (5.3%) = 675 gal

Vol of dilution water = 608 gal

Assume the NaMnO4 solution will be injected at 0.75 gpm at two locations simultaneously.

Injection Rate =	0.75	gpm			
Injection Time =	675	gal /	0.75	gpm/	2 wells
=	450	min			
=	8	hour			
=	2	days @6 hours/day for injection			
Say total of	4	days including mob/demob and transition between wells for 2 men crew			

Shallow and Deep Bedrock TTZs

Assume KMnO4 and sand blend would be emplaced in the shallow bedrock TTZ via hydraulic fracturing.
Assume three fractures would be required at each boring.
Assume 1,000 lb of blend would be delivered into each fracture.

	No. of Borings	Boring Depth (ft)	Fractures per boring	No. of fractures	Blend mass/ frac (lb)	Mass of blend, lb	Fracturing interval
Shallow Bedrock TTZ	3	40	3	9	1,000	9,000	18 - 40 ft
Deep Bedrock TTZ	2	60	3	6	1,000	6,000	40 - 60 ft

It is assumed that 15 days will be needed to complete the fracturing program based on information provided by Geocleanse (see Attachment B). Equipment will include a sonic drill rig, box truck for support of the drill rig, a trailer-mounted injection system, and a forklift to manage the supersacks and palletized reagents. The sonic drill rig and box truck will be on-site for approximately three days, and the injection system and forklift will be on-site for approximately 12 days.

Post Injection Monitoring

Assume groundwater samples are collected from each TTZ for post injection performance monitoring as follows:

TTZ ID	Sample #
Deep Overburden	2
Shallow Bedrock	2
Deep Bedrock	2
Total	6

Assume 5 sampling events for post injection performance evaluation in the first year as follows:

- 2 weeks after injection
- 4 weeks after injection
- 8 weeks after injection
- 12 weeks after injection
- 24 weeks after injection

CLIENT: SOUTH WEYMOUTH		JOB NUMBER: 112G02073 - FS.DF.B81
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BY: JWL Date: 12/27/2012	CAH Date: 1/8/2013	APPROVED BY: DATE:

Sampling labor - 50 hours per event
Sampling ODCs - $500 per event
Sample analysis (VOCs) - $1,000 per event
Report - 40 hours per event

Second Injection for Deep Overburden @ Year 1

Assume second injection equal to a level of effort of 50% of the first injection amount would be applied after 6 months - 1 year in the deep overburden TTZ.

Component 2: Bio-barriers in the overburden and bedrock east of Shea Memorial Drive

Identical to Component 1 of Alternative G-2.

Component 3: MNA

Identical to Component 2 of Alternative G-2.

Component 4: LUCs

Identical to Component 3 of Alternative G-2.

Five Year Reviews

Five year reviews are required under this alternative.

SOUTH WEYMOUTH
BUILDING 81 FS
SUMMARY OF INPUTS TO BIOBARRIER SPREADSHEETS
12/11/12

Input	Deep Overburden	Shallow Bedrock	Deep Bedrock
Velocity, feet/day	0.6	0.71	0.086
PCE, ug/L	200	57	220
TCE, ug/L	6	3	5
cDCE, ug/L	18	1.2	15
VC, ug/L	0.25	0.2	2.6
Dissolved oxygen, mg/L	1	0.5	1.3
Nitrate, mg/L	0.34	0.1	0.0
Sulfate, mg/L	24	23	60
Total porosity	0.32	0.02	0.02
Effective porosity (RI)	0.2	0.02	0.02
Hydraulic conductivity, feet/day (RI)	6.14	0.71	0.09
Hydraulic gradient (RI)	0.02	0.02	0.02
foc	0.001	0.001	0.001
Bulk density, lb/ft3	112	144	144
Length, feet (perpendicular to GW flow)	120	100	60
Thickness, feet	11	22	20
Depth to water, feet	7	7	7
Total well depth, feet	18	40	60
Max oil retention. g/g (typical clayey sand)	0.003	0.003	0.003
Methane produced, mg/L (Midrange of typical)	10	10	10
Mn2+ produced, mg/L (Midrange of typical)	50	50	50
Fe2+ produced, mg/l (Midrange of typical)	50	50	50
Contact time, days	60	60	60
VSf (typical)	0.6	0.6	0.6
MSf (typical)	0.6	0.6	0.6

SOUTH WEYMOUTH
BUILDING 81 FEASIBILITY STUDY
BIOBARRIERS SUMMARY AND QUANTITIES
12/27/2012

	EOS, lb (per spread sheet)	Effective life single inj, yr	Total EOS (5-year), lb	Water, gal	Injection rate, gpm	Number of wells	Depth per well, feet	Total well depth, feet	Hours to inject	Hours to inject, 2 wells at a time	As Aqua-BupH product, lb	As Aqua-BupH product, drums
Deep Overburden	9,450	5	9,450	42,000	2.5	24	18	432	280	140	23,625	49.2
Shallow Bedrock	1,058	5	1,058	400	1	21	40	840	7	3	2,645	5.5
Deep Bedrock	183	5	183	100	1	4	60	240	2	1	458	1.0
Total				42,500		49		1,512	288	144		56

Injection labor with 2-man crew, 2 wells at a time, and 8 hours per day, days	36	man-days
Add mob/demob as 1 crew-day for each	40	man-days

AquaBupH product at 40 % EOS

Site Data - Aquifer Description

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	Building 81 Deep Overburden - Biobarrier
b	Description (e.g., project number)	
c	Location	South Weymouth

2 *Hydraulic Characteristics*

a	Depth to water table	7	ft	2.10	m
b	Depth to top of injection zone	7	ft	2.10	m
c	Depth to bottom of injection zone	18	ft	5.40	m
d	Hydraulic Gradient	0.02	ft/ft	0.02	m/m
e	Hydraulic Conductivity	6.14	ft/day	2.17E-03	cm/s
f	Estimated Total Porosity	0.32			
g	Estimated Effective Porosity	0.2			
h	Seepage Velocity	0.61	ft/day	2.17E-04	cm/s
		224.1	ft/yr	68.31	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	sand and silt			
b	Bulk Density	112	lbs/ft^3	1.8	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4	200	165.8	8	9.65E-06
b	Trichloroethene (TCE), C_2HCl_3	6	131.4	6	2.74E-07
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	18	96.9	4	7.43E-07
d	Vinyl Chloride (VC), C_2H_3Cl	0	62.5	2	8.00E-09
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*-tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3		133.4	6	
i	1,1-Dichloroethane (DCA), CH_2CHCl_2		99.0	4	
j	Chloroethane, C_2H_5Cl		64.9	2	
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	1.07E-05	e- equiv/L

Site Data - Biogeochemical Characterization

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	1	32.0	4	1.25E-04
b	Background Nitrate (mg/L as N)	0.34	14.0	5	1.21E-04
c	Background Sulfate (mg/L)	24	96.1	8	2.00E-03
d	Estimated methane produced (mg/L)	10	16.0	8	5.00E-03
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)	50	54.9	2	1.82E-03
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)	50	55.8	1	8.96E-04
i	pH (not used in calculation)				
j	Alkalinity (mg/L) (not used in calculation)				

k	e- equiv demand from biogeochemical characterizeation	9.96E-03	e- equiv/L

Total e- equiv demand (e- equiv/L)
9.97E-03

Site Data - Substrates and Reagents

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 ***Substrate Used in Design***

a	Brand and Product ID		
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))		
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	40%	percent
i	Electron equivalents per Kg raw product	145.17	e-/Kg
j	Cost per pound of product including shipping		$/lb
k	Cost per pound of oil	0.00	$/lb

Single Permeable Reactive Barrier - Design Information

Design criteria for installation of a single permeable reactive barrier is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	120	ft	36.00	m
b	Treatment Zone Thickness	11	ft	3.30	m
c	Percentage of injection zone that transmits most flow	100%			
d	Effective Treatment Zone Thickness	11	ft	3.30	m
e	Seepage Velocity	0.61	ft/day	2.2E-04	cm/s
f	Groundwater Flux through Treatment Zone	442,554	gal/yr	1,675,069	L/yr

2 *Treatment Zone Contact Time*

A minimum contact time of 2 to 4 months is typically required for effective treatment of chlorinated solvents in emulsified oil barriers. Longer contact times may be needed for difficult to degrade contaminants, with higher contaminant concentrations, and/or high concentrations of competing electron acceptors. Shorter contact times may be acceptable for easily treated contaminants (e.g. nitrate or perchlorate) or when only partial treatment is required.

a	Minimum Allowable Contact time	60	days

3 *Targeted Carbon Released*

Emulsified oil barriers release dissolved organic carbon (DOC) over the life of the barrier. This DOC released is in excess of that required for contaminant biodegradation and consumption of competing electron acceptors. Field monitoring data indicates that DOC released from barriers declines from hundreds mg/L shortly after emulsion injection to tens of mg/L near the end of the operating life. Long-term average DOC concentrations are typically in the range of 40 - 100 mg/L.

a	Average Amount of DOC Released	50	mg/L		
b	DOC Released per year	185	lb	84	kg

4 *Design Life*

The design tool estimates reinjection frequency based on amount of substrate injected, the annual substrate consumption rate, and fraction of initial substrate consumed when when treatment performance declines. However, users may specify a maximum time between reinjections. The design tool will then use the smaller of these two values. Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Total Project Life (Max of 30 years)	30	years
b	Subtrate Scaling Factor (typically 0.3 to 0.6)	0.5	
c	Maximum Time between Reinjections	5.0	years

5 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and flow contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.5)	0.6		
b	Mass Scaling Factor (0.1 to 1.5)	0.6		
c	Estimated Contact Efficiency for Injection	72%	to	85%

Single Permeable Reactive Barrier - Selected Design

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	Building 81 Deep Overburden - Biobarrier	
b	Description (e.g., project number)	0	
c	Location	South Weymouth	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Design Information*

a	Reinjection Interval	5	years
b	Total Project Life	30	years
c	Minimum Allowable Contact time	60	days

3 *Well Layout*

a	Well Spacing	15	ft	4.57	m
b	Number of Rows	3	rows		
c	Total Number of Wells	24	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	9,405	lbs	4,266	kg
b	Total Injection Volume	41,878	gallons	158,526	L
c	Total Injection Volume per well	1,745	gal/well	6,605	L/well
d	Estimated Injection Rate	5.0	gpm/well		
e	Number of wells injected simultaneously	8	wells		

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (engineering and installation)	$0
b	Well Installation Costs	#DIV/0!
c	Labor Cost for Injection	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$0
b	Well Rehabilitation and/or Installation Costs	#DIV/0!
c	Labor Cost for Injection	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

7 *Total Life Cycle Costs*

a	Annual Interest Rate	0%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	#DIV/0!
d	Project Life NPV	#DIV/0!

8 *Design Parameters*

a	Substrate Scaling Factor	0.5		
b	Volume Scaling Factor	0.6		
c	Mass Scaling Factor	0.6		
d	Estimated Contact Efficiency for Injection	72%	to	85%

Site Data - Aquifer Description

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	Building 81 Shallow bedrock - Barrier
b	Description (e.g., project number)	
c	Location	South Weymouth

2 *Hydraulic Characteristics*

a	Depth to water table	7	ft	2.10	m
b	Depth to top of injection zone	18	ft	5.40	m
c	Depth to bottom of injection zone	40	ft	12.00	m
d	Hydraulic Gradient	0.02	ft/ft	0.02	m/m
e	Hydraulic Conductivity	0.71	ft/day	2.50E-04	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	0.71	ft/day	2.50E-04	cm/s
		259.2	ft/yr	78.99	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	Bedrock			
b	Bulk Density	144	lbs/ft^3	2.3	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4	57	165.8	8	2.75E-06
b	Trichloroethene (TCE), C_2HCl_3	3	131.4	6	1.37E-07
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	1	96.9	4	4.95E-08
d	Vinyl Chloride (VC), C_2H_3Cl	0	62.5	2	6.40E-09
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*-tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3		133.4	6	
i	1,1-Dichloroethane (DCA), CH_2CHCl_2		99.0	4	
j	Chloroethane, C_2H_5Cl		64.9	2	
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	2.94E-06	e- equiv/L

Site Data - Biogeochemical Characterization

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	0.5	32.0	4	6.25E-05
b	Background Nitrate (mg/L as N)	0.1	14.0	5	3.57E-05
c	Background Sulfate (mg/L)	23	96.1	8	1.91E-03
d	Estimated methane produced (mg/L)	10	16.0	8	5.00E-03
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)	50	54.9	2	1.82E-03
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)	50	55.8	1	8.96E-04
i	pH (not used in calculation)				
j	Alkalinity (mg/L) (not used in calculation)				

k	e- equiv demand from biogeochemical characterizeation	9.73E-03	e- equiv/L

Total e- equiv demand (e- equiv/L)
9.74E-03

Site Data - Substrates and Reagents

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 ***Substrate Used in Design***

a	Brand and Product ID		
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))		
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	40%	percent
i	Electron equivalents per Kg raw product	145.17	e-/Kg
j	Cost per pound of product including shipping		$/lb
k	Cost per pound of oil	0.00	$/lb

Single Permeable Reactive Barrier - Design Information

Design criteria for installation of a single permeable reactive barrier is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	100	ft	30.00	m
b	Treatment Zone Thickness	22	ft	6.60	m
c	Percentage of injection zone that transmits most flow	5%			
d	Effective Treatment Zone Thickness	1.1	ft	0.33	m
e	Seepage Velocity	0.71	ft/day	2.5E-04	cm/s
f	Groundwater Flux through Treatment Zone	4,265	gal/yr	16,141	L/yr

2 *Treatment Zone Contact Time*

A minimum contact time of 2 to 4 months is typically required for effective treatment of chlorinated solvents in emulsified oil barriers. Longer contact times may be needed for difficult to degrade contaminants, with higher contaminant concentrations, and/or high concentrations of competing electron acceptors. Shorter contact times may be acceptable for easily treated contaminants (e.g. nitrate or perchlorate) or when only partial treatment is required.

a	Minimum Allowable Contact time	60	days

3 *Targeted Carbon Released*

Emulsified oil barriers release dissolved organic carbon (DOC) over the life of the barrier. This DOC released is in excess of that required for contaminant biodegradation and consumption of competing electron acceptors. Field monitoring data indicates that DOC released from barriers declines from hundreds mg/L shortly after emulsion injection to tens of mg/L near the end of the operating life. Long-term average DOC concentrations are typically in the range of 40 - 100 mg/L.

a	Average Amount of DOC Released	50	mg/L		
b	DOC Released per year	2	lb	1	kg

4 *Design Life*

The design tool estimates reinjection frequency based on amount of substrate injected, the annual substrate consumption rate, and fraction of initial substrate consumed when when treatment performance declines. However, users may specify a maximum time between reinjections. The design tool will then use the smaller of these two values. Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Total Project Life (Max of 30 years)	30	years
b	Subtrate Scaling Factor (typically 0.3 to 0.6)	0.5	
c	Maximum Time between Reinjections	5.0	years

5 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and flow contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.5)	0.6		
b	Mass Scaling Factor (0.1 to 1.5)	0.6		
c	Estimated Contact Efficiency for Injection	72%	to	85%

Single Permeable Reactive Barrier - Selected Design

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	Building 81 Shallow bedrock - Barrier	
b	Description (e.g., project number)	0	
c	Location	South Weymouth	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Design Information*

a	Reinjection Interval	5	years
b	Total Project Life	30	years
c	Minimum Allowable Contact time	60	days

3 *Well Layout*

a	Well Spacing	15	ft	4.57	m
b	Number of Rows	3	rows		
c	Total Number of Wells	21	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	1,058	lbs	480	kg
b	Total Injection Volume	366	gallons	1,387	L
c	Total Injection Volume per well	17	gal/well	66	L/well
d	Estimated Injection Rate	1.0	gpm/well		
e	Number of wells injected simultaneously	8	wells		

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (engineering and installation)	$0
b	Well Installation Costs	#DIV/0!
c	Labor Cost for Injection	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$0
b	Well Rehabilitation and/or Installation Costs	#DIV/0!
c	Labor Cost for Injection	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

7 *Total Life Cycle Costs*

a	Annual Interest Rate	0%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	#DIV/0!
d	Project Life NPV	#DIV/0!

8 *Design Parameters*

a	Substrate Scaling Factor	0.5		
b	Volume Scaling Factor	0.6		
c	Mass Scaling Factor	0.6		
d	Estimated Contact Efficiency for Injection	72%	to	85%

Site Data - Aquifer Description

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	Building 81 Deep bedrock - Barrier
b	Description (e.g., project number)	
c	Location	South Weymouth

2 *Hydraulic Characteristics*

a	Depth to water table	7	ft	2.10	m
b	Depth to top of injection zone	40	ft	12.00	m
c	Depth to bottom of injection zone	60	ft	18.00	m
d	Hydraulic Gradient	0.02	ft/ft	0.02	m/m
e	Hydraulic Conductivity	0.09	ft/day	3.18E-05	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	0.09	ft/day	3.18E-05	cm/s
		32.9	ft/yr	10.01	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	bedrock			
b	Bulk Density	144	lbs/ft^3	2.3	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4	220	165.8	8	1.06E-05
b	Trichloroethene (TCE), C_2HCl_3	5	131.4	6	2.28E-07
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	15	96.9	4	6.19E-07
d	Vinyl Chloride (VC), C_2H_3Cl	3	62.5	2	8.32E-08
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*-tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3		133.4	6	
i	1,1-Dichloroethane (DCA), CH_2CHCl_2		99.0	4	
j	Chloroethane, C_2H_5Cl		64.9	2	
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	1.15E-05	e- equiv/L

Site Data - Biogeochemical Characterization

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	1.3	32.0	4	1.63E-04
b	Background Nitrate (mg/L as N)	0	14.0	5	
c	Background Sulfate (mg/L)	60	96.1	8	4.99E-03
d	Estimated methane produced (mg/L)	10	16.0	8	5.00E-03
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)	50	54.9	2	1.82E-03
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)	50	55.8	1	8.96E-04
i	pH (not used in calculation)				
j	Alkalinity (mg/L) (not used in calculation)				

k	e- equiv demand from biogeochemical characterizeation	1.29E-02	e- equiv/L

Total e- equiv demand (e- equiv/L)
1.29E-02

Site Data - Substrates and Reagents

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 *Substrate Used in Design*

a	Brand and Product ID		
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))		
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	40%	percent
i	Electron equivalents per Kg raw product	145.17	e-/Kg
j	Cost per pound of product including shipping		$/lb
k	Cost per pound of oil	0.00	$/lb

Single Permeable Reactive Barrier - Design Information

Design criteria for installation of a single permeable reactive barrier is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	60	ft	18.00	m
b	Treatment Zone Thickness	20	ft	6.00	m
c	Percentage of injection zone that transmits most flow	5%			
d	Effective Treatment Zone Thickness	1	ft	0.30	m
e	Seepage Velocity	0.09	ft/day	3.2E-05	cm/s
f	Groundwater Flux through Treatment Zone	295	gal/yr	1,116	L/yr

2 *Treatment Zone Contact Time*

A minimum contact time of 2 to 4 months is typically required for effective treatment of chlorinated solvents in emulsified oil barriers. Longer contact times may be needed for difficult to degrade contaminants, with higher contaminant concentrations, and/or high concentrations of competing electron acceptors. Shorter contact times may be acceptable for easily treated contaminants (e.g. nitrate or perchlorate) or when only partial treatment is required.

a	Minimum Allowable Contact time	60	days

3 *Targeted Carbon Released*

Emulsified oil barriers release dissolved organic carbon (DOC) over the life of the barrier. This DOC released is in excess of that required for contaminant biodegradation and consumption of competing electron acceptors. Field monitoring data indicates that DOC released from barriers declines from hundreds mg/L shortly after emulsion injection to tens of mg/L near the end of the operating life. Long-term average DOC concentrations are typically in the range of 40 - 100 mg/L.

a	Average Amount of DOC Released	50	mg/L		
b	DOC Released per year	0	lb	0	kg

4 *Design Life*

The design tool estimates reinjection frequency based on amount of substrate injected, the annual substrate consumption rate, and fraction of initial substrate consumed when when treatment performance declines. However, users may specify a maximum time between reinjections. The design tool will then use the smaller of these two values. Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Total Project Life (Max of 30 years)	30	years
b	Subtrate Scaling Factor (typically 0.3 to 0.6)	0.5	
c	Maximum Time between Reinjections	5.0	years

5 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and flow contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.5)	0.6		
b	Mass Scaling Factor (0.1 to 1.5)	0.6		
c	Estimated Contact Efficiency for Injection	72%	to	85%

Single Permeable Reactive Barrier - Selected Design

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	Building 81 Deep bedrock - Barrier	
b	Description (e.g., project number)	0	
c	Location	South Weymouth	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Design Information*

a	Reinjection Interval	5	years
b	Total Project Life	30	years
c	Minimum Allowable Contact time	60	days

3 *Well Layout*

a	Well Spacing	15	ft	4.57	m
b	Number of Rows	1	rows		
c	Total Number of Wells	4	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	183	lbs	83	kg
b	Total Injection Volume	63	gallons	240	L
c	Total Injection Volume per well	16	gal/well	60	L/well
d	Estimated Injection Rate	1.0	gpm/well		
e	Number of wells injected simultaneously	2	wells		

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (engineering and installation)	$0
b	Well Installation Costs	#DIV/0!
c	Labor Cost for Injection	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$0
b	Well Rehabilitation and/or Installation Costs	#DIV/0!
c	Labor Cost for Injection	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

7 *Total Life Cycle Costs*

a	Annual Interest Rate	0%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	#DIV/0!
d	Project Life NPV	#DIV/0!

8 *Design Parameters*

a	Substrate Scaling Factor	0.5		
b	Volume Scaling Factor	0.6		
c	Mass Scaling Factor	0.6		
d	Estimated Contact Efficiency for Injection	72%	to	85%

SOUTH WEYMOUTH
BUILDING 81 FS
SUMMARY OF INPUTS TO SOURCE ZONE SPREADSHEETS
12/11/12

Input	Deep Overburden	Shallow Bedrock	Deep Bedrock
Length, feet (parallel to GW flow)	20	40	40
Width, feet (perpendicular to GW flow)	20	30	20
Thickness, feet	11	22	20
Depth to water, feet	7	7	7
Total well depth, feet	18	40	60
Total porosity	0.32	0.02	0.02
Effective porosity (RI)	0.2	0.02	0.02
Hydraulic conductivity, feet/day (RI)	6.14	0.71	0.09
Hydraulic gradient (RI)	0.02	0.02	0.02
Velocity, feet/day	0.6	0.71	0.086
Bulk density			
foc	0.001	0.001	0.001
Bulk density, lb/ft3	112	144	144
Dissolved oxygen, mg/L	0.5	4.8	8.1
Nitrate, mg/L	0.065	0.025	0
Sulfate, mg/L	8	25	24
PCE, ug/L	280	11,000	1,600
TCE, ug/L	20	120	190
cDCE, ug/L	100	9	26
VC, ug/L	11	1.5	1
Max oil retention. g/g (typical clayey sand)	0.003	0.003	0.003
Methane produced, mg/L (Midrange of typical)	10	10	10
Mn2+ produced, mg/L (Midrange of typical)	50	50	50
Fe2+ produced, mg/l (Midrange of typical)	50	50	50
VSf (typical)	0.6	0.6	0.6
MSf (typical)	0.6	0.6	0.6

SOUTH WEYMOUTH
BUILDING 81 FEASIBILITY STUDY
SOURCE ZONE SUMMARY AND QUANTITIES
12/11/2012

	EOS, lb (per spread sheet)	Effective life single inj, yr	Total EOS (5-year), lb	Water, gal	Injection rate, gpm	Number of wells	Depth per well, feet	Total well depth, feet	Hours to inject	Hours to inject, 2 wells at a time	As Aqua-BupH product, lb	As Aqua-BupH product, drums
Deep Overburden	887	5	887	3,950	2	4	18	72	33	16	2,218	4.6
Shallow Bedrock	342	5	342	118	1	12	40	480	2	1	855	1.8
Deep Bedrock	207	5	207	72	1	8	60	480	1	1	518	1.1
Total				4,140		24		1,032	36	18		7.5

Injection labor with 2-man crew, 2 wells at a time, and 8 hours per day, days	5	man-days
Add mob/demob as 1 crew-day for each	9	man-days

AquaBupH product at 40 % EOS

Site Data - Aquifer Description

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	Building 81 Deep Overburden - Source
b	Description (e.g., project number)	
c	Location	South Weymouth

2 *Hydraulic Characteristics*

a	Depth to water table	7	ft	2.10	m
b	Depth to top of injection zone	7	ft	2.10	m
c	Depth to bottom of injection zone	18	ft	5.40	m
d	Hydraulic Gradient	0.02	ft/ft	0.02	m/m
e	Hydraulic Conductivity	6.14	ft/day	2.17E-03	cm/s
f	Estimated Total Porosity	0.32			
g	Estimated Effective Porosity	0.2			
h	Seepage Velocity	0.61	ft/day	2.17E-04	cm/s
		224.1	ft/yr	68.31	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	sand and silt			
b	Bulk Density	112	lbs/ft^3	1.8	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4	280	165.8	8	1.35E-05
b	Trichloroethene (TCE), C_2HCl_3	20	131.4	6	9.13E-07
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	100	96.9	4	4.13E-06
d	Vinyl Chloride (VC), C_2H_3Cl	11	62.5	2	3.52E-07
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*-tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3		133.4	6	
i	1,1-Dichloroethane (DCA), CH_2CHCl_2		99.0	4	
j	Chloroethane, C_2H_5Cl		64.9	2	
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	1.89E-05	e- equiv/L

Site Data - Biogeochemical Characterization

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	0.5	32.0	4	6.25E-05
b	Background Nitrate (mg/L as N)	0.065	14.0	5	2.32E-05
c	Background Sulfate (mg/L)	8	96.1	8	6.66E-04
d	Estimated methane produced (mg/L)	10	16.0	8	5.00E-03
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)	50	54.9	2	1.82E-03
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)	50	55.8	1	8.96E-04
i	pH (not used in calculation)				
j	Alkalinity (mg/L) (not used in calculation)				

k	e- equiv demand from biogeochemical characterizeation	8.47E-03	e- equiv/L

Total e- equiv demand (e- equiv/L)
8.49E-03

Site Data - Substrates and Reagents

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 ***Substrate Used in Design***

a	Brand and Product ID		
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))		
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	40%	percent
i	Electron equivalents per Kg raw product	145.17	e-/Kg
j	Cost per pound of product including shipping		$/lb
k	Cost per pound of oil	0.00	$/lb

Area Treatment - Design Information

Design criteria for installation of area treatments is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	20	ft	6.00	m
b	Length (parallel to groundwater flow)	20	ft	6.00	m
c	Row Spacing (Specify ratio of well spacing to row spacing) Note: The contact efficiency is dependent upon which ratio is selected.	◉ 1 to 1 / ○ 2 to 1			
d	Treatment Zone Thickness	11	ft	3.30	m
e	Percentage of injection zone that transmits water	100%			
f	Effective Treatment Zone Thickness	11	ft	3.30	m

2 *Design Life*

Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Reinjection Interval	5	years
b	Total Project Life (Max of 30 years)	5	years

3 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and volume contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.0)	0.6		
b	Mass Scaling Factor (0.1 to 1.0)	0.6		
c	Estimated Contact Efficiency for Injection	45%	to	60%

Area Treatment Using a Series of Barriers - Selected Design

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	Building 81 Deep Overburden - Source	
b	Description (e.g., project number)	0	
c	Location	South Weymouth	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Treatment Design Criteria*

a	Reinjection Interval	5	years
b	Timeframe in which all groundwater in targeted area should theoretically flush through active treatment zones.	5	years

3 *Well Layout*

a	Well Spacing	10	ft	3.05	m
b	Number of Wells per Row	2	wells/row		
c	Row Spacing	10	ft	3.05	m
d	Number of Rows	2	rows		
e	Total Number of Wells	4	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	887	lbs	402	kg
b	Total Injection Volume	3,950	gallons	14,951	L
c	Total Injection Volume per well	987	gal/well	3,738	L/well
d	Estimated Injection Rate	2.0	gpm/well		
e	Number of wells injected simultaneously	2	wells		

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (planning and installation)	$0
b	Well Installation Costs	#DIV/0!
c	Injection Costs	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$0
b	Well Rehabilitation and/or Installation Costs	#DIV/0!
c	Labor Cost for Injection	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

7 *Total Life Cycle Costs*

a	Annual Interest Rate	0%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	#DIV/0!
d	Project Life NPV	#DIV/0!

8 *Design Parameters*

a	Volume Scaling Factor	0.6		
b	Mass Scaling Factor	0.6		
c	Estimated Contact Efficiency for Injection	45%	to	60%

Site Data - Aquifer Description

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	Building 81 Shallow Bedrock - Source
b	Description (e.g., project number)	
c	Location	South Weymouth

2 *Hydraulic Characteristics*

a	Depth to water table	7	ft	2.10	m
b	Depth to top of injection zone	18	ft	5.40	m
c	Depth to bottom of injection zone	40	ft	12.00	m
d	Hydraulic Gradient	0.02	ft/ft	0.02	m/m
e	Hydraulic Conductivity	0.71	ft/day	2.50E-04	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	0.71	ft/day	2.50E-04	cm/s
		259.2	ft/yr	78.99	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	Bedrock			
b	Bulk Density	144	lbs/ft^3	2.3	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4	11,000	165.8	8	5.31E-04
b	Trichloroethene (TCE), C_2HCl_3	120	131.4	6	5.48E-06
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	9	96.9	4	3.72E-07
d	Vinyl Chloride (VC), C_2H_3Cl	2	62.5	2	4.80E-08
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*-tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3		133.4	6	
i	1,1-Dichloroethane (DCA), CH_2CHCl_2		99.0	4	
j	Chloroethane, C_2H_5Cl		64.9	2	
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	5.37E-04	e- equiv/L

Site Data - Biogeochemical Characterization

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	4.8	32.0	4	6.00E-04
b	Background Nitrate (mg/L as N)	0.025	14.0	5	8.93E-06
c	Background Sulfate (mg/L)	25	96.1	8	2.08E-03
d	Estimated methane produced (mg/L)	10	16.0	8	5.00E-03
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)	50	54.9	2	1.82E-03
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)	50	55.8	1	8.96E-04
i	pH (not used in calculation)				
j	Alkalinity (mg/L) (not used in calculation)				

k	e- equiv demand from biogeochemical characterizeation	1.04E-02	e- equiv/L

Total e- equiv demand (e- equiv/L)
1.09E-02

Site Data - Substrates and Reagents

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 *Substrate Used in Design*

a	Brand and Product ID		
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))		
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	40%	percent
i	Electron equivalents per Kg raw product	145.17	e-/Kg
j	Cost per pound of product including shipping		$/lb
k	Cost per pound of oil	0.00	$/lb

Area Treatment - Design Information

Design criteria for installation of area treatments is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	30	ft	9.00	m
b	Length (parallel to groundwater flow)	40	ft	12.00	m
c	Row Spacing (Specify ratio of well spacing to row spacing) Note: The contact efficiency is dependent upon which ratio is selected.	● 1 to 1 / ○ 2 to 1			
d	Treatment Zone Thickness	22	ft	6.60	m
e	Percentage of injection zone that transmits water	5%			
f	Effective Treatment Zone Thickness	1.1	ft	0.33	m

2 *Design Life*

Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Reinjection Interval	5	years
b	Total Project Life (Max of 30 years)	5	years

3 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and volume contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.0)	0.6		
b	Mass Scaling Factor (0.1 to 1.0)	0.6		
c	Estimated Contact Efficiency for Injection	45%	to	60%

Area Treatment Using a Series of Barriers - Selected Design

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	Building 81 Shallow Bedrock - Source	
b	Description (e.g., project number)	0	
c	Location	South Weymouth	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Treatment Design Criteria*

a	Reinjection Interval	5	years
b	Timeframe in which all groundwater in targeted area should theoretically flush through active treatment zones.	5	years

3 *Well Layout*

a	Well Spacing	10	ft	3.05	m
b	Number of Wells per Row	3	wells/row		
c	Row Spacing	10	ft	3.05	m
d	Number of Rows	4	rows		
e	Total Number of Wells	12	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	342	lbs	155	kg
b	Total Injection Volume	118	gallons	449	L
c	Total Injection Volume per well	10	gal/well	37	L/well
d	Estimated Injection Rate	1.0	gpm/well		
e	Number of wells injected simultaneously	6	wells		

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (planning and installation)	$0
b	Well Installation Costs	#DIV/0!
c	Injection Costs	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$0
b	Well Rehabilitation and/or Installation Costs	#DIV/0!
c	Labor Cost for Injection	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

7 *Total Life Cycle Costs*

a	Annual Interest Rate	0%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	#DIV/0!
d	Project Life NPV	#DIV/0!

8 *Design Parameters*

a	Volume Scaling Factor	0.6		
b	Mass Scaling Factor	0.6		
c	Estimated Contact Efficiency for Injection	45%	to	60%

Site Data - Aquifer Description

Information on the physical characteristics of the aquifer are entered on this page. This information will later be used to calculate injection volumes and costs for barrier and area treatments.

1 *Site Information*

a	Name	Building 81 Deep Bedrock - Source
b	Description (e.g., project number)	
c	Location	South Weymouth

2 *Hydraulic Characteristics*

a	Depth to water table	7	ft	2.10	m
b	Depth to top of injection zone	40	ft	12.00	m
c	Depth to bottom of injection zone	60	ft	18.00	m
d	Hydraulic Gradient	0.02	ft/ft	0.02	m/m
e	Hydraulic Conductivity	0.09	ft/day	3.18E-05	cm/s
f	Estimated Total Porosity	0.02			
g	Estimated Effective Porosity	0.02			
h	Seepage Velocity	0.09	ft/day	3.18E-05	cm/s
		32.9	ft/yr	10.01	m/yr

3 *Aquifer Material Characteristics*

a	Description of Aquifer Material Lithology	bedrock			
b	Bulk Density	144	lbs/ft^3	2.3	g/cm^3
c	Maximum Oil Retention by aquifer material (see Appendix 1 in design manual). This value has a critical impact on cost and treatment performance.	0.003	lbs oil/lbs soil	0.003	kg oil/kg soil

Site Data - Contaminant Concentrations

Information on the concentration of common contaminants are entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to biodegrade these contaminants. Several of the more common contaminants are listed below along with their molecular weight (MW) and e- equiv/mole. Blank cells in rows m, n, and o allow the user to enter information on additional contaminants. For these additional contaminants, the user must enter the contaminant concentration, MW and e- equiv/mole.

		µg/L	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Tetrachloroethene (PCE), C_2Cl_4	1,600	165.8	8	7.72E-05
b	Trichloroethene (TCE), C_2HCl_3	190	131.4	6	8.68E-06
c	cis-1,2-dichloroethene (c-DCE), $C_2H_2Cl_2$	26	96.9	4	1.07E-06
d	Vinyl Chloride (VC), C_2H_3Cl	1	62.5	2	3.20E-08
e	Carbon tetrachloride, CCl_4		153.8	8	
f	Chloroform, $CHCl_3$		119.4	6	
g	*sym*-tetrachloroethane, $C_2H_2Cl_4$		167.8	8	
h	1,1,1-Trichloroethane (TCA), CH_3CCl_3		133.4	6	
i	1,1-Dichloroethane (DCA), CH_2CHCl_2		99.0	4	
j	Chloroethane, C_2H_5Cl		64.9	2	
k	Perchlorate, ClO_4^-		99.4	8	
l	Hexavalent Chromium, Cr[VI]		52.0	3	
m					
n					
o					

p	e- equiv demand from contaminant concentrations	8.70E-05	e- equiv/L

Site Data - Biogeochemical Characterization

Information on the concentration of background electron acceptors is entered on this page. This information is used to calculate the number of electron equivalents (e- equiv) required to deplete these materials. The total e- equivalent is then calculated from the contaminant demand and the background electron acceptor demand. This value is later used to calculate the annual substrate demand.

		mg/L or mg/Kg	MW (g/mole)	e- equiv/ mole	e- equiv demand (e- equiv/L)
a	Background Dissolved Oxygen (mg/L)	8.1	32.0	4	1.01E-03
b	Background Nitrate (mg/L as N)	0	14.0	5	
c	Background Sulfate (mg/L)	24	96.1	8	2.00E-03
d	Estimated methane produced (mg/L)	10	16.0	8	5.00E-03
e	Soil Manganese Content (mg/Kg) (not used in calculation)				
f	Estimated Mn^{2+} produced (mg/L)	50	54.9	2	1.82E-03
g	Soil Iron Content (mg/Kg) (not used in calculation)				
h	Estimated Fe^{2+} produced (mg/L)	50	55.8	1	8.96E-04
i	pH (not used in calculation)				
j	Alkalinity (mg/L) (not used in calculation)				

k	e- equiv demand from biogeochemical characterizeation	1.07E-02	e- equiv/L

Total e- equiv demand (e- equiv/L)
1.08E-02

Site Data - Substrates and Reagents

Information on the cost and chemical properties of substrate is entered on this page. The cost per pound of oil is used to determine the substrate cost.

1 *Substrate Used in Design*

a	Brand and Product ID		
b	Chemical Formula (e.g., $C_{56}H_{100}O_6$ (approx. formula for soybean oil))		
c	Molecular Weight	868	g/mole
d	Percent by weight C	77%	
e	Percent by weight H	12%	
f	Percent by weight O	11%	
g	Electrons released per mole	315	e-/mole
h	% vegetable oil (lactate, emulsifiers, and yeast extract not included)	40%	percent
i	Electron equivalents per Kg raw product	145.17	e-/Kg
j	Cost per pound of product including shipping		$/lb
k	Cost per pound of oil	0.00	$/lb

Area Treatment - Design Information

Design criteria for installation of area treatments is entered on this page. This criteria is later used to determine material quantities and estimate costs for a variety of design alternatives.

1 *Treatment Zone Dimensions*

a	Width (perpendicular to groundwater flow)	20	ft	6.00	m
b	Length (parallel to groundwater flow)	40	ft	12.00	m
c	Row Spacing (Specify ratio of well spacing to row spacing) Note: The contact efficiency is dependent upon which ratio is selected.	◉ 1 to 1 / ○ 2 to 1			
d	Treatment Zone Thickness	20	ft	6.00	m
e	Percentage of injection zone that transmits water	5%			
f	Effective Treatment Zone Thickness	1	ft	0.30	m

2 *Design Life*

Life cycle costs are calculated based on the reinjection frequency and other ongoing costs (monitoring, etc.)

a	Reinjection Interval	5	years
b	Total Project Life (Max of 30 years)	5	years

3 *Contact Efficiency*

For good treatment, emulsified oil should be uniformly distributed between injection wells. Oil distribution can be enhanced by injecting more water and/or more oil. Shown below is a function illustrating the relationship between Volume Scaling Factor, Mass Scaling Factor, and volume contact efficiency. Users must specify the Volume and Mass Scaling Factors to be used in the design. Additional information on the factors influencing contact efficiency is presented in Chapter 2 of the design manual.

a	Volume Scaling Factor (0.1 to 1.0)	0.6		
b	Mass Scaling Factor (0.1 to 1.0)	0.6		
c	Estimated Contact Efficiency for Injection	45%	to	60%

Area Treatment Using a Series of Barriers - Selected Design

This sheet shows a summary of the selected design that can be saved or printed before looking at alternative designs.

1 *Site Information*

a	Name	Building 81 Deep Bedrock - Source	
b	Description (e.g., project number)	0	
c	Location	South Weymouth	
d	Maximum Oil Retention	0.003	lbs oil/lbs soil

2 *Treatment Design Criteria*

a	Reinjection Interval	5	years
b	Timeframe in which all groundwater in targeted area should theoretically flush through active treatment zones.	5	years

3 *Well Layout*

a	Well Spacing	10	ft	3.05	m
b	Number of Wells per Row	2	wells/row		
c	Row Spacing	10	ft	3.05	m
d	Number of Rows	4	rows		
e	Total Number of Wells	8	wells		

4 *Logistics for Each Injection Event*

a	Total Mass of Oil Injected	207	lbs	94	kg
b	Total Injection Volume	72	gallons	272	L
c	Total Injection Volume per well	9	gal/well	34	L/well
d	Estimated Injection Rate	1.0	gpm/well		
e	Number of wells injected simultaneously	4	wells		

5 *Costs for Initial Installation and Injection*

a	Fixed Costs (planning and installation)	$0
b	Well Installation Costs	#DIV/0!
c	Injection Costs	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

6 *Costs for Future Injection Events*

a	Fixed Costs (engineering and installation)	$0
b	Well Rehabilitation and/or Installation Costs	#DIV/0!
c	Labor Cost for Injection	$0
d	Substrate Costs	$0
e	Total Installation and Injection Costs	#DIV/0!

7 *Total Life Cycle Costs*

a	Annual Interest Rate	0%
b	Monitoring and Reporting	$0
c	Total Injection Costs (fixed, well installation, labor for injection, and substrate)	#DIV/0!
d	Project Life NPV	#DIV/0!

8 *Design Parameters*

a	Volume Scaling Factor	0.6		
b	Mass Scaling Factor	0.6		
c	Estimated Contact Efficiency for Injection	45%	to	60%

YOUR NATURAL SOLUTIONS

Patented Products for *In Situ* Bioremediation

Quotation

Name: Li Wang
Company: Tetra Tech
Address: 661 Andersen Drive Foster Plaza 7
Pittsburgh, PA
Phone: 412.920.7015
Email: li.wang@tetratech.com

Date: 12/21/2011
Quotation Number: EOS111587.122111
Quotation Expiration: 2/20/2012

Project Reference	Technical Contact	Ship date	FOB Point	Shipping Via	Payment Terms	Fed ID No.
Weymouth, MA	Brad Elkins	TBD	Louisburg NC	Common Carrier	Net 30 Days	26-1995740

Quantity	Unit	Description	Unit Rate	Total
11	Drums (net 480 lbs.)	**AquaBupH plus 1x16 oz EOS ® Vitamin B12 supplement**	$ 1,344.00	$ 14,784.00
1	Load	**Shipping - Less Than Load**	$ 1,494.00	$ 1,494.00
			Subtotal	$ 16,278.00
			Tax Rate	NA
			Total	**$ 16,278.00**

Note:

1. The freight rate is highly variable and dependent on quantity shipped and cost of diesel fuel. The unit rate quoted is based on current rate schedules from our suppliers.
2. Lift gate service is available on **Less than Load** shipments for an additional $90.00.
3. EOS Remediation **is not registered** to collect taxes in the jurisdiction shown on the initial page of this Quotation.
4. Upon acceptance of this Quotation, EOS Remediation prefers **three weeks to process an order**.
5. Recycling and disposal service can be arranged by EOS Remediation for an additional quoted price. Otherwise client will be responsible for recycling and disposal of purchased totes and/or drums.

Accepted By* Date

Thank you for selecting EOS Remediation, LLC

*Upon Acceptance please provide shipping location, site contact information and special delivery instructions.
Please review the Terms and Conditions on the following pages.

YOUR NATURAL SOLUTIONS

Patented Products for *In Situ* Bioremediation

Product Information Sheet

AquaBu*pH*™

Description & Use:

AquaBu*pH*™ is a premium emulsified oil product that combines the proven **EOS®** technology with a slow release pH buffer to adjust the pH of acidic aquifers to optimal levels for biodegradation. As with other **EOS®** products, **AquaBu*pH*™** is designed to enhance anaerobic bioremediation of chlorinated solvents, perchlorate, energetics, acid mine drainage, oxidized metals, and other recalcitrant chemicals in contaminated groundwater. **AquaBu*pH*™**'s patent-pending formulation consists of:

- a slow-release alkaline buffer that provides nearly 4 times the buffering capacity of $CaCO_3$;
- an equilibrium pH of ~ 9 eliminating the risk of overshooting the pH by buffer addition;
- an easily biodegradable soluble substrate for rapid onset of anaerobic conditions; and
- a slowly biodegradable substrate to support long-term contaminant reduction.

AquaBu*pH*™ is shipped as a ready-to-use concentrate that can be easily diluted with water in the field. No complicated field mixing procedures are required – only simple mixing with water is needed to prepare a high quality emulsion. **AquaBu*pH*™** has a low viscosity and is amenable to pumping with commonly available pumps. Dilution ratios for **AquaBu*pH*™** commonly range from 1:1 to 4:1 (water:**AquaBu*pH*™**); however, actual dilution rates may vary depending on site conditions. **AquaBu*pH*™** injections should be followed with a calculated volume of chase water to maximize distribution of **AquaBu*pH*™** into the formation.

Chemical & Physical Properties:

Oil Emulsion Concentrate: AquaBu*pH*™	**Typical**
Refined and Bleached Soybean Oil (% by wt)	39.7
Rapidly Biodegradable Soluble Substrate (% by wt)	4
Other Organics (emulsifiers, food additives, etc.) (% by wt)	7
Alkaline Buffer (% by wt)	10 - 15
Specific Gravity	1.07
pH (Standard units)	9
Organic Carbon (% by wt)	51
Viscosity (cP)	40 - 70
Mass of Hydrogen Produced (lbs H_2 per lb **AquaBu*pH*™**)	0.17

Packaging:

Shipped in 55-gallon (208 L) drums (net content: 480 lbs [218 kg]), 275-gallon (1,041 L) IBC totes (net content: 2,400 lbs [1,089 kg]), or bulk tankers (40,000 lbs [18,140 kg] min.)

Storage & Handling:

AquaBu*pH*™ should be diluted with water prior to injection. Workers should use eye protection and prevent skin contact. Consult the MSDS for additional information before using **AquaBu*pH*™.** Clean up spills promptly and dispose in accordance with all appropriate regulations. For best performance, use **AquaBu*pH*™** within 30 days of delivery and store at a temperature of 40°F (4°C) to 100°F (38°C).

NOTICE

The information contained herein is, to the best of our knowledge and belief, accurate. Any recommendations or suggestions made are without warranty or guarantee of results since conditions of handling and of use are beyond our control. We, therefore, assume no liability for loss or damage incurred by following these suggestions. EOS Remediation warrants only that this product will meet the specifications set forth, any other representation or warranty, either expressed or implied, is specifically disclaimed including warranties of fitness for a particular purpose and of merchantability. EOS Remediation's only obligation shall be to replace such quantity of the product proved to be defective before using. User shall determine the suitability of the product for user's intended application and user assumes all risk and liability whatsoever in connection therewith. EOS Remediation shall not be liable in tort, contract or under any theory for any loss or damage, incidental or consequential, arising out of the use of or the inability to use the product. (Product Revision Date: 10/25/2011)

EOS Remediation, LLC

▪ EOS Remediation, LLC ▪ 1101 Nowell Road ▪ Raleigh, NC 27607 ▪ 888.873.2204 ▪
▪ www.eosremediation.com ▪ info@eosremediation.com ▪

EOS Remediation, LLC
TERMS AND CONDITIONS

GENERAL

Acceptance: The products specified on the order acknowledgement and/or invoice (the "Product") are offered by EOS Remediation, LLC, ("Seller" or "EOS Remediation") only to the buyer identified thereon ("Buyer"), only at the prices specified thereon, and only under the terms and conditions of sale stated herein. Seller hereby gives notice of its objection to any different or additional terms and conditions other than those set forth herein.

Confidentiality: In the event that trade secrets, EOS® Product formulations or proprietary information of EOS Remediation are disclosed to the Buyer; the Buyer agrees to keep this knowledge or information confidential and the Buyer shall not disclose such confidential and/or proprietary information to a third party(ies), person(s), corporation(s) or employee(s) of such entities without prior written permission from EOS Remediation. The Buyer further agrees not to use such knowledge or information to develop products or assist a third party(ies), person(s), corporation(s) or employee(s) of such entities others in development of products that could compete with EOS® Products or with EOS Remediation.

"Reverse Engineering": The Buyer agrees not to perform actions that could enable the Buyer, a third party(ies), person(s), corporation(s) or employee(s) of such entities to duplicate, reformulate or imitate the EOS® Product sample(s).

Unavoidable Circumstances: Seller shall not be liable for delays in delivery or failure to manufacture or deliver due to causes beyond its reasonable control, including but not limited to acts of God, fires, strikes, flood, epidemic, war, riot, delays in transportation, or inability to obtain necessary labor, materials, components or services through normal supply channels at normal prices. In any such event, Seller may, at any time and from time to time, postpone the delivery dates under this contract or make partial delivery or cancel all or any portion of this and any other contract without further liability to Buyer. Seller shall give reasonable notice to Buyer, but notice shall not be a prerequisite to Seller's rights or relief as set out herein. Partial cancellation shall not affect Seller's right to payment for any Product delivered.

Payment Terms and Collection Charges: Sales are made to Open Accounts, only if requirements are met; otherwise, cash in advance. Terms for approved Open Accounts are net 30 days from the date of invoice unless otherwise agreed. Any amounts not paid are subject to a late charge of one and one-half percent per month or the highest amount allowed by law, whichever is less, whether before or after judgment. Buyer shall pay all costs of collection including reasonable attorney fees.

Taxes and Other Levies: Unless proof of exemption is provided by Buyer, sales tax will be added for all sales subject to North Carolina sales tax. Buyer shall be responsible for all use taxes, customs, import duties and all other taxes, and shall indemnify and hold Seller harmless from any claims arising therefrom.

Location, Governing Law, Jurisdiction and Construction: The contract of sale shall be deemed to have been concluded in North Carolina. Except where in conflict with International and United States law, this agreement shall be governed by the laws of the State of North Carolina. All prior understandings of the parties, whether oral or written, are incorporated herein, and no changes may be made except in writing signed by the party against whom enforcement is sought. In the event of conflict between this document and any terms, conditions or other qualifications provided in the Buyer's purchase order or other documents, this document shall control. If any portion of the Limited Warranty or these Terms and Condition are determined to be unenforceable, then the remainder shall be enforced without the unenforceable portion. To the extent permissible by law, the parties agree that any unenforceable provision shall be interpreted and rewritten to achieve the parties' intent. Unless otherwise agreed, all matters shall be heard in the Superior Court of Wake County, North Carolina.

SALES

The sales of all Products sold by EOS Remediation are subject to the following Limited Warranty and Other Terms and Conditions.

Limited Warranty

Seller warrants that the Product sold is as specified on the order acknowledgement and/or invoice. Seller makes no other warranty of any kind respecting the Product, and expressly disclaims all other warranties of whatever kind respecting the Product, including all warranties of merchantability and fitness for particular purpose. Buyer's sole remedy for breach of this limited warranty shall be refund of the purchase price of any unused product, provided that any unused portion of the Product is promptly returned to Seller. Under no circumstances will Seller be liable for any consequential or other damages. Notice of defect or other breach shall be given to Seller by Buyer in accordance with the terms of the Uniform Commercial Code as adopted in North Carolina.

Other Terms and Conditions

Resale and Other Use: Buyer agrees to transmit a copy of these Terms and Conditions set forth herein to any and all persons to whom Buyer sells, or otherwise furnishes the Products and/or services provided Buyer by Seller and Buyer agrees to indemnify Seller for any liability, loss, costs and attorney's fees which Seller may incur by reason, in whole or in part, of failure by Buyer to transmit the Terms and Conditions as provided herein. Seller disclaims to the full extent permitted by law all warranties, expressed or implied, including any implied warranty of merchantability, fitness for any particular purpose or against infringement, to any person other than Buyer. Where warranties to a person other than Buyer may not be disclaimed under law, Seller extends to such a person the same warranty Seller makes to Buyer or lessee as set forth herein, subject to all disclaimers, exclusions and limitations of warranties, all limitations of liability and all other provisions set forth in this Limited Warranty and Other Terms and Conditions.

Buyer's Responsibility and Indemnity: By purchasing the Products from Seller, Buyer represents and warrants that it, its agents, subcontractors and other parties which may utilize the Products recognize the risks inherent to the use of the Products and that all

appropriate personnel are trained and knowledgeable in the proper use and application of the Products purchased. Instructions, technical advice, or other information provided by Seller are provided as guidelines for the convenience of Buyer only and should not be construed as substitute for appropriate engineering and geologic design by qualified professionals. Requirements for use and the effectiveness of the Products will vary according to the specific circumstances and Seller shall not be responsible for the effectiveness of the Product, including, but not limited to, the prevention of the spread of environmentally hazardous material. Buyer agrees to defend and indemnify Seller of and from any and all claims or liabilities asserted against Seller in connection with the manufacture, sale, delivery, resale, or repair or use of any goods covered by or furnished hereunder arising in whole or in part out of or by reason of the failure of Buyer, its agents, servants, employees or Buyers to follow instructions, warnings or recommendations furnished by Seller in connection with such goods, by reason of the failure of Buyer, its agents, servants, employees or Buyers to comply with all federal, state and local laws applicable to such goods, or the use thereof, including the Occupational Safety and Health Act of 1970, or by reason of the negligence of Buyer, its agents, servants, employees or Buyers. Buyer is solely responsible for disposal of unused Product and container(s) (e.g. drum, tote, bucket, etc.) in accordance with all applicable federal, state and local regulations.

Changes: Seller reserves the right to change Product specifications and formulations without notice and without liability for such changes.

Returns: All Sales Are Final. No exchanges unless notated otherwise. Returns, with EOS Remediation approval, including those for warranty consideration must be shipped prepaid. Freight collect returns will not be accepted. Minimum restocking charge is 40%. Goods must be in original container and in saleable condition to be considered for restocking.

EOS® PROCESS AUTHORIZED USES

The EOS® Process license of U.S. Patent No.RE40448 and 40734 is included with the purchase of EOS® innocuous oil products sold by EOS Remediation, LLC and is provided to Buyer for the use of the products in accordance with the patented process.

With the exception of federal property and federal facilities located in the United States of America, when used to remediate aquifers contaminated with organic compounds, the EOS® Process and the EOS® innocuous oil product are authorized for use only under the following conditions:

1. The EOS® emulsified oil product is used for treatment of contaminated aquifers where nitrates either are not present or are present at non-contaminant levels;
2. The EOS® emulsified oil product is not injected through a heated bore; and
3. The EOS® emulsified oil product is not designed to rise through the plume and be extracted.

With the exception of federal property and federal facilities located in the United States of America, when used to remediate aquifers contaminated with nitrates, the EOS Process and the EOS® innocuous oil product are authorized for use only under the following conditions that:

1. The EOS® emulsified oil product is used for treatment of contaminated aquifers where organic compounds either are not present or are present at a non-contaminant levels;
2. The EOS® emulsified oil product is not injected through a heated bore; and
3. The EOS® emulsified oil product is not designed to rise through the plume and be extracted.

The above directions and limitations are provided so that the usage is consistent with the patents for the EOS® Process and the EOS® innocuous oil product. The EOS® Process and the EOS® innocuous oil product must therefore be used in accordance with EOS Remediation, LLC's recommended practices and procedures. Any other use is strictly prohibited without the written consent of Seller. If Buyer desires to use the EOS® Process and the EOS® innocuous oil products for other purposes, the Buyer must first contact EOS Remediation, LLC and set out in writing any proposed variation from the licensed use. Authorization for other uses may or may not be granted at the sole discretion of EOS Remediation, LLC.

Conditions for Use: The use of monitoring wells for the introduction of EOS® and/or AquaBupH™ into the subsurface is not advised. However, if the design professional intends to use wells, the potential of permeability loss within the well filter pack and or screen blockage may be minimized by removing the diluted product from the well or flushing the well with the injection of additional (chase) water. Even with adequate flushing, some aquifer materials may be susceptible to reductions in hydraulic conductivity after injection that may affect use of the monitoring well for future sample collection or subsequent injections.

BIOAUGMENTATION CULTURE

EOS Remediation warrants that the Dehalococcoides sp. (DHC) concentration in the unconcentrated BAC-9™ culture will be equal to or greater than 1 x 10^{10} DHC/L as determined by quantitative PCR. EOS Remediation warrants that the BAC-9™ culture will actively degrade PCE, TCE, cis-1,2-DCE and vinyl chloride upon delivery to the Buyer. If EOS Remediation agrees that said culture is not active upon delivery, based on evidence provided by the Buyer, EOS Remediation will replace the culture at no cost to the Buyer. The foregoing indemnification and culture replacement agreement are the Buyer's sole and exclusive remedies for any breach of this limited warranty and are in lieu of all other warranties of merchantability, of fitness for a particular purpose or of any other warranty, whether express or implied. The warranties contained in this paragraph are continuing and shall survive the execution and termination of this agreement.

LEASE/RENTAL EQUIPMENT
The following conditions apply to the rental equipment:

General: Buyer shall be responsible for the proper operation, care, maintenance and safety of the equipment during the rental period. Any personnel operating the equipment must be trained. Buyer shall be solely liable and shall indemnify EOS Remediation and its subcontractors for any loss, delay or damage of any kind occasioned by the operation, handling or transportation of the equipment during the rental period or while the equipment is in the possession or control of Buyer.

Damage, Loss, or Theft: Buyer will immediately cease using the equipment if it is damaged or in need of repair and will make any necessary repairs subject to the satisfaction of EOS Remediation. Buyer is responsible for payment of reasonable costs to repair or replace the equipment due to loss, theft or damage during the rental period. Identification of any possible damage is subject to inspection by EOS Remediation upon its return to EOS Remediation.

Service and Repairs: Buyer will not authorize or permit any repairs to be made to the equipment, without the prior consent of EOS Remediation.

Excessive Wear and Tear or Equipment Abuse: When operated properly, the equipment should experience minimal wear and tear during the rental period. If it is determined that upon receipt and inspection of the returned equipment there has been excessive wear and tear or abuse, Buyer will be charged for repair/replacement.

Liability: Buyer shall indemnify and save EOS Remediation harmless from all loss, damage, claims, demands, and liabilities that may arise directly or indirectly from or in connection with Buyer's possession, use or operation of EOS Remediation equipment. Buyer's indemnity shall apply whether such claims are made by Buyer, by Buyer's employees, or by third parties.

Title and Passage of Risk: Title and ownership of all equipment on rental or lease shall remain with EOS Remediation and Buyer agrees not to alter, change or duplicate equipment or parts thereof. When Buyer leasing equipment exercises an option to purchase, title shall pass from EOS Remediation to Buyer upon receipt by EOS Remediation of all monies required to purchase the equipment. Lease or rental equipment shall be used by Buyer only at the site and in the operations designated by Buyer in its order to EOS Remediation.

Warranties: EOS Remediation represents that its equipment and accessories are free from defects in materials and workmanship when shipped.

Agreement and Sub-Letting: Any agreement resulting from a Customer order, and the rights and duties in any such agreement shall not be assigned or sublet by Buyer without EOS Remediation's consent.

Wang, Li

From: Will Moody <wmoody@geocleanse.com>
Sent: Tuesday, January 17, 2012 3:56 PM
To: Wang, Li
Subject: South Weymouth Project
Attachments: Confidential Greenville, SC Site Summary.pdf

Hi Li,

Attached to this e-mail is the pilot test case study that I briefly discussed with you. The case study is just a brief overview; please let me know if you want any detailed site information. Below are designs and costs to address the overburden and bedrock at the Building 81 site:

Overburden Treatment Program Design

- I have addressed a 20 ft by 20 ft area with a vertical treatment zone from approximately 7 to 18 ft bgs. I have assumed that the overburden is primarily sand, silty sand and gravel and that maximum PCE concentrations are 280 ppb.
- Based on the site conditions, I recommend applying sodium permanganate through temporary direct push injection points. I have assumed that the permanganate natural oxidant demand (PNOD) is 2 grams per kilogram of soil. I strongly recommend conducting a PNOD test prior to field implementation. The PNOD is site-specific and can vary considerably depending upon site conditions. Testing costs are included in this estimate, but soil sample collection is not.
- A total of 778 lbs of sodium permanganate will be required, which is based upon reasonable soil characteristic assumptions and a 2 g/kg PNOD. The sodium permanganate will be diluted to approximately 675 gallons of a 5.3% solution. I have assumed that it will require two days to inject the 675 gallons of 5.3% solution and two days for mobilization, site setup and demobilization.

Overburden Treatment Program Costs

Project Design: $2,300 (Includes work plan, health and safety plan, and project meetings.)
On-Site Injection Program: $21,280 (Includes injection and drilling equipment, field personnel, and power.)
Reagents: $2,458 (Includes 778 lbs of sodium permanganate, transportation and tax.)
Project Documentation: $2,650 (Includes post-treatment report and meetings.)
Mobilization: $5,860 (Includes vehicle rentals, per diem and equipment mobilization.)

Total Costs: $34,548

Shallow Bedrock Treatment Program Design

- I have addressed a 30 ft by 40 ft area with a vertical treatment zone from approximately 18 to 40 ft bgs. I have assumed that the shallow bedrock consists of partially weathered rock and competent bedrock, and that maximum PCE concentrations are 11,000 ppb.
- Based on the site conditions, I recommend fracturing and emplacing a potassium permanganate and sand blend. Three borings with three fractures per boring will be required. The fracture depths will be based upon a complete review of the collected site data and if possible, field observations.
- We recommend that 1,000 lbs of blend is introduced into each fracture; this is based upon our experience, not on PNOD.

Deep Bedrock Treatment Program Design

- I have addressed a 20 ft by 40 ft area with a vertical treatment zone from approximately 40 to 60 ft bgs. I have assumed that the deep bedrock zone consists of competent bedrock, and that maximum PCE concentrations are 1,600 ppb.

- Based on the site conditions, I recommend fracturing and emplacing a potassium permanganate and sand blend. Two borings with three fractures per boring will be required. The fracture depths will be based upon a complete review of the collected site data and if possible, field observations.
- We recommend that 1,000 lbs of blend is introduced into each fracture; this is based upon our experience, not on PNOD.

Bedrock Treatment Program Costs
Project Design: $3,800 (Includes work plan, health and safety plan, and project meetings.)
On-Site Fracturing Program: $121,680 (Includes fracturing and drilling equipment, office and field personnel, and power. We have estimated that 15 days will be required to complete the fracturing program.)
Reagents: $34,886 (Includes approximately 15,000 lbs of potassium permanganate and sand blend, transportation and tax.)
Project Documentation: $3,100 (Includes post-treatment report and meetings.)
Mobilization: $19,691 (Includes vehicle rentals, per diem and equipment mobilization.)

Total Costs: $183,167

Please contact me if you have questions or need any additional information. Thank you for the opportunity and I look forward to the possibility working with you in the future.

Regards,

Will

Will Moody
Project Manager
Geo-Cleanse International, Inc.
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Fax (732) 970-6697
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www.geocleanse.com

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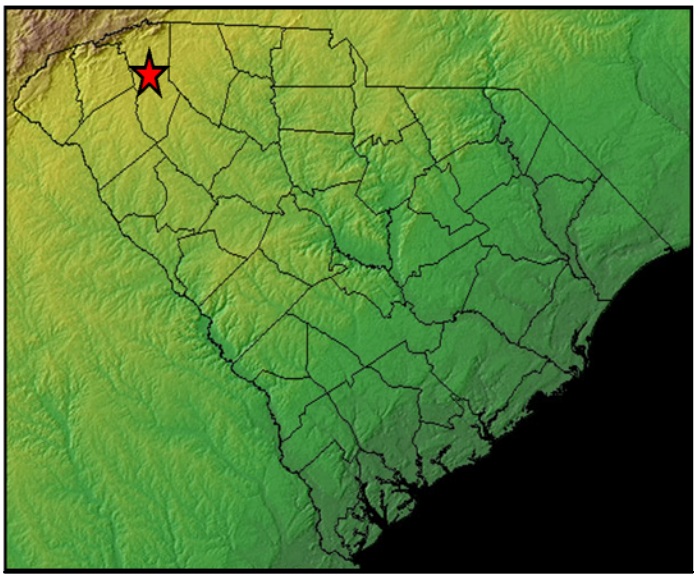
Geo-Cleanse®
INTERNATIONAL, INC.

Coupling Oxidants and Reductants for In-Situ Chemical Remediation

Geo-Cleanse International, Inc. (Geo-Cleanse) was contracted to perform two pilot studies at a former manufacturing facility located in Greenville, South Carolina to assess in-situ treatment of volatile organic compounds (VOCs), primarily trichloroethene (TCE), present in groundwater. Located in the Piedmont physiographic region, the site geology consists of fill material (mostly silty sands) underlain by saprolite and bedrock. The saprolite consists of thinly laminated, variably micaceous silty sands weathered from the underlying schist and gneiss bedrock. The thickness of the saprolite ranges from approximately 2.5 to 26 feet below ground surface (ft bgs) and partially weathered rock ranges from approximately 10 to 35 ft bgs, depending on the area of the site. Groundwater moves in a southwestern direction (Figure 2), and ranges from approximately 50 to 65 ft bgs. The depth to water-bearing units vary across the site depending upon the fractured zones within the saprolite, however groundwater throughout the majority of the site is located in the saprolite. The groundwater velocity is approximately 60 feet per year.

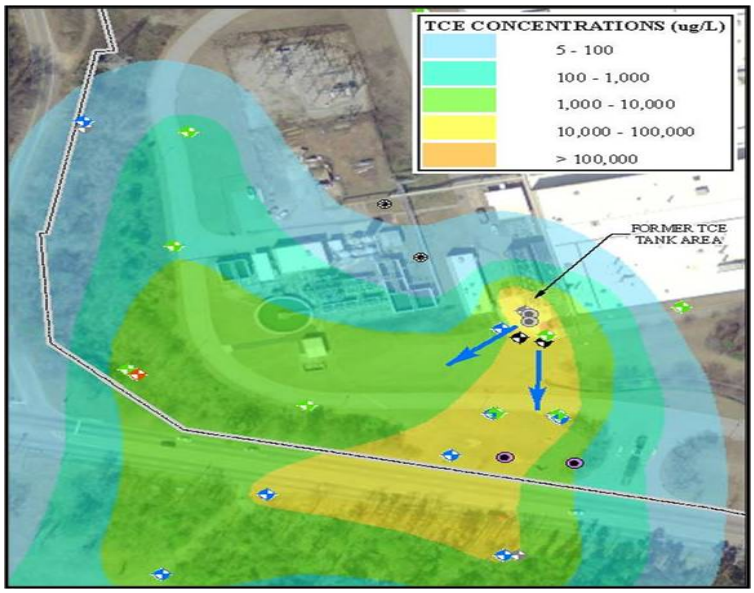
Figure 1. Site Location



The South Carolina Department of Health and Environmental Control (SC DHEC) along with the owner of the property began to investigate the nature and extent of the contamination as a result of previous site activities that utilized TCE. A storage unit located near the southwest corner of the facility, which was in operation for about ten years, was determined to be the primary source of the contamination. It was estimated that approximately 1,365 gallons of TCE were released within this tank area. Initial investigation included the installation of monitoring and recovery wells, and geoprobe sampling. The investigations revealed on- and off-site contamination of TCE and breakdown products, primarily dichloroethenes and vinyl chloride, in the soil and groundwater. The site was characterized by a relatively high concentration TCE source area, low permeability saprolite, highly transmissive bedrock, low natural attenuation, and a large plume located on- and off-site. Due to the high solubility in groundwater, the TCE plume migrated off-site to the south and west. The entire plume covers approximately 16 acres with concentrations historically greater than

200 mg/L in the source area and up to 96 mg/L in the mid-plume area near the on-site access road (Figure 2).

Figure 2. TCE Plume



Approximately 140 tons of media were excavated from the source area during the removal of the TCE storage tank, as well as the in-ground sumps and piping. Several remedial technologies were applied to address the remaining impacted groundwater and soils within the source area, including soil vapor extraction, in-situ thermal desorption, and pump & treat. Following the additional remedial efforts, high concentrations still remained in the saprolite and bedrock zones. The client sought a remedial option to obtain the drinking water maximum contaminant levels (MCLs) for TCE and its breakdown daughter products for the groundwater plume. Thus, Geo-Cleanse designed a pilot-scale field application that consisted of a novel combination of technologies to address this particularly challenging site. The site challenges included high contaminant concentrations, various land gradients throughout the area, effectively introducing a reagent into the media, and providing a long-lasting treatment option that would prevent disturbance of heavily forested land. Our approach integrated in-situ chemical oxidation using potassium permanganate ($KMnO_4$) in the source area, with in-situ chemical reduction using a zero valent iron (ZVI) permeable reactive barrier (PRB) in the downgradient plume area. The utilization of hydraulic slurry emplacement was selected to apply the reagents to the subsurface.

Permanganate is a chemical oxidant that is capable of oxidizing a variety of contaminants, particularly chlorinated solvents such as TCE. The active oxidant is the permanganate anion (MnO_4^-), which is a strong and persistent oxidant within the subsurface. It is supplied as a soluble salt, either as potassium (solid form) or sodium permanganate (liquid form). Potassium permanganate ($KMnO_4$) has a modest solubility (approximately 2% under practical environmental conditions, with an equilibrium solubility of approximately 6%). Permanganate oxidation of VOCs does not generate hazardous intermediates or breakdown products. Furthermore, permanganate diffuses into fine-grained soil and bedrock, thus it can inhibit back-diffusion of VOCs from the matrix. Based on these factors, the selection of hydraulic slurry emplacement of $KMnO_4$ was selected to provide an aggressive remedy for the source area impacts. Utilizing potassium permanganate provides the ability to deliver large oxidant volumes in a time-efficient manner in a relatively low permeability formation. When the groundwater moves through the permanganate-filled emplacements, the oxidant will very slowly dissolve (over periods of months to more than a year) and will destroy the TCE and breakdown products in the groundwater. In addition, the dissolved permanganate will diffuse and advect with groundwater, allowing migration of permanganate

away from the emplacements and through the aquifer. The downgradient area from the source consists of a steep slope (Figure 3.), which makes installation of wells and implementation of remediation technologies difficult.

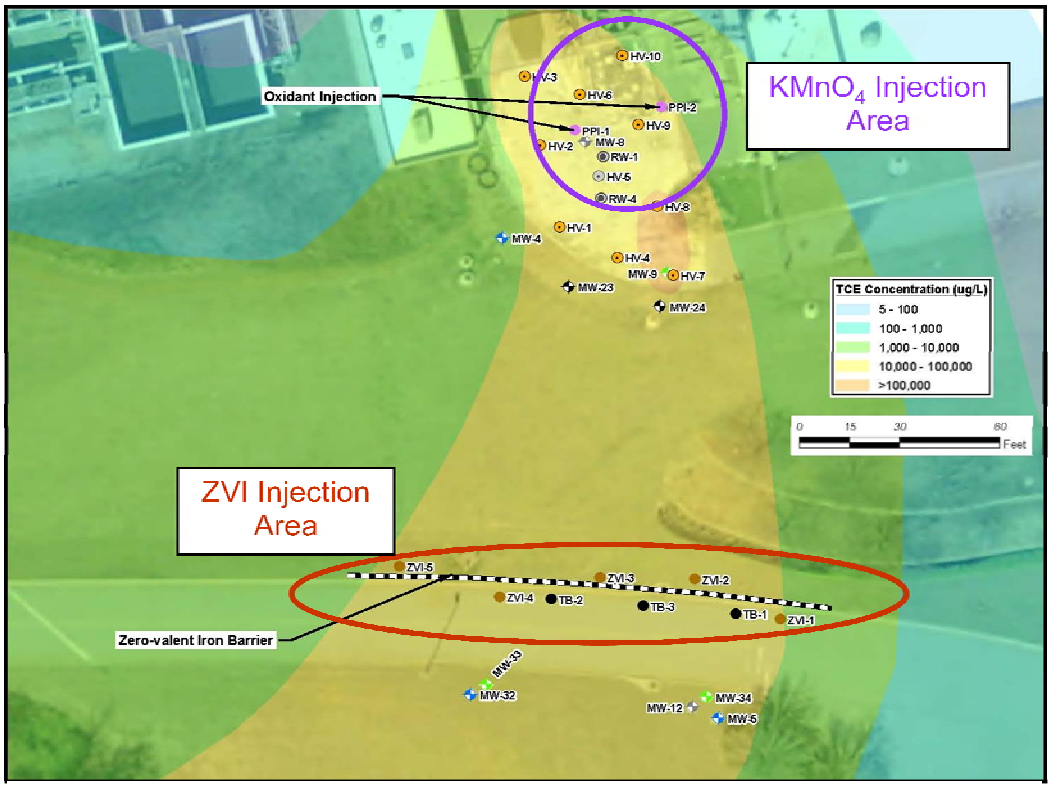
Figure 3. Permanganate Source Area

ZVI is typically used for the application of PRBs to remediate chlorinated solvent contamination in groundwater. Chlorinated organic compounds, such as TCE, are in an oxidized state because of the presence of chlorine. ZVI (Fe^0), a strong reductant, reacts with the chlorinated organic compounds through electron transfer. When measurable, chloride mass balances close to 100% are typically obtained in column experiments with granular iron and contaminated groundwater. In the case of TCE and its breakdown products, dechlorination is complete with ethene and ethane as the final carbon-containing compounds (Sivavec and Horney, 1995; Orth and Gillham, 1996; Fennelly and Roberts, 1998). Ethene/ethane mass balance of 80% and higher have been reported from closed-system tests with chlorinated ethenes and ethanes (Sivavec and Horney, 1995; Fennelly and Roberts, 1998; Roberts et al., 1996). The use of ZVI for groundwater remediation is well established (see recent reviews by Lo et al. 2006), with applications at over 150 sites around the world since the early 1990's. ZVI can provide a rapid degradation of the COCs present, and will not produce hazardous intermediates or breakdown products. ZVI was selected because it can be readily applied with hydraulic slurry emplacement and can provide treatment for decades with a single application. The plume downgradient of the selected ZVI locations is off-site and consists of a main road and heavy vegetation. Therefore, implementing this long-lasting treatment would also provide treatment for these inaccessible areas.

One of the main concerns of applying both of these in-situ treatment programs was the possibility of impact from the permanganate on the ZVI lifetime. However, there was very little potential for the permanganate treatment in the upgradient source area to impact the ZVI barrier in the plume due to the distance between the areas, groundwater velocity, and soil oxidant demand for the permanganate. Groundwater that has been treated by permanganate will have an elevated oxidation-reduction potential (ORP), which will persist after the permanganate has degraded below detectable levels. The ORP is a very general measure of the overall electron activity in the groundwater and reflects a wide range of chemical species and reactions. Similar to attenuation of permanganate, the elevated ORP will also attenuate due to the reaction with aquifer solids (Barcelona and Holm, 1991), but is more complicated to model because the reaction kinetics are affected by the wide range of chemical species involved. Given the anticipated permanganate attenuation rate, the ORP of groundwater entering the ZVI treatment area was not anticipated to be elevated due to the permanganate. Other permanganate reaction byproducts (such as chloride and sodium) do not react significantly with the ZVI.

The total pilot-scale treatment area for the site is approximately 4,300 ft^2. The pilot-scale treatment program was designed to target the source area and the mid-section of the downgradient plume (Figure 4) from the water table to approximately 10 ft into bedrock. The primary objectives of the pilot study were to evaluate the potential overall effectiveness of each technology, and to assess engineering assumptions relevant for full-scale project design and implementation. As previously mentioned, hydraulic slurry emplacement was utilized to overcome the density and low permeability of the saprolite and bedrock.

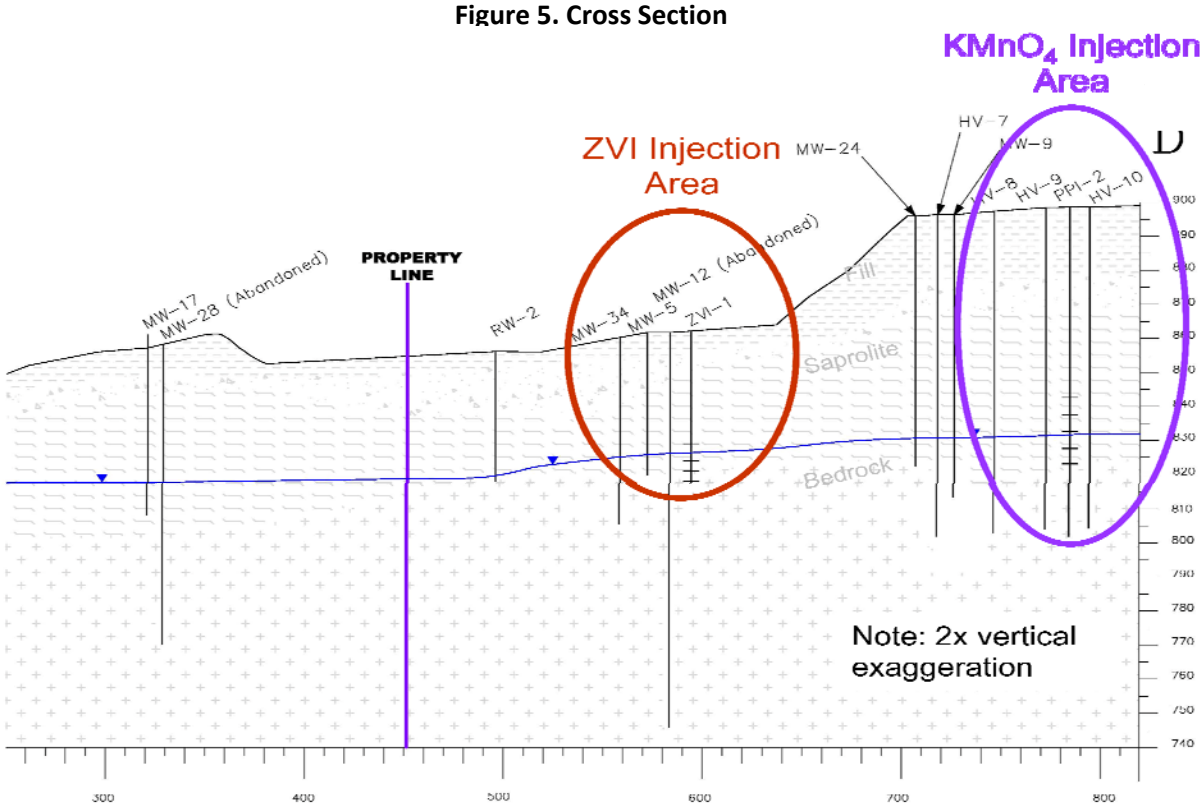
Figure 4. $KMnO_4$ and ZVI Treatment Areas



Hydraulic slurry emplacement is a process in which a fluid is introduced at a pressure sufficient to overcome the in-situ confining stress and the material strength of the solid matrix, causing the surrounding soil or rock to mechanically induce or enhance fluid flow into the formation. Slurry emplacement allows delivery of large quantities of the reagents in a short period of time, thus providing efficient injection and a very long-term supply of the reagent. The boring locations to emplace the ZVI and $KMnO_4$ slurries were all installed via sonic drilling technology due to the saprolite and bedrock (Figure 5). The cross section illustrates the stratigraphic data, depth to water, and two example locations where the ZVI and $KMnO_4$ was slurry emplaced. These borings were advanced by the drill rig, and the casing was extracted approximately three to six inches then left in the boring in order to prevent the borehole from collapsing and to optimize emplacement nucleation.

The advantage of creating an emplacement from a particular width of the open borehole is that the nucleation stresses can be better focused in the horizontal plane; pressurizing the entire borehole tends to induce a vertical emplacement that can propagate upwards or downwards out of the target zone, rather than the desired horizontal emplacement. The nucleation stresses are further focused to nucleate a horizontal emplacement by cutting a "kerf" into the exposed borehole wall. The kerf is cut with a

Figure 5. Cross Section



water jet or water blaster at a pressure of up to 10,000 psi, which in weathered saprolite has been shown to extend 6-8 inches into the soil, transforming the pressurized borehole from a pressurized cylinder to a pressurized disk. A slurry is prepared using tanks on a support trailer and then injected into the formation. Stress induced by the emplacement pressure accumulates in the hoop that defines the circumference on the disk shape, and this hoop is in the horizontal plane; hence the nucleation of a horizontal emplacement. Once the emplacement is nucleated, the initial horizontal form influences the course of propagation briefly, but soon natural forces become significant and the final form of the emplacement can be quite irregular. This process is repeated for each hydraulic slurry emplacement.

A total of five soil borings were utilized for the ZVI slurry emplacement application. One of the locations was constructed of a 4-inch diameter, schedule 40 PVC casing that was grouted into place. The remaining four were applied through boreholes. The locations were perpendicular to the direction of groundwater flow (for barrier design), and were in the core of the plume area with a range of VOC concentrations. The boring locations were installed at a spacing of approximately 30 ft, which was determined based upon empirical experience of the hydraulic emplacement subcontractor. ZVI was emplaced into multiple discrete intervals within each boring, with the borings spaced closely together to

ensure overlap. Each boring included 4 to 6 slurry emplacements from the static water table into the saprolite and bedrock. This approach was believed to be a very conservative design intended to ensure both horizontal and vertical overlap between emplacements. A granular form of ZVI was utilized rather than microscale or nanoscale due to the much longer lifetime. The amount of ZVI required was based on three main factors: initial concentrations of VOCs entering and exiting the barrier, the travel velocity of the VOCs, and the length and vertical thickness of the treatment zone. The ZVI slurry was prepared by blending the ZVI with guar gum in an aqueous matrix, which thickens the slurry to suspend the ZVI in the fluid. Approximately 73 tons of ZVI slurry was emplaced into the five boring locations forming a 150-ft barrier line. Along with the injection of ZVI and guar gum, an enzyme was also injected to break down the guar gum, which exposes the iron to the reaction with the water.

Two locations were utilized for the $KMnO_4$ slurry emplacement application. Based on the results of the ZVI application, it was determined that constructing the borehole with the PVC casing was the optimal design. Therefore, the two locations were constructed of a 4-inch diameter, schedule 40 PVC casing that was grouted into place. The locations were approximately 25 ft apart, which was considered a conservative spacing. The $KMnO_4$ product that was emplaced was RemOx®-S blended with sand, which is manufactured by Carus Corporation. The sand was blended into the permanganate in a 50/50 ratio by weight; the grain size distribution of the sand was sized to be nearly identical to that of the potassium permanganate. The permanganate slurry was prepared using bentonite, rather than guar gum (as used with the ZVI), to suspend the solid permanganate in the slurry. In order to determine the amount of $KMnO_4$ for the pilot test, an estimated contaminant mass was calculated for the treatment area. Once this amount of contamination was determined, a permanganate total oxidant demand (TOD) test was conducted. This test would determine the amount of permanganate that would be necessary to remediate 1 kg of soil. The average TOD was 8.5 g of KMnO4 per 1 kg of soil. This calculation included an "effective oxidant demand" factor. This factor adjusts the bench test results, which are performed under "perfectly mixed" conditions, to more closely reflect field conditions in which contact is not homogenous (particularly for the more competent bedrock zone). The oxidant demand from the VOCs is estimated from the contaminant mass utilizing stoichiometric redox equations. The permanganate oxidant demand is the sum of the soil oxidant demand plus the VOC oxidant demand. Utilizing these demands, approximately 28,225 lbs of $KMnO_4$ and sand blend was emplaced. Each boring location received five vertical slurry emplacements.

The monitoring program included sampling events prior to, during and after the emplacement of each reagent. Monitoring, recovery, and abandoned thermal desorption treatment wells were utilized to conduct this sampling. Performance monitoring was conducted to analyze specific parameters, evaluate performance and provide a basis for the full-scale project design. The parameters tested in the source permanganate area consisted of VOC sampling, color, ORP, specific conductivity and pH. Permanganate has a distinct characteristic light pink to purple color. This characteristic provides direct evidence in groundwater samples of reagent distribution. Figure 6 displays the visual color that was observed in wells surrounding the $KMnO_4$ emplacement borings. The picture to the left was taken from a location which was approximately 40 ft southwest and the picture on the right was taken approximately 30 ft southeast of the emplacement locations. The change in color (e.g., light pink to dark purple) provides

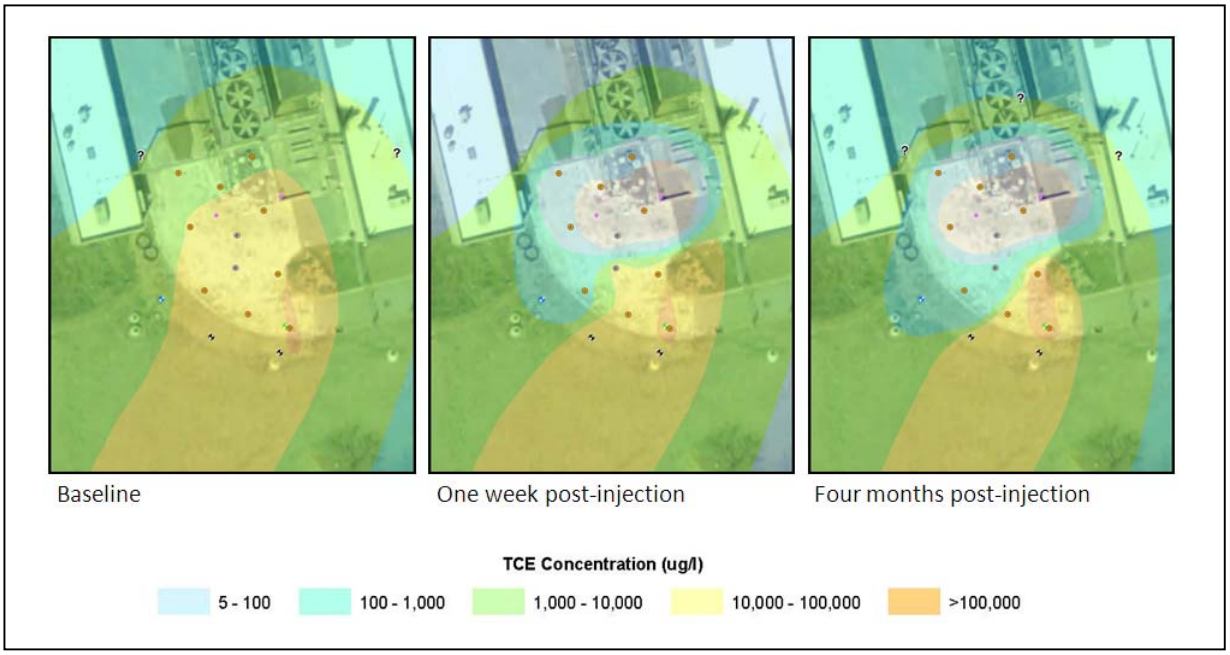
direct evidence of the presence and concentration of the permanganate distribution in surrounding wells. The parameters tested for the downgradient ZVI barrier consisted of ferrous iron, ORP, specific conductivity and pH. During ZVI emplacement, water levels were monitored and soil boring sampling was conducted. The soil boring sampling was only conducted within the ZVI treatment area due to a requirement of the state regulators to receive pilot test work plan approval. Three soil borings were taken to evaluate the physical distribution of the ZVI. Adjacent groundwater sampling locations were also monitored to determine if the ZVI emplacement borings were in hydraulic communication with the water-bearing zones.

Figure 6. Visual Indication of $KMnO_4$

Tiltmeters were used to measure surface deformation during the ZVI and $KMnO_4$ emplacement, which reflected distribution within the subsurface. The tiltmeters can measure surface deflection to a resolution of 5 microradians (five units of vertical movement per 1,000,000 units of lateral distance). These data were collected continuously throughout the creation of each emplacement. The tiltmeters were stabilized prior to the each emplacement. As the emplacement was propagated, minute deflections in the earth surface (reflecting formation of the emplacement) were recorded by the tiltmeters. The tiltmeter data were analyzed by plotting deflection as a function of time during the emplacement process. The resulting data (consisted of a two-point coordinate for the tiltmeter and a corresponding maximum tilt) are utilized to calculate a vector whose orientation and length represent the direction and magnitude of the tilt, respectively.

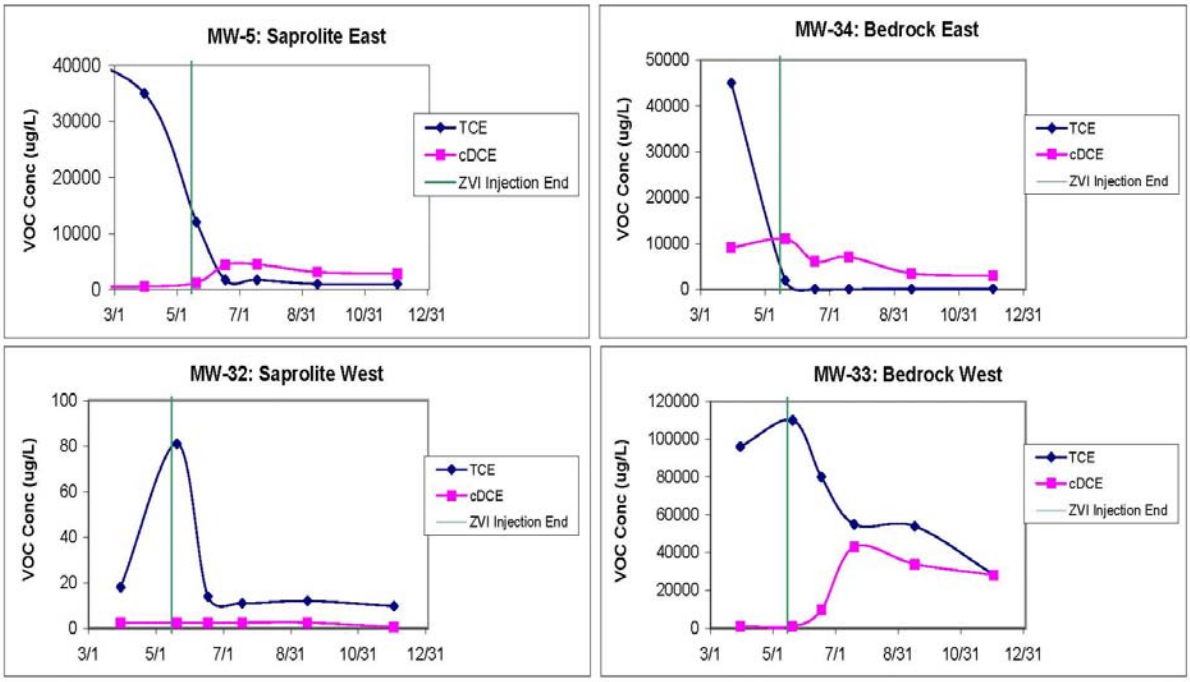
The source area pilot test proved to be very effective at reducing VOCs. Permanganate was physically observed (based upon the distinctive pink to purple color of the reagent in groundwater) approximately 40 ft from the emplacement boring locations. Permanganate was observed in 11 of the 15 well locations within the pilot test area immediately following emplacement. After three months, permanganate was observed in 9 of the 11 locations. The overall TCE concentrations were reduced by approximately 84-100% relative to the baseline concentrations (Figure 7). Concentrations were reduced by two to five orders of magnitude, in one case from 82,000 µg/L to non-detect. Permanganate was not observed in any of the wells located outside the radius of influence; therefore the permanganate did not come into contact with the ZVI, which was a primary concern.

Figure 7. VOC Concentrations - KMnO4 Area



The middle downgradient plume pilot test also proved to be a successful at reducing VOCs. Multiple conclusions can be drawn from the field observations and post-emplacement analytical results. Each ZVI slurry emplacement boring achieved a radius of influence of approximately 15 ft. This conclusion was based upon direct observation of ZVI in the three soil borings (confirmed by visual evidence, magnetic susceptibility and X-ray diffraction analysis of ZVI particles in soil) advanced after the emplacement, and indirectly based upon tiltmeter data reflecting surface deflections. The inorganic geochemistry results from groundwater downgradient of the treatment barrier also reflected the influence of ZVI. Groundwater ORP is particularly sensitive to the ZVI and decreases were observed in all of the four monitoring wells (two in the saprolite and two in the bedrock). The groundwater pH and specific conductivity also reflected transient shifts associated with ZVI applications, which can also be influenced by the soil buffering capacity and other factors in addition to the ZVI. Prior to the pilot test, the groundwater did not exhibit any concentrations of boron, which is a component of the ZVI reagent. However, following the pilot test, all four monitoring wells had significant increases in boron concentrations independently confirming the hydraulic connectivity of the ZVI emplacements. The VOC concentrations in the groundwater downgradient from the barrier also exhibited significant reductions. TCE concentrations were reduced by approximately 46 to 100% relative to the baseline concentrations in the four downgradient monitoring wells (Figure 8). The TCE concentrations were reduced from approximately 35,000 µg/L to 950 µg/L and from 18 µg/L to 9.7 µg/L in the two saprolite monitoring wells. The two wells within the bedrock were reduced from approximately 96,000 µg/L to 28,300 µg/L, and from 45,000 µg/L to non-detect. The daughter breakdown products initially increased following the injection, however additional post-injection sampling has shown a subsequent decrease as a function of time.

Figure 8. VOC Concentrations – ZVI Area



*Note: All samples reported < RDL are plotted at a value of half of the RDL.

In conclusion, the application of the field pilot tests in two different areas of the site proved to be effective. Sonic drilling methods provided an efficient method of installing the emplacement borings for several reasons; there were no issues with short-circuiting of reagents between the drill rod and the formation, and the emplacement method allowed specific depth intervals to be targeted. Equipment and labor resources were used effectively with minimal standby time, and casings can be reoccupied for additional injection during future mobilizations. Quarterly monitoring of VOC and inorganic chemical parameters is ongoing to confirm the lifetime and long-term effectiveness of the remedies. Full-scale expansion of the pilot test remedies is planned for 2013.

References Cited

Barcelona, M.J., and Holm, T.R. 1991. Oxidation-reduction capacities of aquifer solids. *Environmental Science & Technology*, v. 25: 1565-1572.

Fennelly, J.P., and Roberts, A.L. 1998. Reaction of 1,1,1-trichloroethane with zero-valent metals and bimetallic reductants. *Environmental Science & Technology*, v. 32, 1980-1988.

Lo, I. M.-C., Surampalli, R.Y., and Lai, K.C.K. 2006. *Zero-Valent Iron Reactive Materials for Hazardous Waste and Inorganics Removal*. ASCE Publications, Reston, VA.

Orth, W.S., and Gillham, R.W. 1996. Dechlorination of trichloroethene in aqueous solution using Fe^0. *Environmental Science & Technology*, v. 30: 66-71.

Roberts, A.L., Totten, L.A., Arnold, W.A., Burris, D.R., and Campbell, T.J. 1996. Reductive elimination of

Sivavec, T.M., and Horney, D.P. 1995. Reductive dechlorination of chlorinated ethenes by iron metal. 209th American Chemical Society National Meeting, Anaheim, CA. Division of Environmental Chemistry *Preprints of Papers*, Vol. 35: 695-698.

APPENDIX E

BIOCHLOR MODEL

BIOCHLOR 2.2 MODELING

Predictive modeling was conducted as part of this Feasibility Study to evaluate the time for groundwater to achieve the RecD Zoning District PRGs presented in Table 2-4. The time to achieve PRGs via natural attenuation alone was predicted as was the time to achieve the PRGs after treatment of a portion of the existing plume followed by natural attenuation. The modeling was performed using BIOCHLOR Version 2.2, a screening level model that can simulate one-dimensional advection, three dimensional dispersion, linear adsorption, and biotransformation via reductive dechlorination. Reductive dechlorination is assumed to occur under anaerobic conditions. The degradation of dissolved PCE, TCE, cis-1,2 DCE and VC are assumed to follow a first-order decay process.

Model Development

Three models were developed, one model of the deep overburden plume, one model of the shallow bedrock plume, and one model of the deep bedrock plume. A groundwater flowpath through the center of each plume was modeled, from locations with the highest concentrations to the western boundary of the plume in each aquifer unit. Based upon a comparison of current and historical data, the overburden and the bedrock models were set up with a centerline that extends from a presumed source area within the highest concentration contour in each plume.

Additional modeling was performed to evaluate the time for groundwater to achieve the VCD Zoning District PRGs presented in Table 2-4 to address concerns raised about the daughter products remaining in the groundwater downgradient of the bio-barriers. The area beyond the bio-barrier was modeled; both a low starting concentration (contaminants treated to the VCD PRGs) and a high starting concentration (contaminants treated to double the VCD PRGs) was modeled.

Uncertainties

The data and assumptions used for modeling are discussed below. The simulations performed were based on available site data. The Biochlor model itself has a number of limitations that could not capture all the site-specific features. It should be noted that the Biochlor tool provides non-unique solutions to the mathematical problem and therefore the best-fit solution must be selected by the modeler. The Biochlor models for the Building 81 were calibrated considering all of the available site specific data in combination with published data, where site specific data are not available. However, due to the non-unique solutions to the problems posed to the model, these models are useful for order of magnitude type estimates and comparison of different remedial alternatives.

Model Calibration

Model inputs include: release date, initial source area concentration, source zone width and thickness, soil density, fraction organic carbon, constituent partition coefficients, aquifer hydraulic conductivity, hydraulic gradient, effective porosity, longitudinal dispersivity, source area decay coefficient, and constituent half-life (biological decay rate).

The release was assumed to be a mixture of compounds with a small amount of PCE dissolved in waste oil. The concentration of PCE in the overburden and bedrock groundwater at the time of the release was taken to be in the range of 1 percent to 20 percentpercent of the maximum solubility of PCE (200 mg/L) in water based on Rault's Law and varied during the course of model calibration. The final calibrated initial concentration was 2 mg/L in deep overburden groundwater, 25 mg/L in shallow bedrock groundwater, and 4 mg/L in deep bedrock groundwater.

The retardation factors for the overburden and bedrock models were calculated using the model's default partition coefficients and the estimated soil bulk density and effective porosity.

The starting time of the simulations was estimated from the historical information regarding the use of the site and surrounding buildings, particularly the former waste oil tank. At Building 81, the former waste oil tank was installed in 1983 and removed in 1991, so the starting time of the model simulations was assumed to be 1991.

The source area decay rates were also estimated by model calibration, as the time-series data in source area wells are not sufficient to estimate using observed concentration trends through time. The source decay rates for the deep overburden plume were 0.1 per year (PCE), 0.13 per year (TCE), 0.2 per year (DCE), and 0.15 per year (VC). The source decay rates for the shallow bedrock plume were 0.09 per year (PCE and VC) and 0.03 per year (TCE and DCE). The source decay rate for all COCs in the deep bedrock plume was 0.016 per year.

The half-lives estimated using model calibration were 1.0 (deep overburden) and 0.20 years (shallow and deep bedrock) for PCE, 0.83 years for TCE, 0.74 years for DCE, and 0.20 years for vinyl chloride. These half-lives are within the range of published literature values and of the BIOCHLOR user's manual.

Deep Overburden Model

The overburden model was set up along a flowpath from the source area (tank grave) to the edge of the plume with a centerline going through I-12, I-09, I-06, and GP-C02. The model was calibrated to the 2006 analytical dataset from these wells.

The seepage velocity (222.3 ft/yr) was calculated based on the measured mean hydraulic conductivity, hydraulic gradient, and assumed effective porosity in the deep overburden model. The length of the plume was taken to be 220 feet and the longitudinal dispersivity (11.7 ft) was calculated in the model using Xu/Eckstein (1995).

Model inputs and the results of the model calibration are shown in the attached screen-shots from BIOCHLOR annotated as "Deep Overburden – Calibration." The calibration was compared to the 2006 groundwater data; PCE concentrations predicted by the model generally match the observed concentrations in each well. TCE and cis-1,2-DCE concentrations predicted by the model generally match the observed concentrations along the plume centerline.

Shallow Bedrock Model

The shallow bedrock model was set up along a flowpath from the source area adjacent to BR-07 to the edge of the plume with the centerline through monitoring wells BR-05, BR-04, BR-23, and MW-21D. The model was calibrated using the maximum concentration associated with either the 2006 or 2009 data from these wells.

The seepage velocity (271.8 ft/yr) was calculated based on the measured mean hydraulic conductivity, hydraulic gradient, and assumed effective porosity in the deep overburden model. The length of the plume was taken to be 220 feet and the longitudinal dispersivity (11.7 ft) was calculated in the model using Xu/Eckstein (1995).

Model inputs and the results of the model calibration are shown in the attached screen-shots from BIOCHLOR annotated as "Calibration – Shallow Bedrock." The calibration was compared to the 2006 and 2009 groundwater data; PCE concentrations predicted by the model generally match the observed concentrations in each well. TCE and cis-1,2-DCE concentrations predicted by the model generally match the observed concentrations along the plume centerline.

Deep Bedrock Model

The deep bedrock model was set up along a flowpath from the source area adjacent to MW-03D to the edge of the plume with the centerline through monitoring wells MW-08D, MW-09D2, MW-24D, MW-33D, and MW-21D2. The model was calibrated using the 2006 data from these wells.

The seepage velocity (31.5 ft/yr) was calculated based on the measured mean hydraulic conductivity, hydraulic gradient, and assumed effective porosity in the deep overburden model. The length of the plume was taken to be 200 feet and the longitudinal dispersivity (11.1 ft) was calculated in the model using Xu/Eckstein (1995).

Model inputs and the results of the model calibration are shown in the attached screen-shots from BIOCHLOR annotated as "Calibration – Deep Bedrock." The calibration was compared to the 2006 groundwater data; PCE concentrations predicted by the model generally match the observed concentrations in each well. TCE and cis-1,2-DCE concentrations predicted by the model generally match the observed concentrations along the plume centerline.

Model Predictions for the Source Area

The calibrated models were used to predict the time to achieve a reduction of PCE, TCE, cis-1,2-DCE, and VC to PRGs in three scenarios. The first scenario was the natural attenuation of the plume, the second scenario was treatment of the source area with enhanced bioremediation to achieve 90 percent concentration reduction followed by natural attenuation (Alternative G-3), and the third scenario was treatment of the source area with chemical oxidation to achieve 70 percent concentration reduction followed by natural attenuation (Alternative G-4).

The assumed source removal efficiencies were based on a literature search of typical values, e.g. *Adamson, D. T., McGuire, T. M., Newell, C. J., and Stroo, H. (2011) Sustained treatment: Implications for treatment timescales associated with source-depletion technologies. Remediation Journal, 21(2), 27–50; ITRC (2011) Integrated DNAPL Site Strategy; McGuire, T. M., McDade, J. M., and Newell, C. J. (2006) Performance of DNAPL Source Depletion Technologies at 59 Chlorinated Solvent-Impacted Sites. Ground Water Monitoring & Remediation, 26(1), 73–84.* The lower source removal efficiency for chemical oxidation (ISCO) was assumed to account for potential rebound of contaminant concentrations that typically occurs after ISCO treatment.

Deep Overburden Model

Deep Overburden Run 1 – MNA Only (Alternative G-2)

The initial concentrations for input into the MNA only predictive overburden model (Alternative G-2) are shown below:

Concentrations and Zone Width*	PRGs
Width: 120 ft	
PCE: 0.28 mg/L (I-12)	0.5 mg/L
TCE: 0.02 mg/L (I-12)	0.023 mg/L
cis-1,2-DCE: 0.1 mg/L (I-12)	29 mg/L
VC: 0.011 mg/L (I-12)	0.018 mg/L

*The source of the concentrations and zone width is Figure 4-21 of the RI.

The input and results are shown as screen shots from the model labeled as "Deep Overburden - Run 1." The pre-MNA concentrations of PCE and cis-1,2-DCE are below the PRGs. The results indicate that using MNA only, it will take 4 years for all CVOCs to attenuate to below their respective PRGs.

Deep Overburden Run 2 – In-situ Chemical Oxidation followed by MNA (Alternative G-4)

To predict the time to achieve PRGs under Alternative G-4, it was assumed that the source concentration of contaminants would achieve 70 percent reduction after source treatment with ISCO. The resulting concentrations are shown below, compared to PRGs:

Concentrations and Zone Width*	PRGs
Width: 120 ft	
PCE: 0.084 mg/L	0.5 mg/L
TCE: 0.006 mg/L	0.023 mg/L
cis-1,2-DCE: 0.03 mg/L	29 mg/L
VC: 0.0033 mg/L	0.018 mg/L

* The source of the concentrations and zone width is Figure 4-21 of the RI.

The results show that the source treatment reduces the concentrations below PRGs.

Deep Overburden Run 3 – Enhanced Bioremediation followed by MNA (Alternative G-3)

To predict the time to achieve PRGs under Alternative G-3, it was assumed that the source concentration of contaminants would achieve 90 percent reduction after source treatment with enhanced bioremediation. The resulting initial concentrations used as input for this predictive model are shown below:

Concentrations and Zone Width*	PRGs
Width: 120 ft	
PCE: 0.028 mg/L	0.5 mg/L
TCE: 0.002 mg/L	0.023 mg/L
cis-1,2-DCE: 0.01 mg/L	29 mg/L
VC: 0.0011 mg/L	0.018 mg/L

* The source of the concentrations and zone width is Figure 4-21 of the RI.

The results show that the source treatment reduces the concentrations below PRGs.

Shallow Bedrock Model

Shallow Bedrock Run 1 – MNA Only (Alternative G-2)

The initial concentrations for input into the MNA shallow bedrock model (Alternative G-2) are shown below:

Concentrations and Zone Width*	PRGs
Width: 120 ft	
PCE: 11 mg/L (BR-07)	0.5 mg/L
TCE: 0.12 mg/L (BR-07)	0.023mg/L
cis-1,2-DCE: 0.009 mg/L (BR-07)	29 mg/L
VC: 0.0015 mg/L (BR-07)	0.018 mg/L

* The source of the concentrations and zone widths is Figure 4-26 of the RI.

The input and results are shown as screen shots from the model labeled as “Shallow Bedrock - Run 1.” The pre-MNA concentrations of cis-1,2-DCE and VC are below the PRGs. The results indicate that using MNA only, it will take 60 years for all CVOCs to attenuate to below their respective PRGs.

Shallow Bedrock Run 2 – In-situ Chemical Oxidation followed by MNA (Alternative G-4)

To predict the time to achieve PRGs under Alternative G-4, it was assumed that the source concentration of contaminants would achieve 70 percent reduction after source treatment with enhanced bioremediation. The resulting initial concentrations used as input for this predictive model are shown below:

Concentrations and Zone Width*	PRGs
Width: 120 ft	
PCE: 3.3 mg/L	0.5 mg/L
TCE: 0.036 mg/L	0.023mg/L
cis-1,2-DCE: 0.003 mg/L	29 mg/L
VC: 0.0045 mg/L	0.018 mg/L

*The source of the concentrations and zone widths is Figure 4-26 of the RI.

The input and results are shown as screen shots from the model labeled as "Shallow Bedrock - Run 2". The pre-treatment concentrations of cis-1,2-DCE and VC are below the PRGs. The results indicate that using in-situ chemical oxidation followed by MNA, it will take 41 years for all CVOCs to attenuate to below their respective PRGs.

Shallow Bedrock Run 3 – Enhanced Bioremediation followed by MNA (Alternative G-3)

To predict the time to achieve PRGs under Alternative G-3, it was assumed that the source concentration of contaminants would achieve 90 percent reduction after source treatment with enhanced bioremediation. The resulting initial concentrations used as input for this predictive model are shown below:

Concentrations and Zone Width*	PRGs
Width: 120 ft	
PCE: 1.1 mg/L	0.5 mg/L
TCE: 0.012 mg/L	0.023mg/L
cis-1,2-DCE: 0.0009 mg/L	29 mg/L
VC: 0.00015 mg/L	0.018 mg/L

*The source of the concentrations and zone widths is Figure 4-26 of the RI.

The input and results are shown as screen shots from the model labeled as "Shallow Bedrock - Run 3". The pre-treatment concentrations of TCE, cis-1,2-DCE and VC are below the PRGs. The results indicate

that using enhanced bioremediation followed by MNA it will take 27 years for all CVOCs to attenuate to below their respective PRGs.

Deep Bedrock Model

Deep Bedrock Run 1 – MNA Only (Alternative G-2)

The initial concentrations for input into the MNA only predictive overburden model (Alternative G-2) are shown below:

Concentrations and Zone Width*	PRGs
Width: 100 ft	
PCE: 2.8 mg/L (BR-07)	0.5 mg/L
TCE: 0.18 mg/L (BR-07)	0.023mg/L
cis-1,2-DCE: 0.027 mg/L (BR-07)	29 mg/L
VC: 0.00015 mg/L (BR-07)	0.018 mg/L

*The source of the concentrations and zone widths is Figure 4-31 of the RI.

The input and results are shown as screen shots from the model labeled as "Deep Bedrock - Run 1." The pre-MNA concentrations of cis-1,2-DCE and VC are below the PRGs. The results indicate that using MNA only, it will take 256 years for all CVOCs to attenuate to below their respective PRGs.

Deep Bedrock Run 2 – In-situ Chemical Oxidation followed by MNA (Alternative G-4)

To predict the time to achieve PRGs under Alternative G-4, it was assumed that the source concentration of contaminants would achieve 70 percent reduction after source treatment with enhanced bioremediation. The resulting initial concentrations used as input for this predictive model are shown below:

Concentrations and Zone Width*	PRGs
Width: 100 ft	
PCE: 0.84 mg/L	0.5 mg/L
TCE: 0.054 mg/L	0.023mg/L
cis-1,2-DCE: 0.0081 mg/L	29 mg/L
VC: 0.000045 mg/L	0.018 mg/L

*The source of the concentrations and zone widths is Figure 4-31 of the RI.

The input and results are shown as screen shots from the model labeled as "Deep Bedrock - Run 2." The pre-MNA concentrations of cis-1,2-DCE and VC are below the PRGs. The results indicate that using ISCO followed by MNA, it will take 180 years for all CVOCs to attenuate to below their respective PRGs.

Deep Bedrock Run 3 – Enhanced Bioremediation followed by MNA (Alternative G-3)

To predict the time to achieve PRGs under Alternative G-3, it was assumed that the source concentration of contaminants would achieve 90 percent reduction after source treatment with enhanced bioremediation. The results show that the source treatment reduces the concentrations of CVOCs below PRGs.

Concentrations and Zone Width*	PRGs
Width: 100 ft	
PCE: 0.28 mg/L	0.5 mg/L
TCE: 0.018 mg/L	0.023mg/L
cis-1,2-DCE: 0.0027 mg/L	29 mg/L
VC: 0.000015 mg/L	0.018 mg/L

*The source of the concentrations and zone widths is Figure 4-31 of the RI.

Model Predictions for the Bio-Barriers

The calibrated models were used to predict the time to achieve a reduction of PCE, TCE, cis-1,2-DCE and VC to PRGs in two scenarios for groundwater that was treated in the bio-barriers. The first scenario was the bio-barriers had achieved reduction of all COCs to the VCD PRGs and the second scenario was the bio-barriers had achieved reduction of the COCs to twice the VCD PRGs.

The initial concentrations for input into the predictive models (deep overburden, shallow bedrock, and deep bedrock) for the two scenarios are shown below:

Concentrations (COCs = VCD PRGs)
PCE: 0.11 mg/L (I-12)
TCE: 0.0085 mg/L (I-12)
cis-1,2-DCE: 0.01 mg/L (I-12)
VC: 0.0026 mg/L (I-12)

Concentrations (COCs = 2x VCD PRGs)
PCE: 0.22 mg/L (I-12)
TCE: 0.017 mg/L (I-12)
cis-1,2-DCE: 0.02 mg/L (I-12)
VC: 0.0052 mg/L (I-12)

Deep Overburden Model

Deep Overburden Run 4 – Reduction to VCD PRGs

The input and results are shown as screen shots from the model labeled as "Bio-barrier Deep Overburden - Run 1." The results indicate that cis-1,2-DCE and VC will be above their PRGs for about 12 years, after which the CVOCs will all be below their PRGs.

Deep Overburden Run 2 – Reduction to twice the VCD PRGs

The input and results are shown as screen shots from the model labeled as "Bio-barrier Deep Overburden - Run 5." The results indicate that after being reduced to the projected concentrations in the bio-barrier, there will be elevated cis-1,2-DCE and VC and it will take 18 years for all CVOCs to attenuate to below their respective PRGs.

Shallow Bedrock Model

Shallow Bedrock Run 1 – Reduction to VCD PRGs

The input and results are shown as screen shots from the model labeled as "Bio-barrier Shallow Bedrock - Run 1." The results indicate that no daughter products will exceed the VCD PRGs beyond the bio-barriers following treatment of groundwater to the VCD PRGs.

Shallow Bedrock Run 5 – Reduction to Twice the VCD PRGs

The input and results are shown as screen shots from the model labeled as "Shallow Bedrock - Run 5." The results indicate that after being reduced to two times the VCD PRGs in the bio-barrier, it will take 23 years for CVOCs in groundwater to attenuate to below their respective PRGs.

Deep Bedrock Model

Deep Bedrock Run 4 – Reduction to VCD PRGs

The input and results are shown as screen shots from the model labeled as “Deep Bedrock - Run 4.” The results indicate that no daughter products will exceed the VCD PRGs beyond the bio-barriers, following treatment of groundwater to the VCD PRGs.

Deep Bedrock Run 5 – Reduction to twice the VCD PRGs

The input and results are shown as screen shots from the model labeled as “Shallow Bedrock - Run 5.” The results indicate that after being reduced to two times the VCD PRGs in the bio-barrier, it will take 44 years for CVOCs in groundwater to attenuate to below their respective PRGs.

Deep Overburden- Calibration

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Deep Overburden
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ or
0.02 → 2. Calculate by filling in gray cells. Press Enter, then C

(To restore formulas, hit "Restore Formulas" button)

Variable* Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	222.3	(ft/yr)
or			
Hydraulic Conductivity	K	2.2E-03	(cm/sec)
Hydraulic Gradient	i	0.0198	(ft/ft)
Effective Porosity	n	0.2	(-)

2. DISPERSION

Alpha x*	11.739	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.8	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	8.67	(-)
TCE	130	(L/kg)	3.34	(-)
DCE	125	(L/kg)	3.25	(-)
VC	30	(L/kg)	1.53	(-)
ETH	302	(L/kg)	6.44	(-)
Common R (used in model)* =			3.34	

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

		λ (1/yr)	half-life (yrs)	Yield
Zone 1				
1	PCE → TCE	1.000		0.79
0.83	TCE → DCE	1.200		0.74
0.74	DCE → VC	1.350		0.64
0.20	VC → ETH	4.900		0.45
Zone 2		λ (1/yr)	half-life (yrs)	
	PCE → TCE	0.000		
	TCE → DCE	0.000		
	DCE → VC	0.000		
	VC → ETH	0.000		

λ HELP

5. GENERAL

Simulation Time*	15	(yr)
Modeled Area Width*	120	(ft)
Modeled Area Length*	220	(ft)
Zone 1 Length*	220	(ft)
Zone 2 Length*	0	(ft)

Zone 2=

6. SOURCE DATA TYPE: Decaying Single Planar

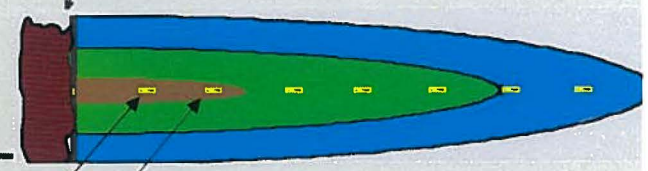
Source Options

Source Thickness in Sat. Zone* 5 (ft)

Y1
Width* (ft) 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	2.0	0.1
TCE		0.13
DCE		0.2
VC		0.15
ETH		0.12

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)	.28	.086	.078	.09							
TCE Conc. (mg/L)	.02	.002	.001	.0							
DCE Conc. (mg/L)	.1	.004	.002	.002							
VC Conc. (mg/L)	0.0										
ETH Conc. (mg/L)											
Distance from Source (ft)	35	95	155	205							
Date Data Collected	2006										

8. CHOOSE TYPE OF OUTPUT TO SEE:

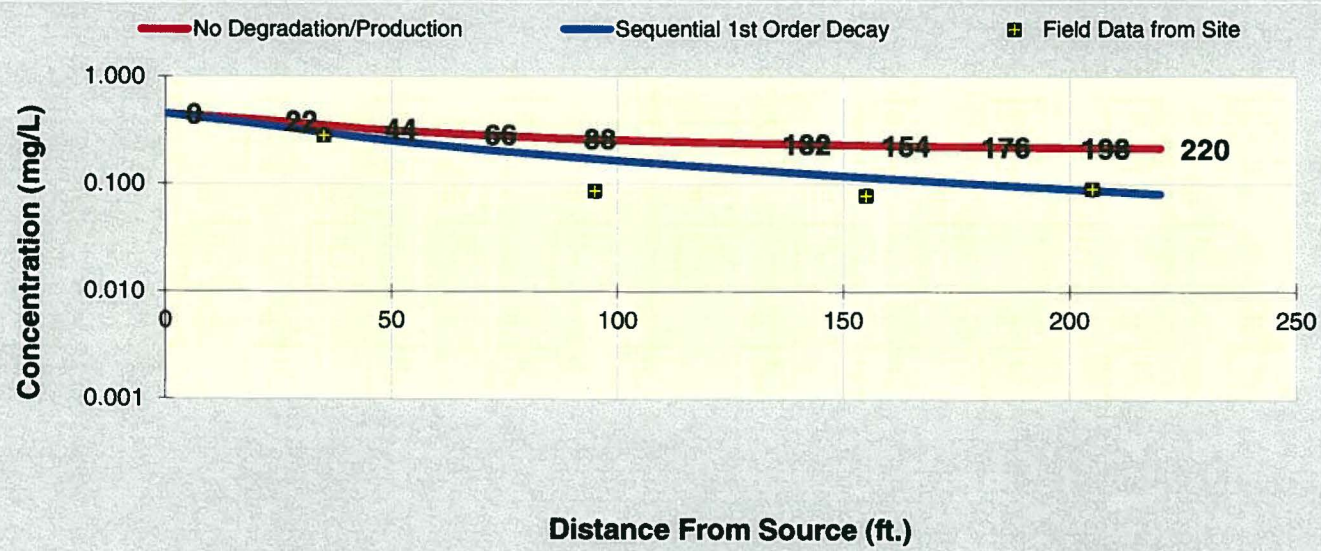
RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Deep Overburden - Calibration

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

PCE	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.446	0.386	0.322	0.285	0.262	0.246	0.235	0.227	0.220	0.216	0.212
Biotransformation	0.4463	0.350	0.265	0.213	0.178	0.151	0.131	0.115	0.101	0.090	0.080

	Monitoring Well Locations (ft)										
	35	95	155	205							
Field Data from Site	0.280	0.086	0.078	0.090							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

To All

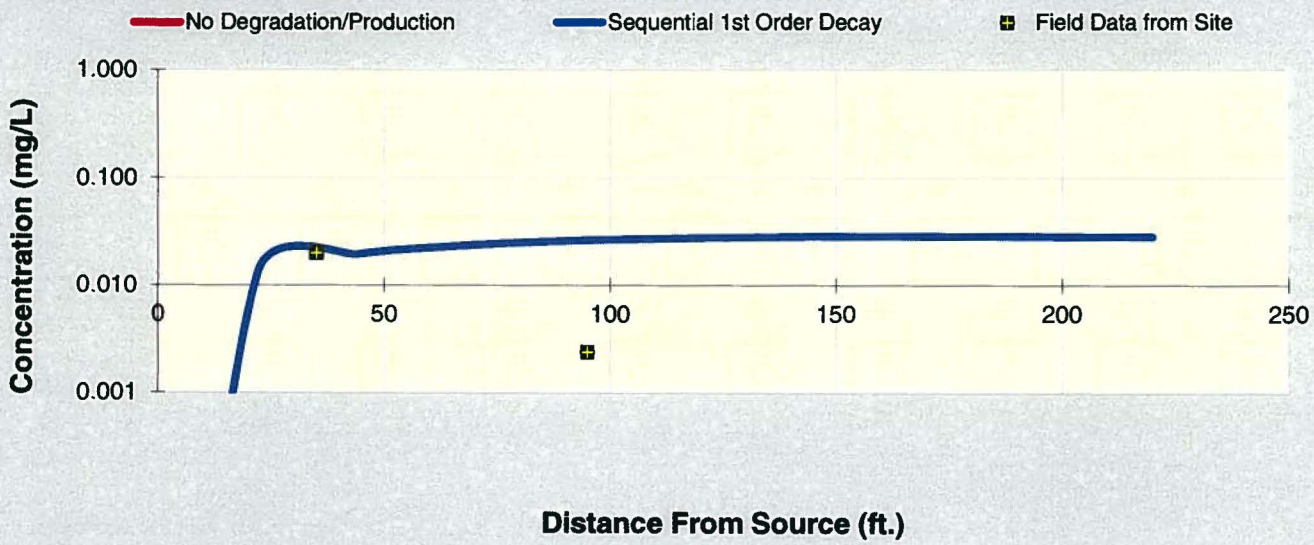
To Array

Deep Overburden- Calibration

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

TCE	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.013	0.019	0.023	0.026	0.027	0.028	0.028	0.029	0.028	0.028

	Monitoring Well Locations (ft)										
	35	95	155	205							
Field Data from Site	0.020	0.002	0.001	0.000							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

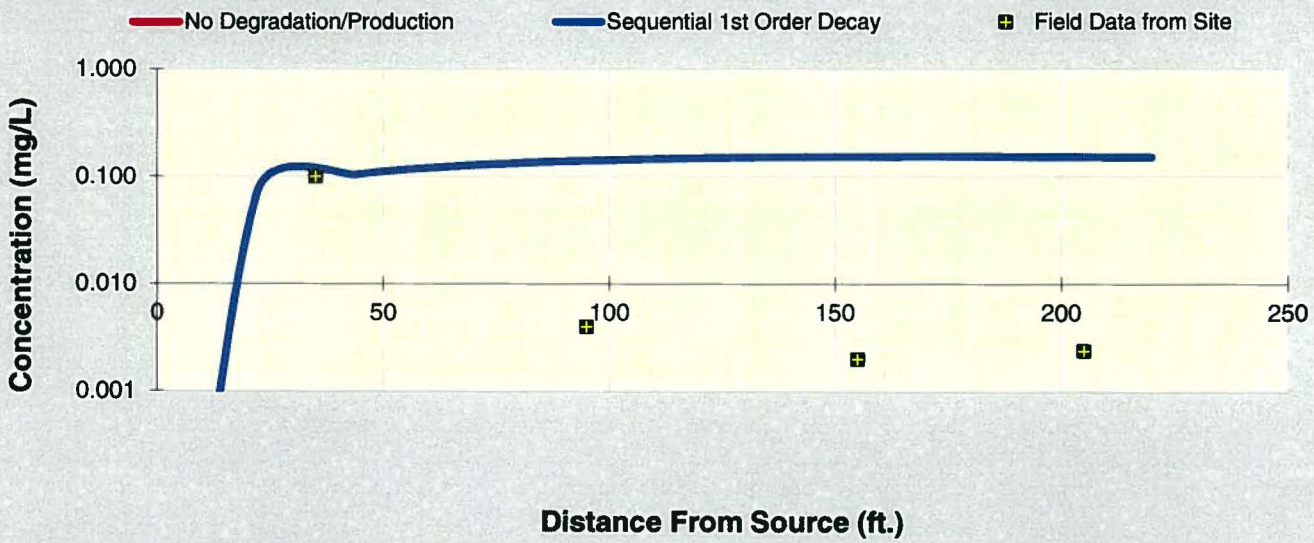
To All

To Array

Deep Overburden - Calibration

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

DCE	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.068	0.103	0.123	0.136	0.145	0.149	0.152	0.152	0.152	0.150
	Monitoring Well Locations (ft)										
	35	95	155	205							
Field Data from Site	0.100	0.004	0.002	0.002							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

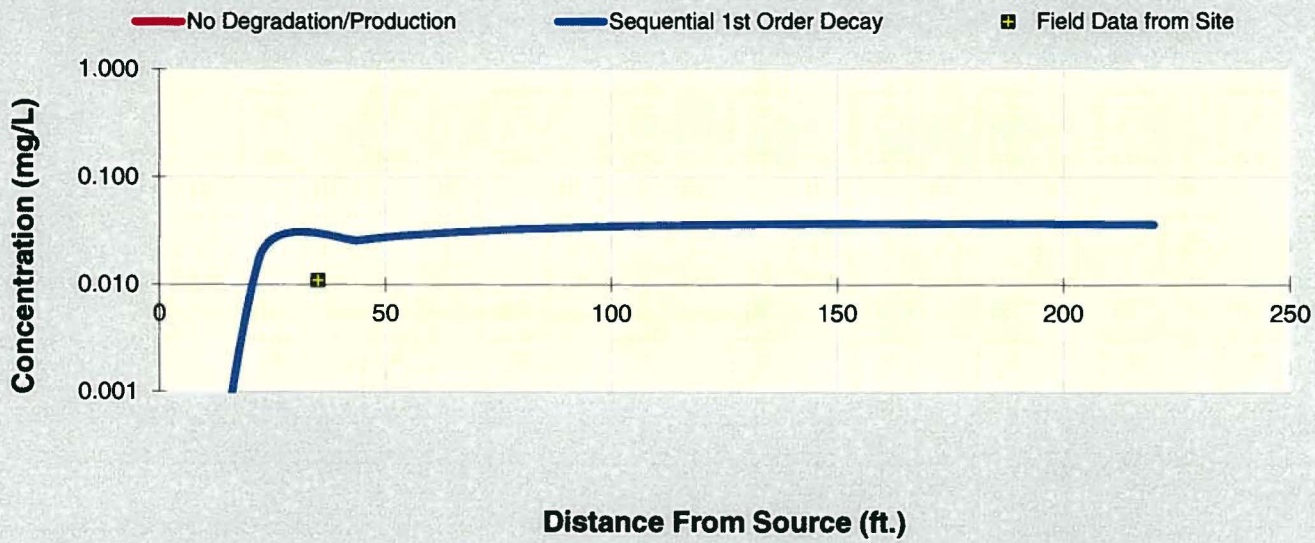
To All

To Array

Deep Overburden - Calibration

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.017	0.026	0.030	0.033	0.035	0.036	0.037	0.037	0.037	0.036
	Monitoring Well Locations (ft)										
	35	95	155	205							
Field Data from Site	0.011										



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Deep Overburden - Run 1 - MNA

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Deep Overburden
Run Name

Data Input Instructions:
115 → 1. Enter value directly....or
↑ or 0.02 → 2. Calculate by filling in gray cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	222.3	(ft/yr)
or			
Hydraulic Conductivity	K	2.2E-03	(cm/sec)
Hydraulic Gradient	i	0.0198	(ft/ft)
Effective Porosity	n	0.2	(-)

2. DISPERSION

Alpha x*	11.739	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R
or
Soil Bulk Density, rho 1.8 (kg/L)
FractionOrganicCarbon, foc 2.0E-3 (-)

Partition Coefficient	Koc		R	
PCE	426	(L/kg)	8.67	(-)
TCE	130	(L/kg)	3.34	(-)
DCE	125	(L/kg)	3.25	(-)
VC	30	(L/kg)	1.53	(-)
ETH	302	(L/kg)	6.44	(-)
Common R (used in model)* =			**3.34**	

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	1.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	4	(yr)
Modeled Area Width*	120	(ft)
Modeled Area Length*	220	(ft)
Zone 1 Length*	220	(ft)
Zone 2 Length*	0	(ft)

L, W

Zone 2=

6. SOURCE DATA

TYPE: Decaying Single Planar

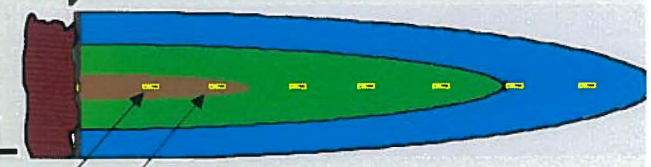
Source Options

Source Thickness in Sat. Zone* 5 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.28	0.1
TCE	.02	0.13
DCE	.1	0.2
VC	.011	0.15
ETH		0.12

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)	0	60	120	170							
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Deep Overburden - Run 1 - MNA

Start Here →

- ○ PCE
- ◉ TCE
- ○ DCE
- ○ VC
- ○ ETH

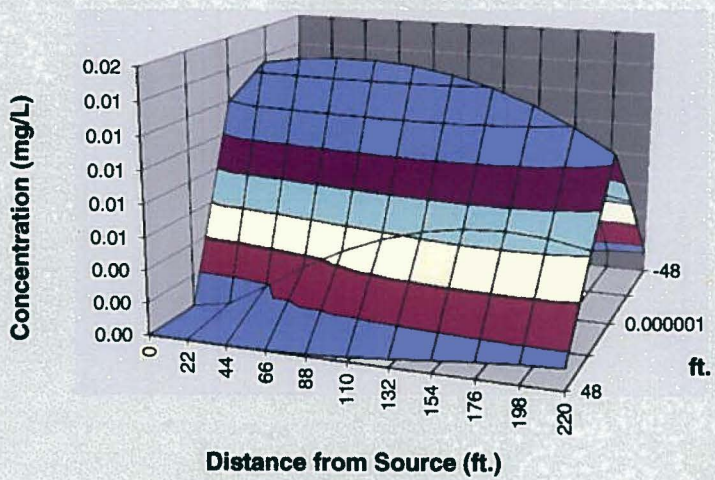
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft)	0	22	44	66	88	110	132	154	176	198	220
48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
24	0.000	0.000	0.002	0.003	0.005	0.006	0.006	0.007	0.007	0.007	0.006
0	0.012	0.015	0.015	0.015	0.015	0.015	0.015	0.014	0.013	0.012	0.011
-24	0.000	0.000	0.002	0.003	0.005	0.006	0.006	0.007	0.007	0.007	0.006
-48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
MASS RATE (mg/day)	4.1E+0	6.4E+0	7.7E+0	9.1E+0	1.0E+1	1.1E+1	1.2E+1	1.2E+1	1.2E+1	1.1E+1	1.1E+1

Show No

Show

Time: 4 yr Target Level: 0.023 mg/L Displayed Model: Biotransformation Displayed Compound: TCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.0	(Kg)
- Plume Mass If Biotransformation/Production	0.0	(Kg)
Mass Removed	0.0	(Kg)
% Biotransformed =	-105.0 %	
% Change in Mass Rate =	-158.5 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	Can't Calc.	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.		
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Deep Overburden Run 1 - MNA

Start Here → ○ PCE ○ TCE ○ DCE ◉ VC ○ ETH

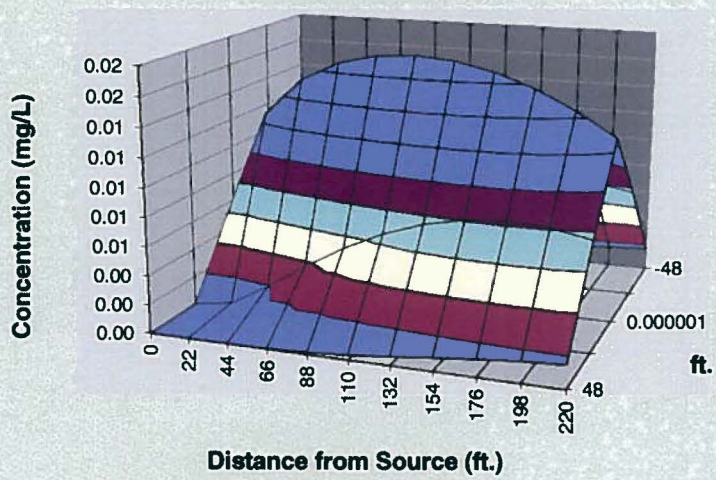
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	22	44	66	88	110	132	154	176	198	220
48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.002
24	0.000	0.000	0.002	0.004	0.005	0.007	0.007	0.008	0.008	0.008	0.008
0	0.006	0.013	0.015	0.017	0.017	0.017	0.017	0.017	0.016	0.014	0.013
-24	0.000	0.000	0.002	0.004	0.005	0.007	0.007	0.008	0.008	0.008	0.008
-48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.002
MASS RATE (mg/day)	2.1E+0	5.6E+0	7.9E+0	9.9E+0	1.2E+1	1.3E+1	1.4E+1	1.4E+1	1.4E+1	1.4E+1	1.3E+1

Show No

Show

Time: 4 yr Target Level: 0.018 mg/L Displayed Model: Biotransformation Displayed Compound: VC



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.0	(Kg)
- Plume Mass If Biotransformation/Production	0.0	(Kg)
Mass Removed	0.0	(Kg)
% Biotransformed =	-341.7 %	
% Change in Mass Rate =	-517.1 %	(source to pdos)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	Can't Calc.	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.		
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Shallow Bedrock (Calibration)

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Shallow Bedrock
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ or
0.02 ↗ 2. Calculate by filling in gray cells. Press Enter, then C

(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	271.8	(ft/yr)
or			
Hydraulic Conductivity	K	2.5E-04	(cm/sec)
Hydraulic Gradient	i	0.0211	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.739	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

	λ (1/yr)	half-life (yrs)	Yield
Zone 1			
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45
Zone 2			
PCE → TCE	0.000		
TCE → DCE	0.000		
DCE → VC	0.000		
VC → ETH	0.000		

0.2
0.83
0.74
0.20

λ HELP

5. GENERAL

Simulation Time*	15	(yr)
Modeled Area Width*	120	(ft)
Modeled Area Length*	220	(ft)
Zone 1 Length*	220	(ft)
Zone 2 Length*	0	(ft)

L, W

Zone 2=

6. SOURCE DATA

TYPE: Decaying Single Planar

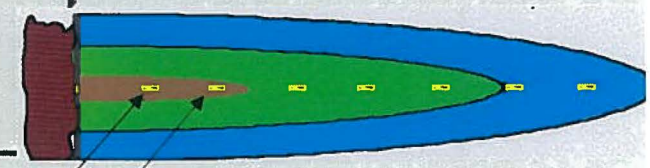
Source Options

Source Thickness in Sat. Zone* 22 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	25.0	0.09
TCE		0.03
DCE		0.03
VC		0.09
ETH		0.09

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)	11.0	.6	.091	.12	.27						
TCE Conc. (mg/L)	.12	.036	.002	.009	.007						
DCE Conc. (mg/L)	.009	.061	.012	.028	.02						
VC Conc. (mg/L)	0.0	.001		.011	.003						
ETH Conc. (mg/L)											
Distance from Source (ft)	7	52	107	147	167						
Date Data Collected	2006										

8. CHOOSE TYPE OF OUTPUT TO SEE:

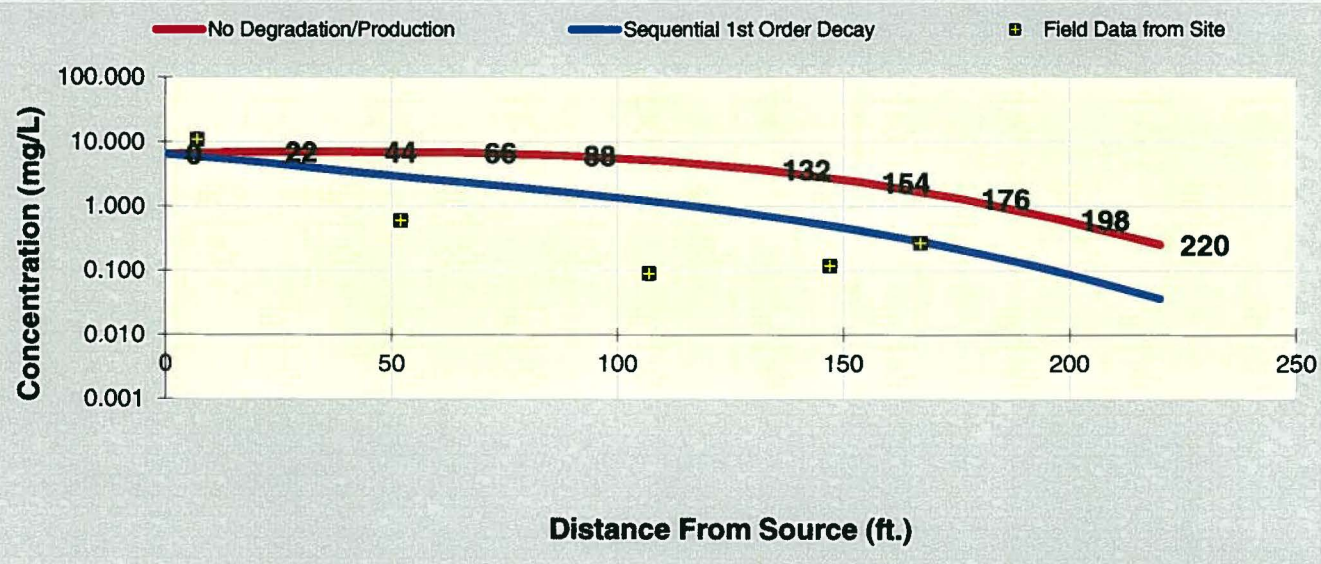
RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Shallow Bedrock (Calibration)

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

PCE	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	6.481	7.020	6.950	6.740	6.112	5.024	3.665	2.339	1.293	0.615	0.250
Biotransformation	6.4810	4.689	3.244	2.326	1.656	1.129	0.715	0.410	0.209	0.094	0.036

	Monitoring Well Locations (ft)										
	7	52	107	147	167						
Field Data from Site	11.000	0.600	0.091	0.120	0.270						



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

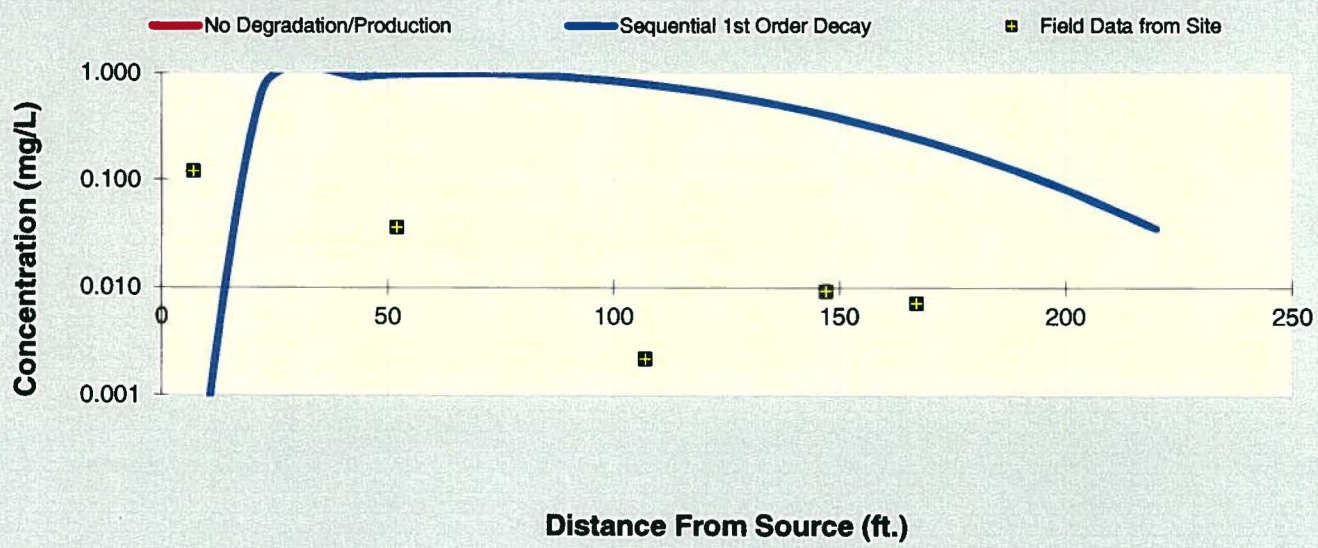
To All

To Array

Shallow Bedrock Calibration

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

TCE	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.645	0.915	0.988	0.921	0.755	0.544	0.342	0.187	0.088	0.035
	Monitoring Well Locations (ft)										
	7	52	107	147	167						
Field Data from Site	0.120	0.036	0.002	0.009	0.007						



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

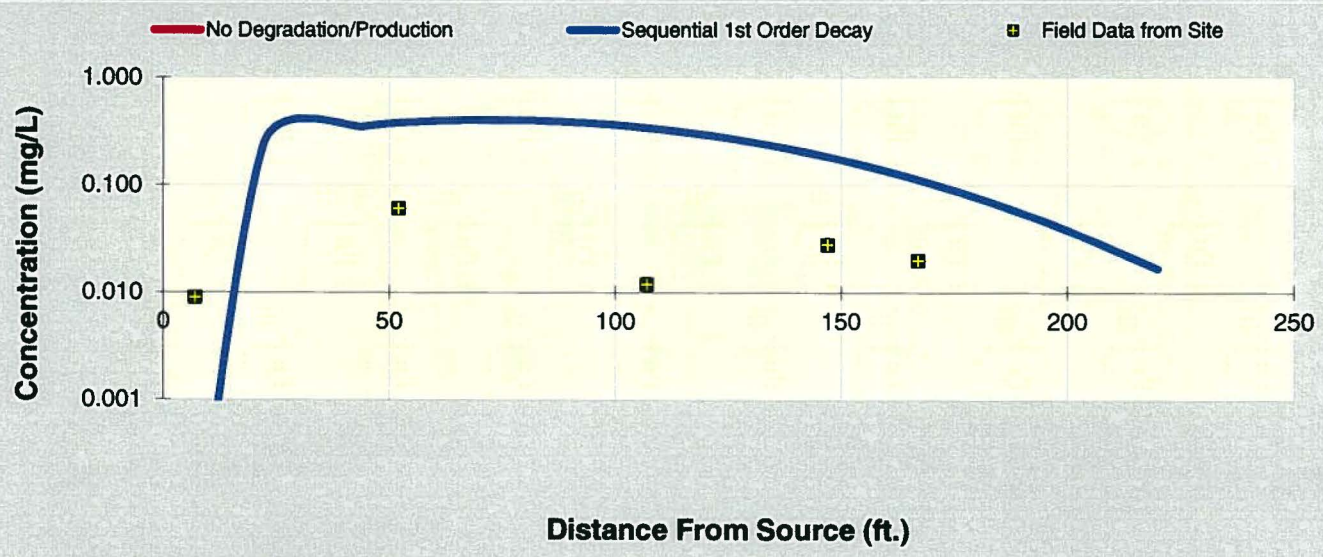
To All

To Array

Shallow Bedrock (Calibration)

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

DCE	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.228	0.347	0.398	0.388	0.329	0.243	0.156	0.086	0.041	0.017
	Monitoring Well Locations (ft)										
	7	52	107	147	167						
Field Data from Site	0.009	0.061	0.012	0.028	0.020						



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

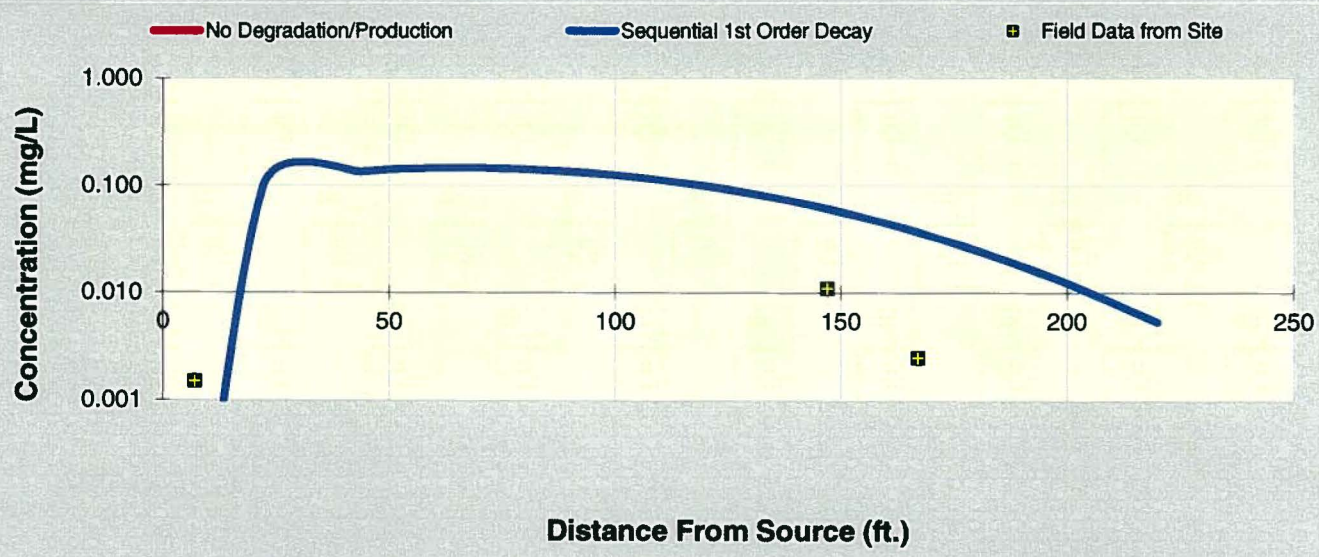
To All

To Array

Shallow Bedrock (Calibration)

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.094	0.134	0.145	0.136	0.112	0.081	0.051	0.028	0.013	0.005
	Monitoring Well Locations (ft)										
	7	52	107	147	167						
Field Data from Site	0.002	0.001		0.011	0.003						



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Shallow Bedrock - Run 1 (MNA)

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Shallow Bedrock
Run Name

Data Input Instructions:
115 → 1. Enter value directly....or
↑ or 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	271.8	(ft/yr)
or			
Hydraulic Conductivity	K	2.5E-04	(cm/sec)
Hydraulic Gradient	i	0.0211	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.739	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

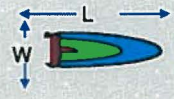
Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	60	(yr)
Modeled Area Width*	120	(ft)
Modeled Area Length*	220	(ft)
Zone 1 Length*	220	(ft)
Zone 2 Length*	0	(ft)



Zone 2=

6. SOURCE DATA TYPE: Decaying Single Planar

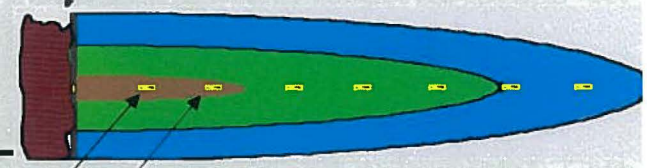
Source Options

Source Thickness in Sat. Zone* 22 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	11.0	0.09
TCE	.12	0.03
DCE	.009	0.03
VC	.002	0.09
ETH		0.09

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)											
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Shallow Bedrock Run 1 (MNA

Start Here → ◉ PCE ○ TCE ○ DCE ○ VC ○ ETH

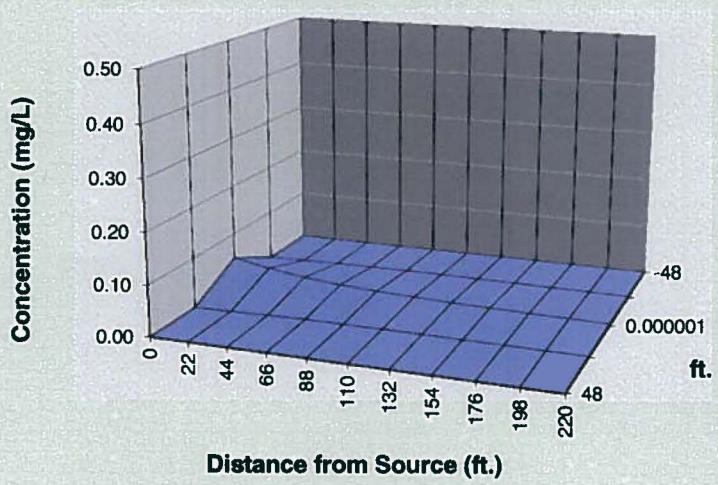
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	22	44	66	88	110	132	154	176	198	220
48	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
24	0.000	0.001	0.003	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.002
0	0.050	0.036	0.025	0.019	0.015	0.011	0.009	0.007	0.006	0.005	0.004
-24	0.000	0.001	0.003	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.002
-48	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
MASS RATE (mg/day)	9.2E+0	8.5E+0	7.0E+0	6.1E+0	5.3E+0	4.6E+0	4.0E+0	3.4E+0	3.0E+0	2.6E+0	2.2E+0

Show No

Show

Time: 60 yr Target Level: 0.500 mg/L Displayed Model: Biotransformation Displayed Compound: PCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.7	(Kg)
- Plume Mass If Biotransformation/Production	0.1	(Kg)
Mass Removed	0.6	(Kg)
% Biotransformed =	+92.0%	
% Change in Mass Rate =	75.7 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	0.02	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Shallow Bedrock - Run 1 (MNA)

Start Here → ○ PCE ◉ TCE ○ DCE ○ VC ○ ETH

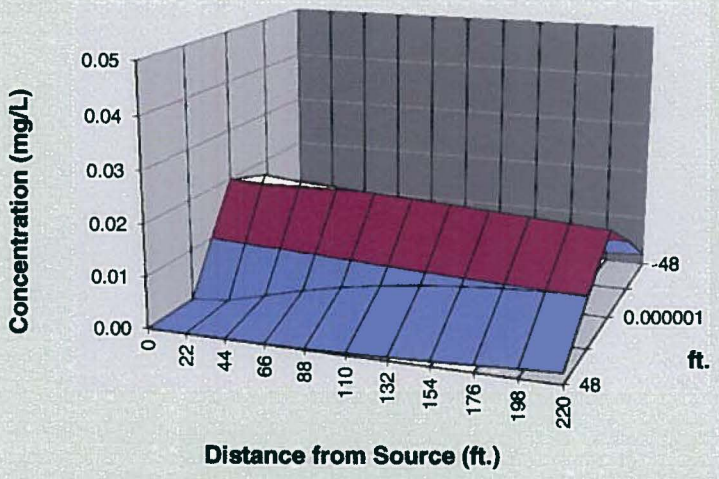
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	22	44	66	88	110	132	154	176	198	220
48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.002
24	0.000	0.001	0.003	0.004	0.006	0.007	0.008	0.009	0.010	0.010	0.010
0	0.020	0.022	0.021	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.017
-24	0.000	0.001	0.003	0.004	0.006	0.007	0.008	0.009	0.010	0.010	0.010
-48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002	0.002
MASS RATE (mg/day)	3.7E+0	5.1E+0	5.8E+0	6.5E+0	7.2E+0	7.7E+0	8.2E+0	8.6E+0	8.9E+0	9.1E+0	9.3E+0

Show No

Show

Time: 60 yr Target Level: 0.023 mg/L Displayed Model: Biotransformation Displayed Compound: TCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.1	(Kg)
- Plume Mass If Biotransformation/Production	0.1	(Kg)
Mass Removed	0.0	(Kg)
% Biotransformed =	-22.7 %	
% Change in Mass Rate =	-151.8 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	Can't Calc.	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.		
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Shallow Bedrock Run 2 - 70% Reduction & MNA

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Shallow Bedrock
Run Name

Data Input Instructions:
115 → 1. Enter value directly....or
↑ or 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	271.8	(ft/yr)
or			
Hydraulic Conductivity	K	2.5E-04	(cm/sec)
Hydraulic Gradient	i	0.0211	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.739	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R
or

			R	
Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	41	(yr)
Modeled Area Width*	120	(ft)
Modeled Area Length*	220	(ft)
Zone 1 Length*	220	(ft)
Zone 2 Length*	0	(ft)

Zone 2=

6. SOURCE DATA

TYPE: Decaying Single Planar

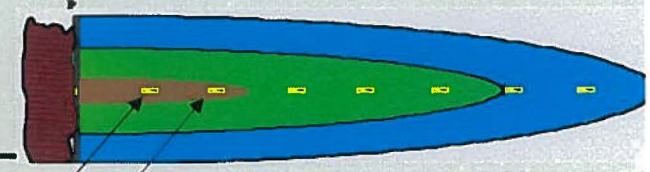
Source Options

Source Thickness in Sat. Zone* 22 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	3.3	0.09
TCE	.036	0.03
DCE	.003	0.03
VC	.0	0.09
ETH		0.09

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)											
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Shallow Bedrock Run 2 - 70% Reduction & MNA

Start Here → ◉ PCE ○ TCE ○ DCE ○ VC ○ ETH

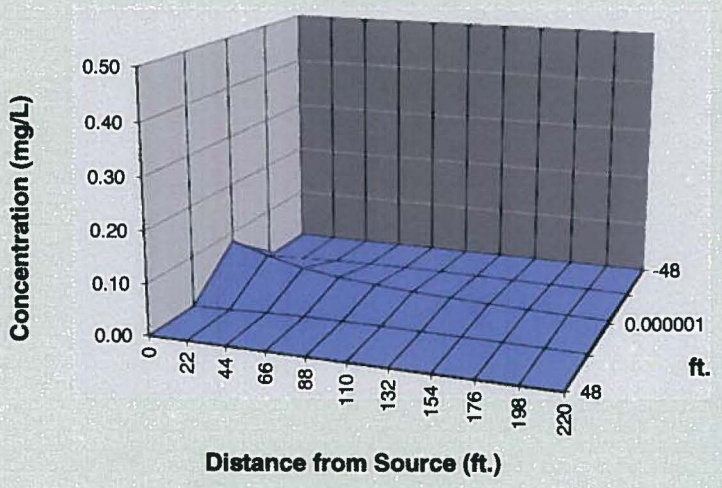
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	22	44	66	88	110	132	154	176	198	220
48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
24	0.000	0.002	0.005	0.007	0.007	0.007	0.007	0.006	0.005	0.005	0.004
0	0.082	0.060	0.042	0.031	0.024	0.019	0.015	0.012	0.010	0.008	0.007
-24	0.000	0.002	0.005	0.007	0.007	0.007	0.007	0.006	0.005	0.005	0.004
-48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
MASS RATE (mg/day)	1.5E+1	1.4E+1	1.2E+1	1.0E+1	8.7E+0	7.6E+0	6.6E+0	5.7E+0	4.9E+0	4.2E+0	3.6E+0

Show No

Show

Time: 41 yr Target Level: 0.500 mg/L Displayed Model: Biotransformation Displayed Compound: PCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.9	(Kg)
- Plume Mass If Biotransformation/Production	0.1	(Kg)
Mass Removed	0.8	(Kg)
% Biotransformed =	+90.0%	
% Change in Mass Rate =	76.4 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	Can't Calc.	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.		
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Shallow Bedrock Run 2 - 70% Reduction & MNA

Start Here → PCE / TCE / DCE / VC / ETH

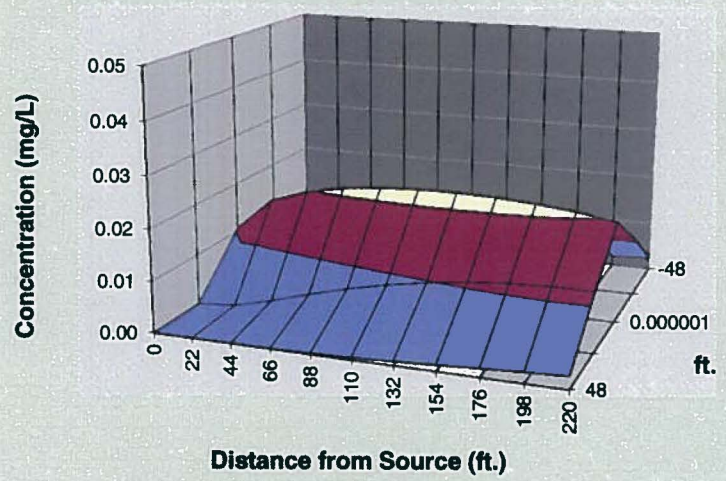
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	22	44	66	88	110	132	154	176	198	220
48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002	0.002
24	0.000	0.001	0.002	0.005	0.007	0.008	0.010	0.011	0.011	0.012	0.012
0	0.011	0.017	0.020	0.021	0.022	0.022	0.022	0.022	0.022	0.021	0.020
-24	0.000	0.001	0.002	0.005	0.007	0.008	0.010	0.011	0.011	0.012	0.012
-48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002	0.002
MASS RATE (mg/day)	2.0E+0	4.1E+0	5.5E+0	6.8E+0	7.9E+0	8.9E+0	9.7E+0	1.0E+1	1.1E+1	1.1E+1	1.1E+1

Show No

Show

Time: 41 yr Target Level: 0.023 mg/L Displayed Model: Biotransformation Displayed Compound: TCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.0	(Kg)
- Plume Mass If Biotransformation/Production	0.1	(Kg)
Mass Removed	-0.1	(Kg)
% Biotransformed =	-166.1 %	
% Change in Mass Rate =	-443.9 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	Can't Calc.	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.		
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Shallow Bedrock Run 3

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Shallow Bedrock
Run Name

Data Input Instructions:

115 1. Enter value directly....or
↑ or 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	271.8	(ft/yr)
or			
Hydraulic Conductivity	K	2.5E-04	(cm/sec)
Hydraulic Gradient	i	0.0211	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.739	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

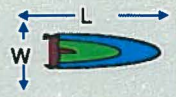
Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	27	(yr)
Modeled Area Width*	120	(ft)
Modeled Area Length*	220	(ft)
Zone 1 Length*	220	(ft)
Zone 2 Length*	0	(ft)



Zone 2=

6. SOURCE DATA TYPE: Decaying Single Planar

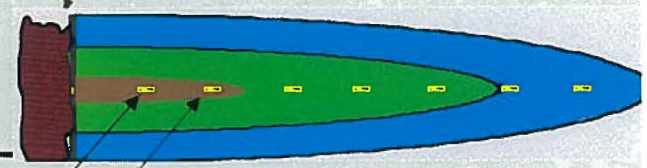
Source Options

Source Thickness in Sat. Zone* 22 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	1.1	0.09
TCE	.012	0.03
DCE	.001	0.03
VC	.0	0.09
ETH		0.09

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)											
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Shallow Bedrock Run 3

Start Here → PCE / TCE / DCE / VC / ETH

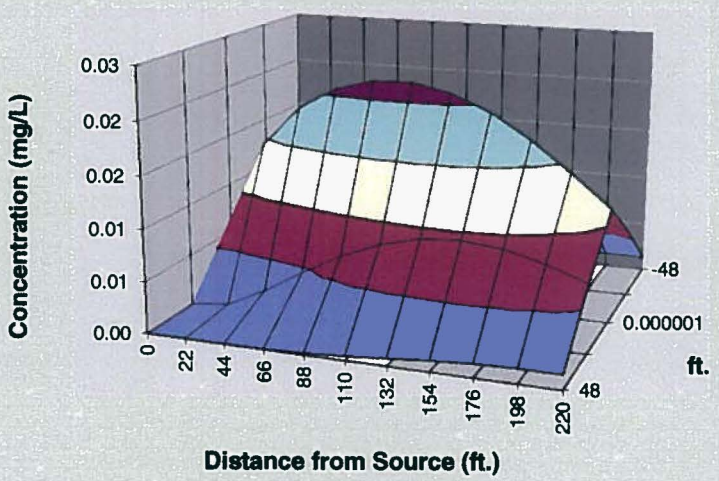
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	22	44	66	88	110	132	154	176	198	220
48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
24	0.000	0.000	0.002	0.005	0.007	0.008	0.009	0.009	0.009	0.008	0.007
0	0.005	0.014	0.018	0.021	0.022	0.022	0.021	0.019	0.017	0.014	0.011
-24	0.000	0.000	0.002	0.005	0.007	0.008	0.009	0.009	0.009	0.008	0.007
-48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
MASS RATE (mg/day)	9.9E-1	3.4E+0	5.1E+0	6.6E+0	7.8E+0	8.6E+0	9.0E+0	8.9E+0	8.3E+0	7.3E+0	6.0E+0

Show No

Show

Time: 27 yr Target Level: 0.023 mg/L Displayed Model: Biotransformation Displayed Compound: TCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.0	(Kg)
- Plume Mass If Biotransformation/Production	0.1	(Kg)
Mass Removed	-0.1	(Kg)
% Biotransformed =	-441.6 %	
% Change in Mass Rate =	-507.3 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	Can't Calc.	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.		
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Shallow Bedrock Run 3

Start Here → ◉ PCE ○ TCE ○ DCE ○ VC ○ ETH

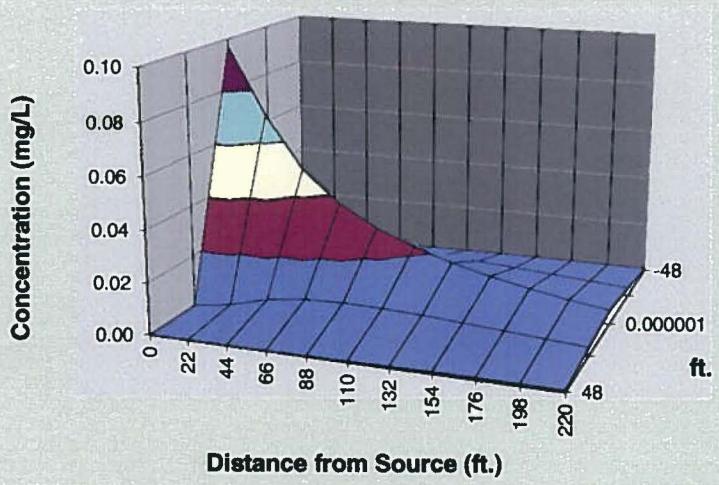
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	22	44	66	88	110	132	154	176	198	220
48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
24	0.000	0.002	0.006	0.008	0.009	0.008	0.007	0.007	0.005	0.004	0.003
0	0.097	0.070	0.049	0.037	0.028	0.022	0.017	0.013	0.010	0.008	0.006
-24	0.000	0.002	0.006	0.008	0.009	0.008	0.007	0.007	0.005	0.004	0.003
-48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
MASS RATE (mg/day)	1.8E+1	1.7E+1	1.4E+1	1.2E+1	1.0E+1	8.7E+0	7.4E+0	6.2E+0	5.1E+0	4.0E+0	3.0E+0

Show No

Show

Time: 27 yr Target Level: 0.500 mg/L Displayed Model: Biotransformation Displayed Compound: PCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.6	(Kg)
- Plume Mass If Biotransformation/Production	0.1	(Kg)
Mass Removed	0.5	(Kg)
% Biotransformed =	+83.6%	
% Change in Mass Rate =	83.4 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	Can't Calc.	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.		
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Deep Bedrock - Calibration

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Deep Bedrock
Run Name

Data Input Instructions:
115 → 1. Enter value directly....or
↑ or
0.02 → 2. Calculate by filling in gray cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	31.5	(ft/yr)
or			
Hydraulic Conductivity	K	3.1E-05	(cm/sec)
Hydraulic Gradient	i	0.0199	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.099	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

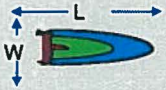
Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	15	(yr)
Modeled Area Width*	100	(ft)
Modeled Area Length*	200	(ft)
Zone 1 Length*	200	(ft)
Zone 2 Length*	0	(ft)



Zone 2=

6. SOURCE DATA TYPE: Decaying Single Planar

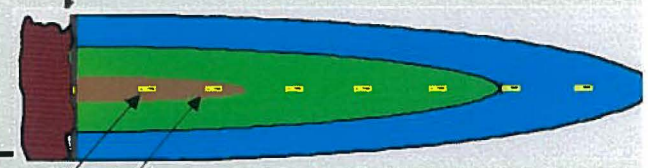
Source Options

Source Thickness in Sat. Zone* 20 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	4.0	0.016
TCE		0.016
DCE		0.016
VC		0.016
ETH		0.016

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)	2.8	.015	.012	.003	.004	.22					
TCE Conc. (mg/L)	.18	.001	.001	.0	.0	.005					
DCE Conc. (mg/L)	.027	.0	.002	.0	.002	.015					
VC Conc. (mg/L)	0.0	.0	.0	.0	.001	.003					
ETH Conc. (mg/L)											
Distance from Source (ft)	0	20	30	90	115	150					
Date Data Collected	2006										

8. CHOOSE TYPE OF OUTPUT TO SEE:

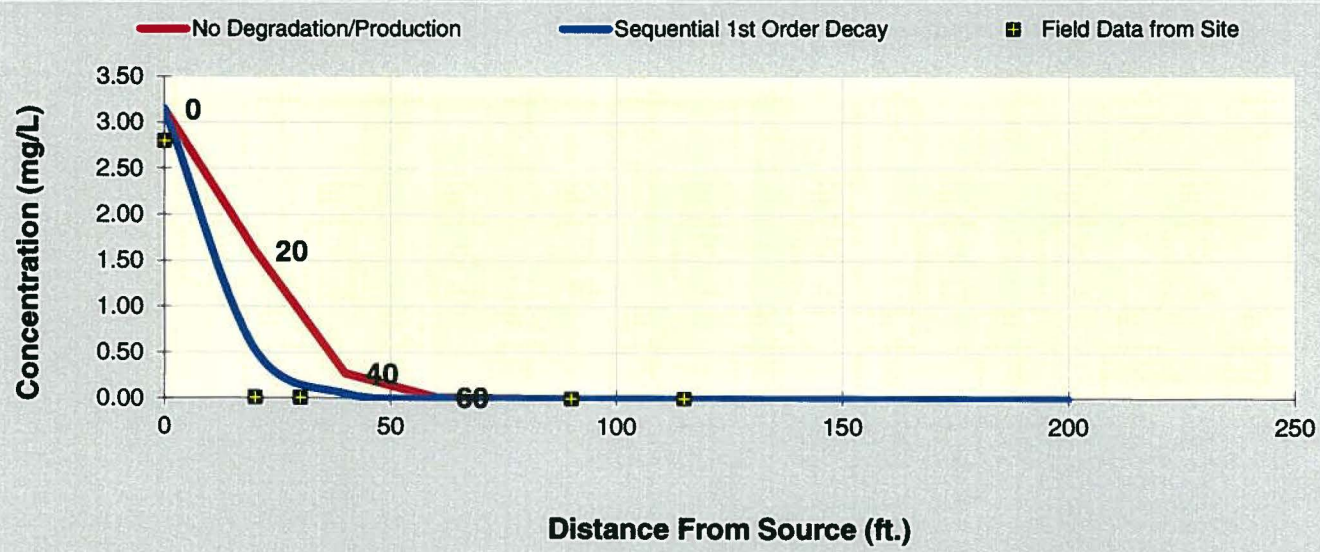
RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Deep Bedrock Calibration

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

PCE	Distance from Source (ft)										
	0	20	40	60	80	100	120	140	160	180	200
No Degradation	3.147	1.612	0.273	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	3.1465	0.534	0.054	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Monitoring Well Locations (ft)					
	0	20	30	90	115	150
Field Data from Site	2.800	0.015	0.012	0.003	0.004	0.220



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Deep Bedrock Calibration

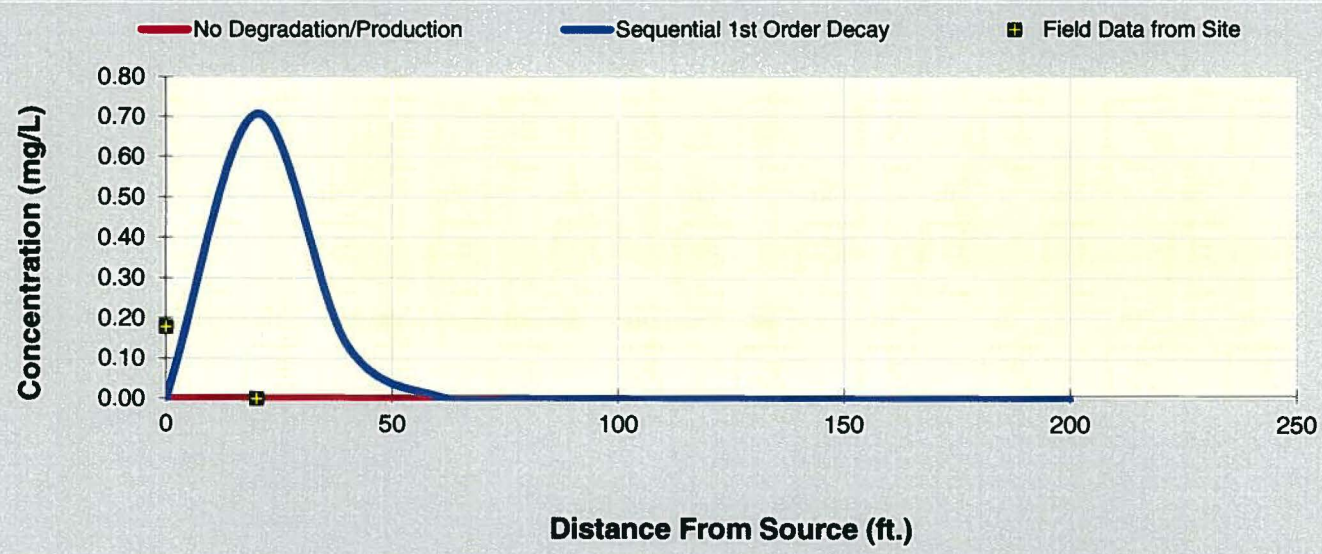
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

TCE	0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.707	0.135	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	20	30	90	115	150					
Field Data from Site	0.180	0.001	0.001	0.000	0.000	0.005					



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

15.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Deep Bedrock Calibration

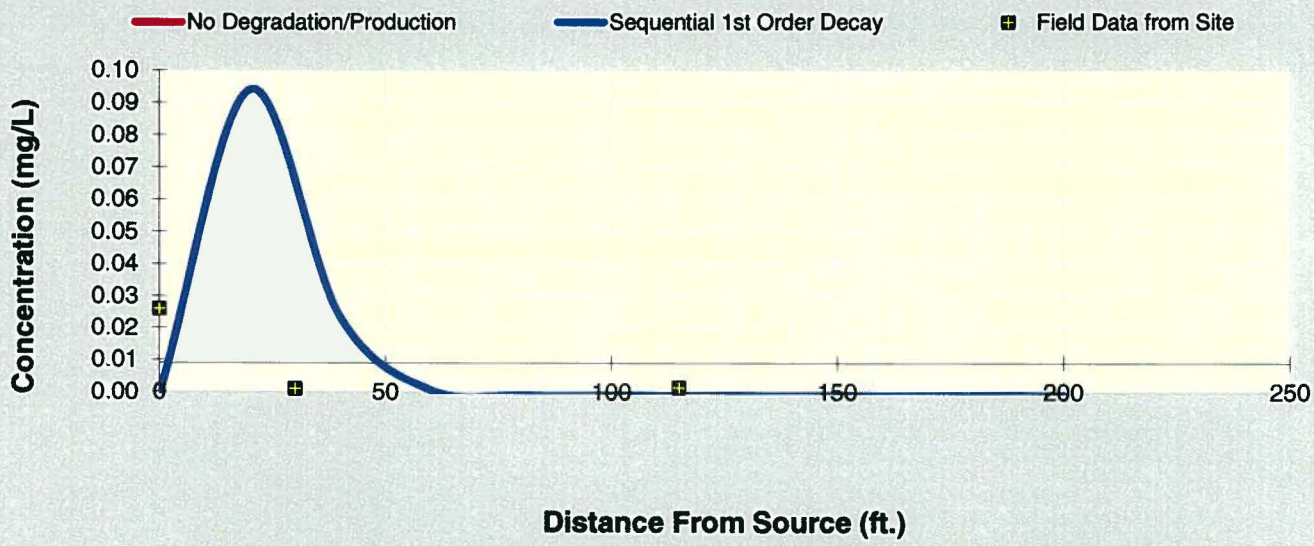
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.095	0.024	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	20	30	90	115	150					
Field Data from Site	0.027	0.000	0.002	0.000	0.002	0.015					



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

To All

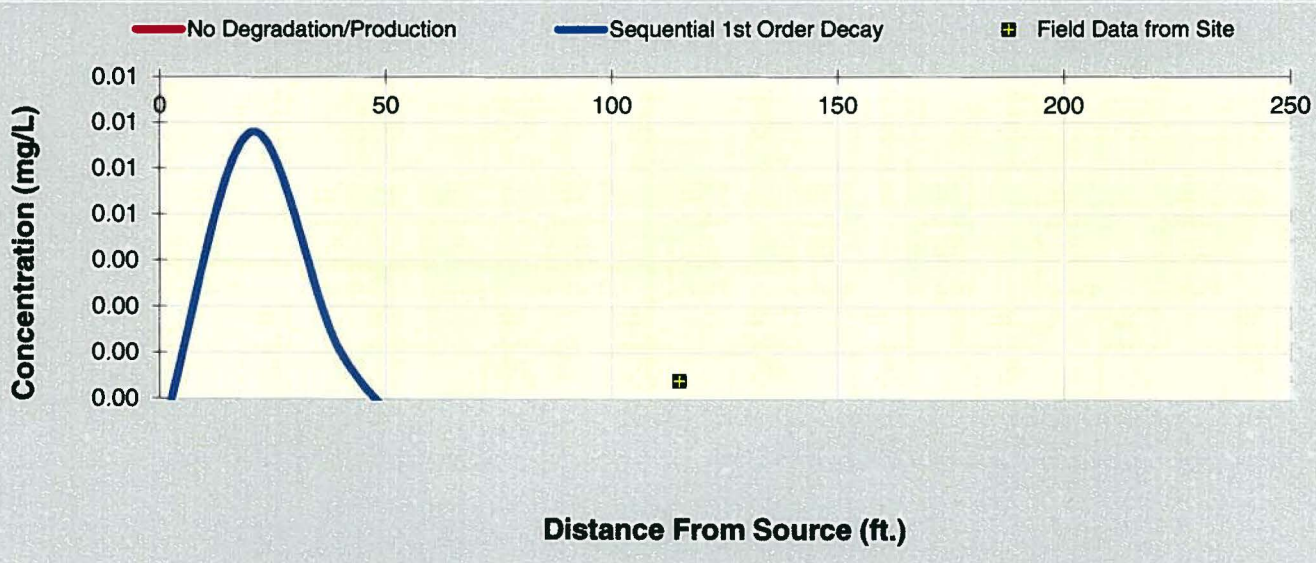
To Array

Deep Bedrock Calibration

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.007	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Monitoring Well Locations (ft)										
	0	20	30	90	115	150					
Field Data from Site	0.000			0.000	0.001	0.003					



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
15.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Deep Bedrock - Run 1 (MNA)

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Deep Bedrock
Run Name

Data Input Instructions:
115 → 1. Enter value directly....or
↑ or
0.02 → 2. Calculate by filling in gray cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	31.5	(ft/yr)
or			
Hydraulic Conductivity	K	3.1E-05	(cm/sec)
Hydraulic Gradient	i	0.0199	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.099	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R
or

Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

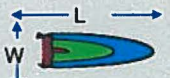
Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	256	(yr)
Modeled Area Width*	100	(ft)
Modeled Area Length*	200	(ft)
Zone 1 Length*	200	(ft)
Zone 2 Length*	0	(ft)



Zone 2=

6. SOURCE DATA TYPE: Decaying Single Planar

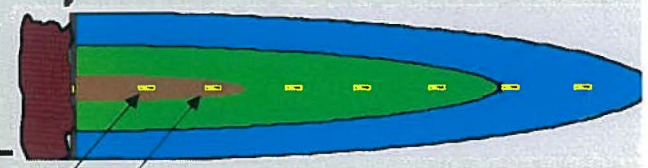
Source Options

Source Thickness in Sat. Zone* 20 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	2.8	0.016
TCE	.18	0.016
DCE	.027	0.016
VC	0.0	0.016
ETH		0.016

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)											
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Deep Bedrock - Run 1 (MNA)

Start Here → ◉ PCE ○ TCE ○ DCE ○ VC ○ ETH

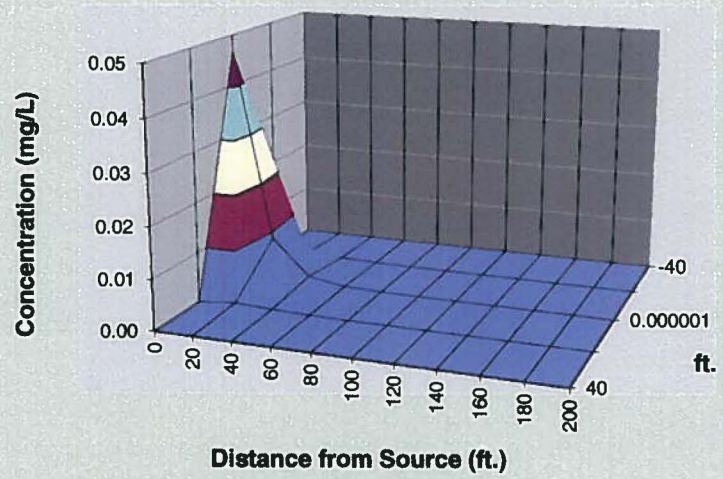
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	20	40	60	80	100	120	140	160	180	200
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.047	0.009	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	9.1E-1	2.0E-1	4.3E-2	9.3E-3	2.0E-3	4.4E-4	9.5E-5	2.1E-5	4.5E-6	9.7E-7	2.1E-7

Show No

Show

Time: 256 yr Target Level: 0.500 mg/L Displayed Model: Biotransformation Displayed Compound: PCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.5	(Kg)
- Plume Mass If Biotransformation/Production	0.0	(Kg)
Mass Removed	0.5	(Kg)
% Biotransformed =	+98.9%	
% Change in Mass Rate =	100.0 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	0.00	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Deep Bedrock - Run 1 (MNA)

Start Here → PCE / TCE / DCE / VC / ETH

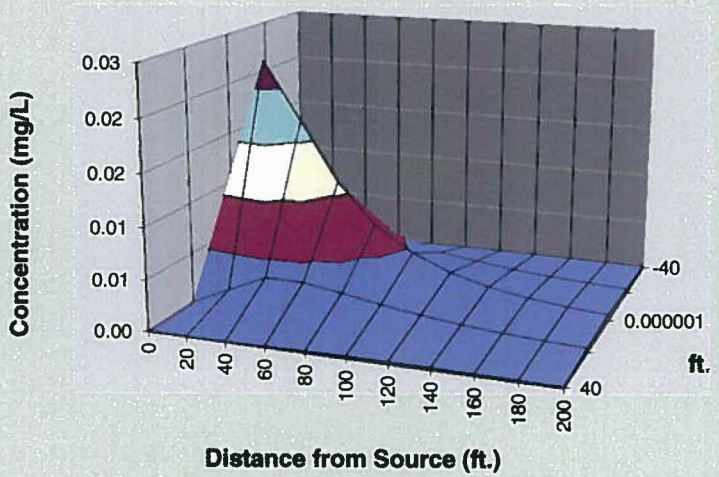
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	20	40	60	80	100	120	140	160	180	200
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.002	0.003	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.000
0	0.003	0.023	0.017	0.011	0.007	0.005	0.003	0.002	0.001	0.001	0.001
-20	0.000	0.002	0.003	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.000
-40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	5.9E-2	5.1E-1	4.6E-1	3.5E-1	2.5E-1	1.8E-1	1.3E-1	9.1E-2	6.4E-2	4.5E-2	3.1E-2

Show No

Show

Time: 256 yr Target Level: 0.500 mg/L Displayed Model: Biotransformation Displayed Compound: TCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.0	(Kg)
- Plume Mass If Biotransformation/Production	0.0	(Kg)
Mass Removed	0.0	(Kg)
% Biotransformed =	+59.6%	
% Change in Mass Rate =	46.9 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	0.00	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Deep Bedrock - Run 2 - 70% Reduction & MNA

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Deep Bedrock
Run Name

Data Input Instructions:
115 → 1. Enter value directly....or
↑ or
0.02 ↗ 2. Calculate by filling in gray cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	31.5	(ft/yr)
or			
Hydraulic Conductivity	K	3.1E-05	(cm/sec)
Hydraulic Gradient	i	0.0199	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.099	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor*			R	
or				
Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	180	(yr)
Modeled Area Width*	100	(ft)
Modeled Area Length*	200	(ft)
Zone 1 Length*	200	(ft)
Zone 2 Length*	0	(ft)

L, W

Zone 2=

6. SOURCE DATA TYPE: Decaying, Single Planar

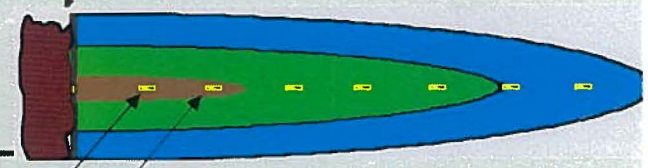
Source Options

Source Thickness in Sat. Zone* 20 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.84	0.016
TCE	.054	0.016
DCE	.008	0.016
VC	0.0	0.016
ETH		0.016

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)											
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Deep Bedrock - Run 2 - 70% Reduction & MNA

Start Here → PCE / TCE / DCE / VC / ETH

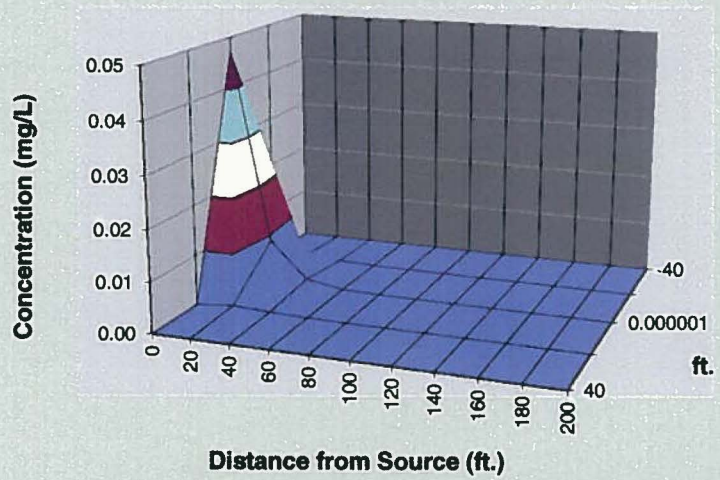
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	20	40	60	80	100	120	140	160	180	200
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.047	0.009	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	9.2E-1	2.0E-1	4.3E-2	9.4E-3	2.0E-3	4.4E-4	9.7E-5	2.1E-5	4.5E-6	9.8E-7	2.1E-7

Show No

Show

Time: 180 yr Target Level: 0.500 mg/L Displayed Model: Biotransformation Displayed Compound: PCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.2	(Kg)
- Plume Mass If Biotransformation/Production	0.0	(Kg)
Mass Removed	0.2	(Kg)
% Biotransformed =	+97.6%	
% Change in Mass Rate =	100.0 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	0.00	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Deep Bedrock - Run 2 - 70% Reduction & MNA

Start Here → ○ PCE ◉ TCE ○ DCE ○ VC ○ ETH

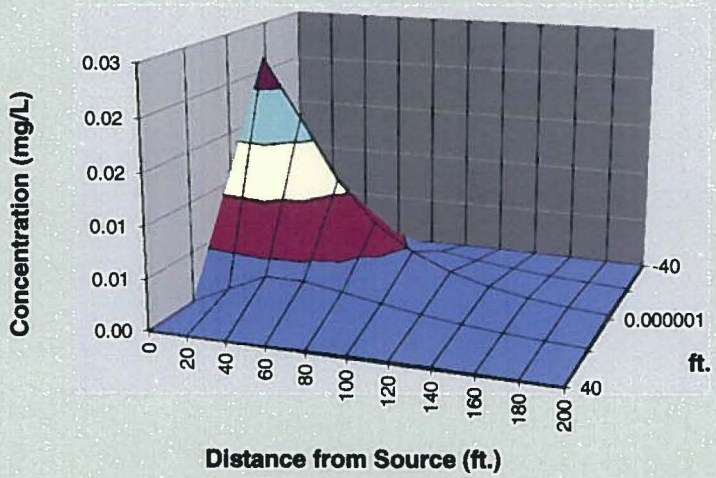
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) ↓ / Distance from Source (ft) →	0	20	40	60	80	100	120	140	160	180	200
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.002	0.003	0.003	0.003	0.002	0.002	0.001	0.001	0.000	0.000
0	0.003	0.023	0.017	0.011	0.007	0.005	0.003	0.002	0.001	0.001	0.000
-20	0.000	0.002	0.003	0.003	0.003	0.002	0.002	0.001	0.001	0.000	0.000
-40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	5.9E-2	5.2E-1	4.7E-1	3.6E-1	2.6E-1	1.8E-1	1.3E-1	8.7E-2	5.8E-2	3.8E-2	2.3E-2

Show No

Show

Time: 180 yr Target Level: 0.023 mg/L Displayed Model: Biotransformation Displayed Compound: TCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallon

Plume Mass If No Degradation	0.0	(Kg)
- Plume Mass If Biotransformation/Production	0.0	(Kg)
Mass Removed	0.0	(Kg)
% Biotransformed =	+14.2%	
% Change in Mass Rate =	60.9 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	0.00	MGal
Flow Rate of Water Through Source Area	0.000	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Bio-barrier - Deep Overburden - Run 1

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Deep Overburden
Run Name

Data Input Instructions:
115 → 1. Enter value directly....or
↑ or
0.02 ↗ 2. Calculate by filling in gray cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	222.3	(ft/yr)
or			
Hydraulic Conductivity	K	2.2E-03	(cm/sec)
Hydraulic Gradient	i	0.0198	(ft/ft)
Effective Porosity	n	0.2	(-)

2. DISPERSION

Alpha x*	11.739	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.8	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	8.67	(-)
TCE	130	(L/kg)	3.34	(-)
DCE	125	(L/kg)	3.25	(-)
VC	30	(L/kg)	1.53	(-)
ETH	302	(L/kg)	6.44	(-)
Common R (used in model)* =			3.34	

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

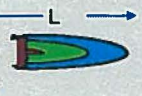
Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	1.100		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	12	(yr)
Modeled Area Width*	120	(ft)
Modeled Area Length*	220	(ft)
Zone 1 Length*	220	(ft)
Zone 2 Length*	0	(ft)



Zone 2=

6. SOURCE DATA

TYPE: Decaying
Single Planar

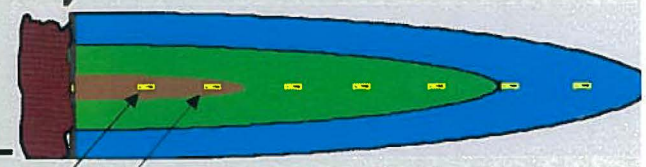
Source Options

Source Thickness in Sat. Zone* 5 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.11	0.1
TCE	.009	0.13
DCE	.01	0.2
VC	.003	0.15
ETH		0.12

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)	0	60	120	170							
Date Data Collected											

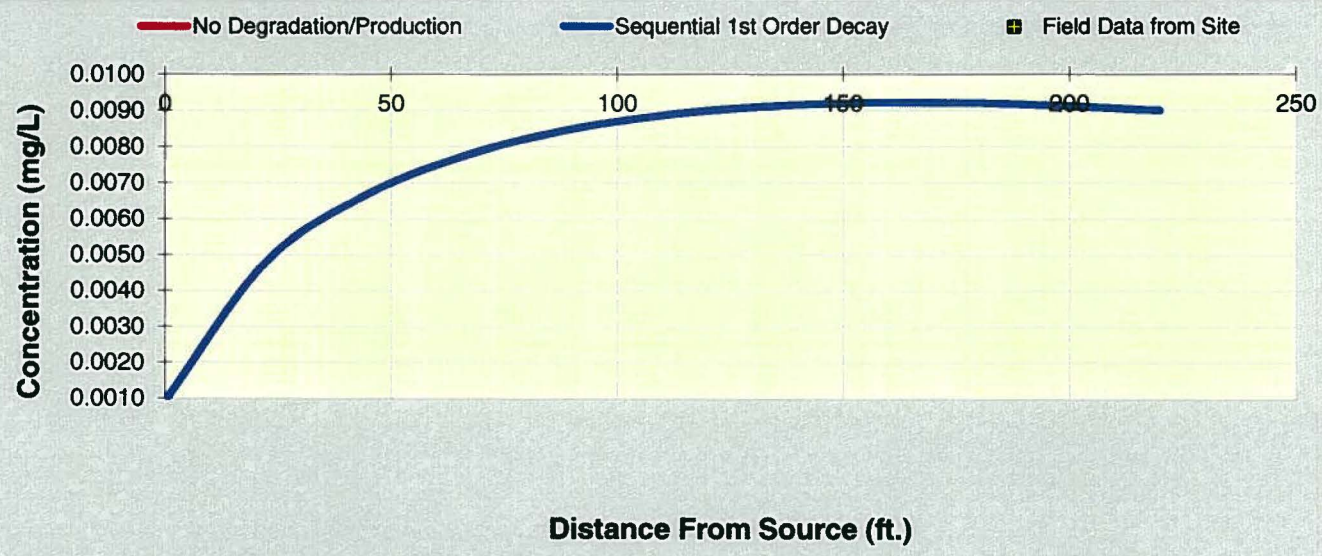
8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Bio-barrier - Deep Overburden - Run 1

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

DCE	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Biotransformation	0.0009	0.005	0.007	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.009
	Monitoring Well Locations (ft)										
	0	60	120	170							
Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:
12.0 Years
Log ⟺ Linear

Return to Input

To All

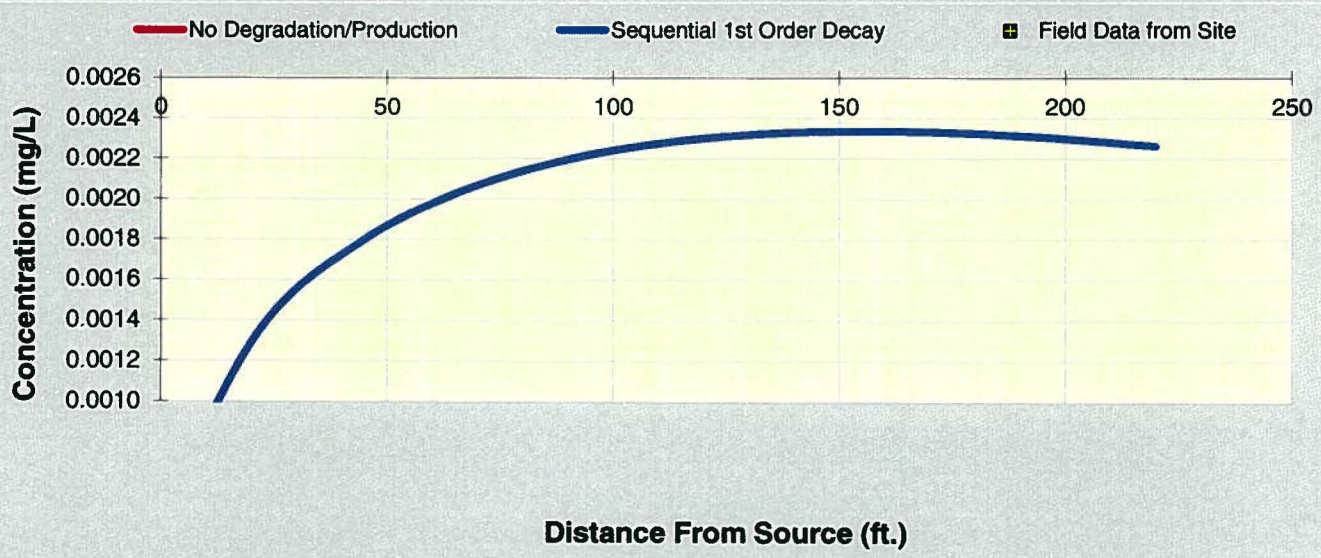
To Array

Bio-barrier - Deep Overburden - Run 1

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0004	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002

	Monitoring Well Locations (ft)										
	0	60	120	170							
Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:
12.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Biobarrier Deep Overburden - Run 2

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Deep Overburden
Run Name

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	222.3	(ft/yr)
or			
Hydraulic Conductivity	K	2.2E-03	(cm/sec)
Hydraulic Gradient	i	0.0198	(ft/ft)
Effective Porosity	n	0.2	(-)

2. DISPERSION

Alpha x*	11.739	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R

or

			R	
Soil Bulk Density, rho	1.8	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	8.67	(-)
TCE	130	(L/kg)	3.34	(-)
DCE	125	(L/kg)	3.25	(-)
VC	30	(L/kg)	1.53	(-)
ETH	302	(L/kg)	6.44	(-)
Common R (used in model)* =			**3.34**	

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	1.100		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	18	(yr)
Modeled Area Width*	120	(ft)
Modeled Area Length*	220	(ft)
Zone 1 Length*	220	(ft)
Zone 2 Length*	0	(ft)

Zone 2=

6. SOURCE DATA

TYPE: Decaying
Single Planar

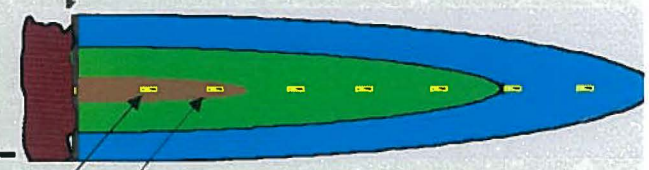
Source Options

Source Thickness in Sat. Zone* 5 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.22	0.1
TCE	.017	0.13
DCE	.02	0.2
VC	.005	0.15
ETH		0.12

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)	0	60	120	170							
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Data Input Instructions:

115 ↑ *or* 0.02

1. Enter value directly....or
2. Calculate by filling in gray cells. Press Enter, then C

(To restore formulas, hit "Restore Formulas" button)

Variable* → Data used directly in model.

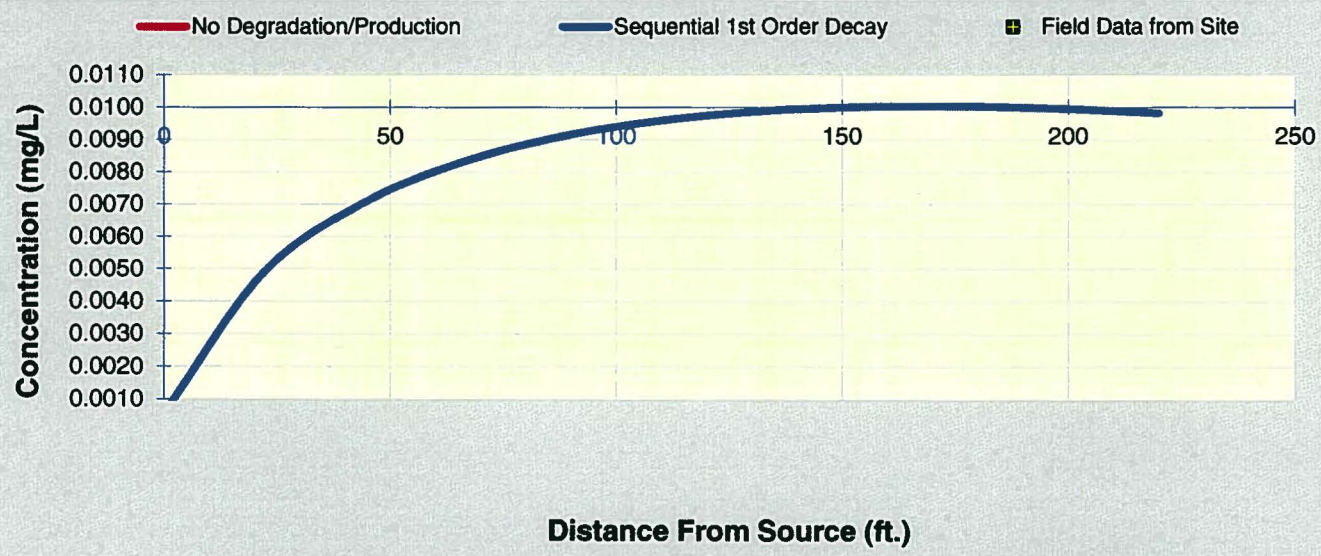
Test if Biotransformation is Occurring → Natural Attenuation

Biobarrier Deep Overburden - Run 2

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

DCE	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0005	0.005	0.007	0.008	0.009	0.010	0.010	0.010	0.010	0.010	0.010

	Monitoring Well Locations (ft)										
	0	60	120	170							
Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
18.0 Years
Log ⟺ Linear

Return to Input

To All

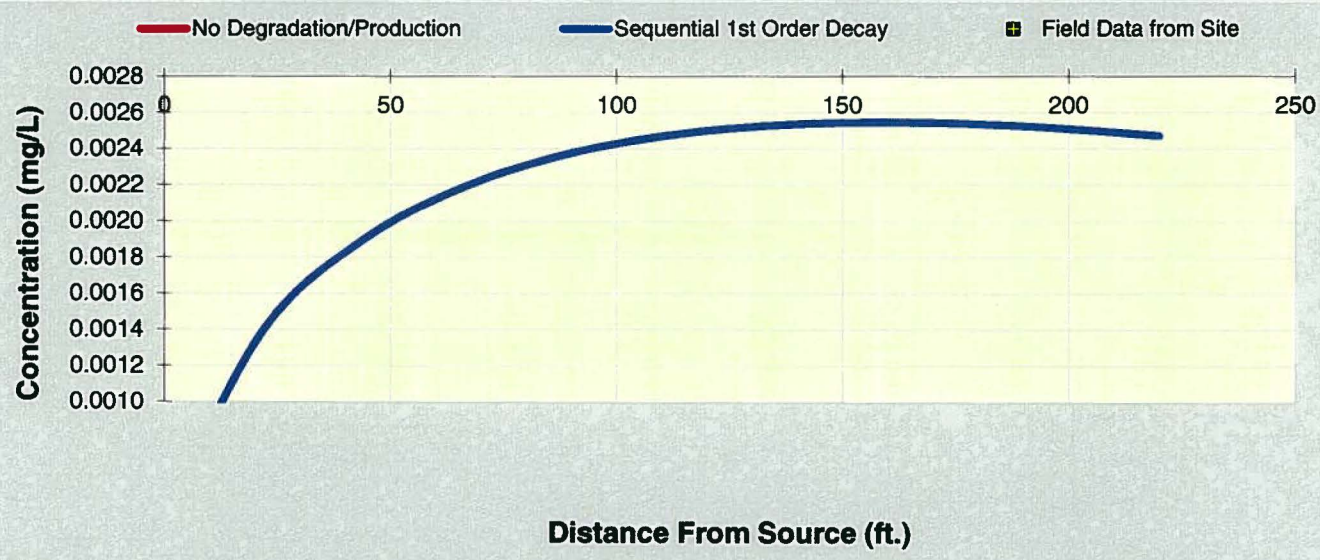
To Array

Biobarrier Deep Overburden - Run 2

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0003	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.002

	Monitoring Well Locations (ft)										
	0	60	120	170							
Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
18.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Bio-barrier - Shallow Bedrock - Run 1

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Shallow Bedrock
Run Name

Data Input Instructions:

115 ← 1. Enter value directly....or
or
0.02 ← 2. Calculate by filling in gray cells. Press Enter, then C

(To restore formulas, hit "Restore Formulas" button)

Variable* Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	271.8	(ft/yr)
or			
Hydraulic Conductivity	K	2.5E-04	(cm/sec)
Hydraulic Gradient	i	0.0211	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.739	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	1	(yr)
Modeled Area Width*	120	(ft)
Modeled Area Length*	220	(ft)
Zone 1 Length*	220	(ft)
Zone 2 Length*	0	(ft)

L, W, Zone 2=

6. SOURCE DATA

TYPE: Decaying Single Planar

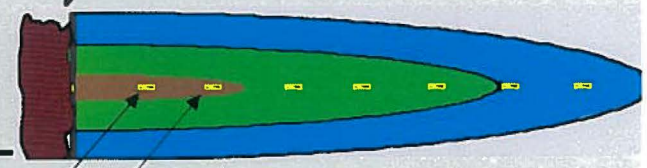
Source Options

Source Thickness in Sat. Zone* 22 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.11	0.09
TCE	.009	0.03
DCE	.01	0.03
VC	.003	0.09
ETH		0.09

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)											
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Bio-barrier - Shallow Bedrock - Run 1

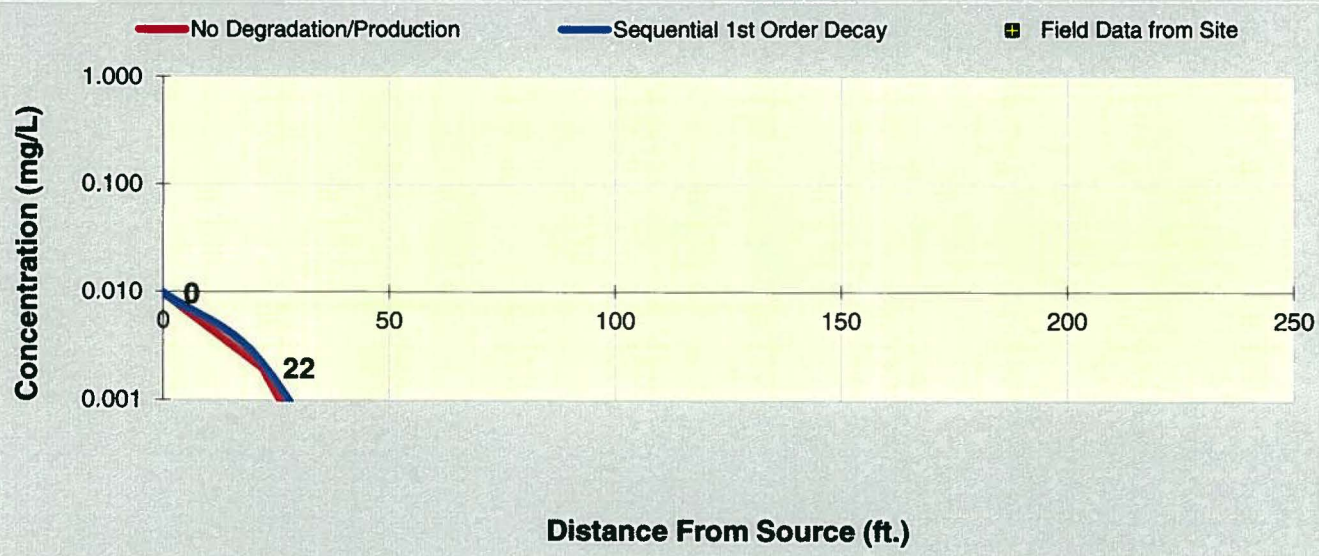
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.010	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0097	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
1.0 Years
Log ⟺ Linear

Return to Input

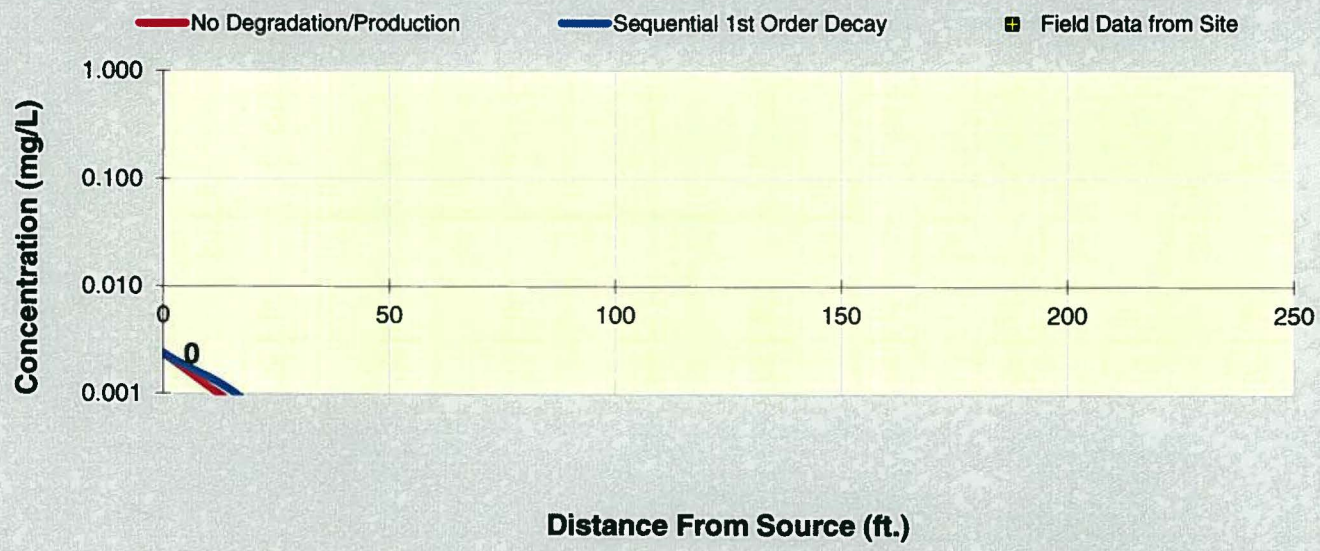
To All

To Array

Bio-barrier - Shallow Bedrock - Run 1

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0024	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Monitoring Well Locations (ft)										
Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
1.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Bio-barrier Shallow Bedrock - Run2

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Shallow Bedrock
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ or 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	271.8	(ft/yr)
or			
Hydraulic Conductivity	K	2.5E-04	(cm/sec)
Hydraulic Gradient	i	0.0211	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.739	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R
or

Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	23	(yr)
Modeled Area Width*	120	(ft)
Modeled Area Length*	220	(ft)
Zone 1 Length*	220	(ft)
Zone 2 Length*	0	(ft)

L, W

Zone 2=

6. SOURCE DATA TYPE: Decaying Single Planar

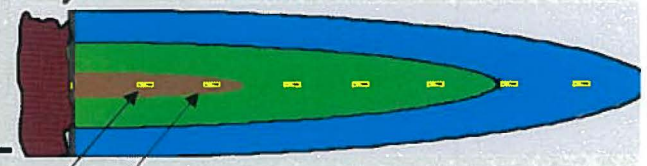
Source Options

Source Thickness in Sat. Zone* 22 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.22	0.09
TCE	.017	0.03
DCE	.02	0.03
VC	.005	0.09
ETH		0.09

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)											
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Bio-barrier Shallow Bedrock - Run 2

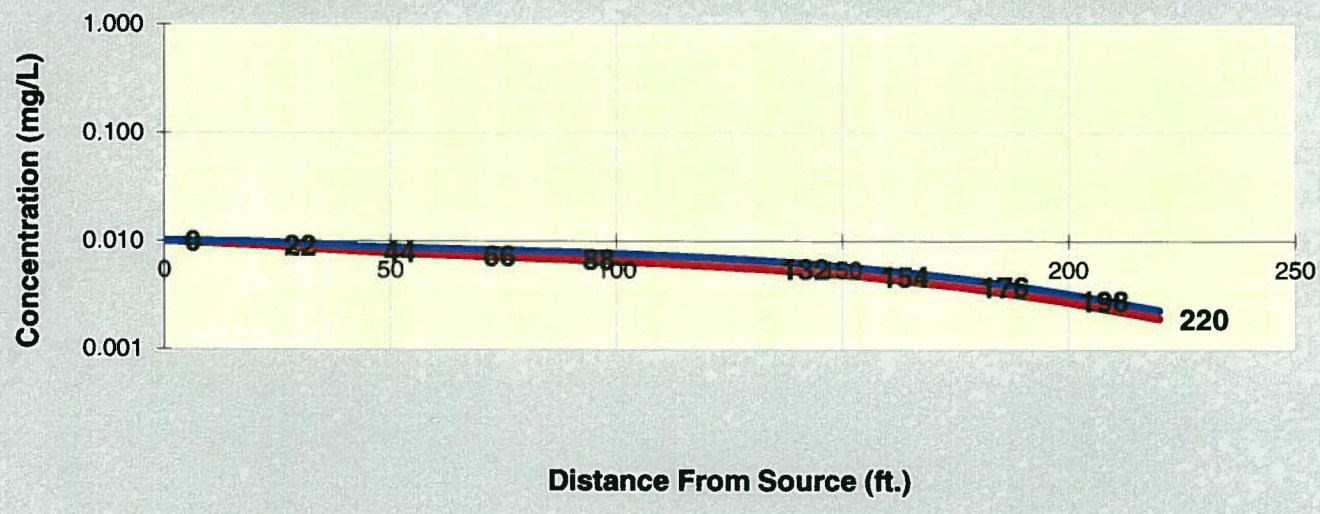
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.010	0.009	0.008	0.007	0.007	0.006	0.006	0.005	0.004	0.003	0.002
Biotransformation	0.0100	0.010	0.009	0.008	0.008	0.007	0.007	0.006	0.004	0.003	0.002

Monitoring Well Locations (ft)

Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:
23.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Bio-barrier Shallow Bedrock - Run 2

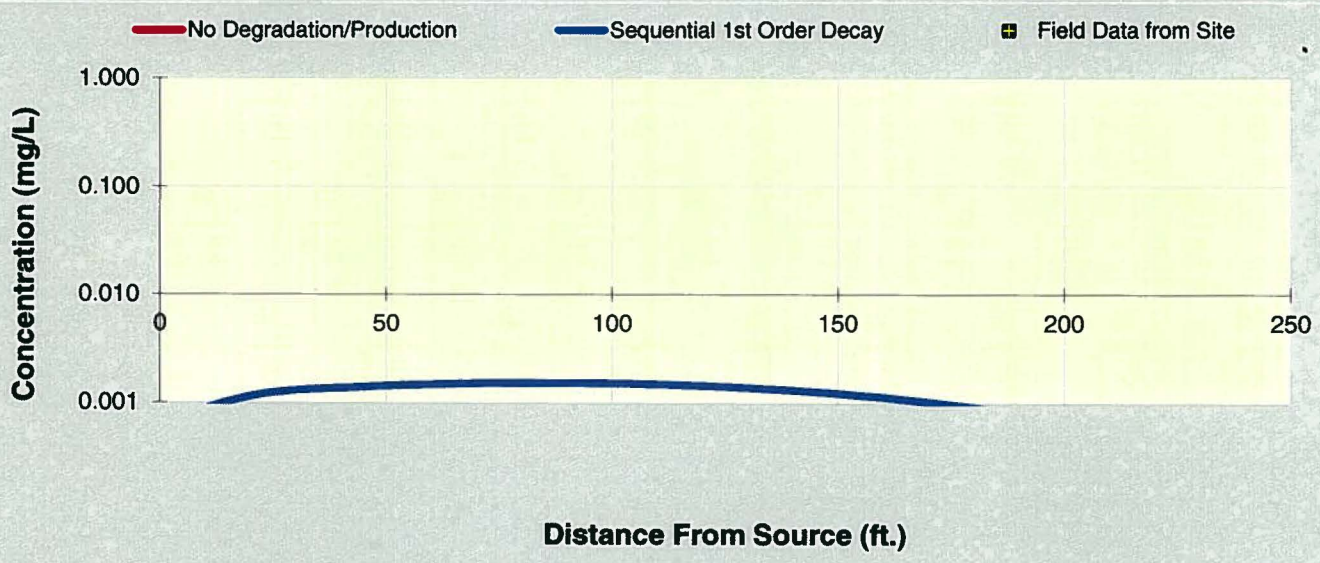
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

VC	0	22	44	66	88	110	132	154	176	198	220
No Degradation	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
Biotransformation	0.0007	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.000

Monitoring Well Locations (ft)

Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:
23.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Bio-barrier Deep Bedrock - Run 1

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Deep Bedrock
Run Name

Data Input Instructions:
115 → 1. Enter value directly....or
or
0.02 → 2. Calculate by filling in gray cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	31.5	(ft/yr)
or			
Hydraulic Conductivity	K	3.1E-05	(cm/sec)
Hydraulic Gradient	i	0.0199	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.099	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R
or

Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

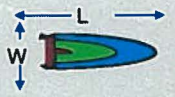
Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	1	(yr)
Modeled Area Width*	100	(ft)
Modeled Area Length*	200	(ft)
Zone 1 Length*	200	(ft)
Zone 2 Length*	0	(ft)



Zone 2=

6. SOURCE DATA TYPE: Decaying Single Planar

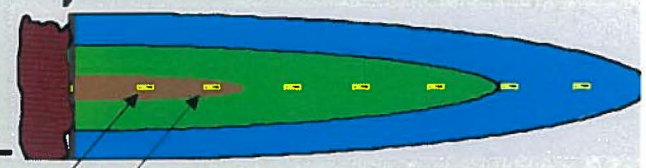
Source Options

Source Thickness in Sat. Zone* 20 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.11	0.016
TCE	.009	0.016
DCE	.01	0.016
VC	0.0	0.016
ETH		0.016

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)											
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Bio-barrier Deep Bedrock - Run 1

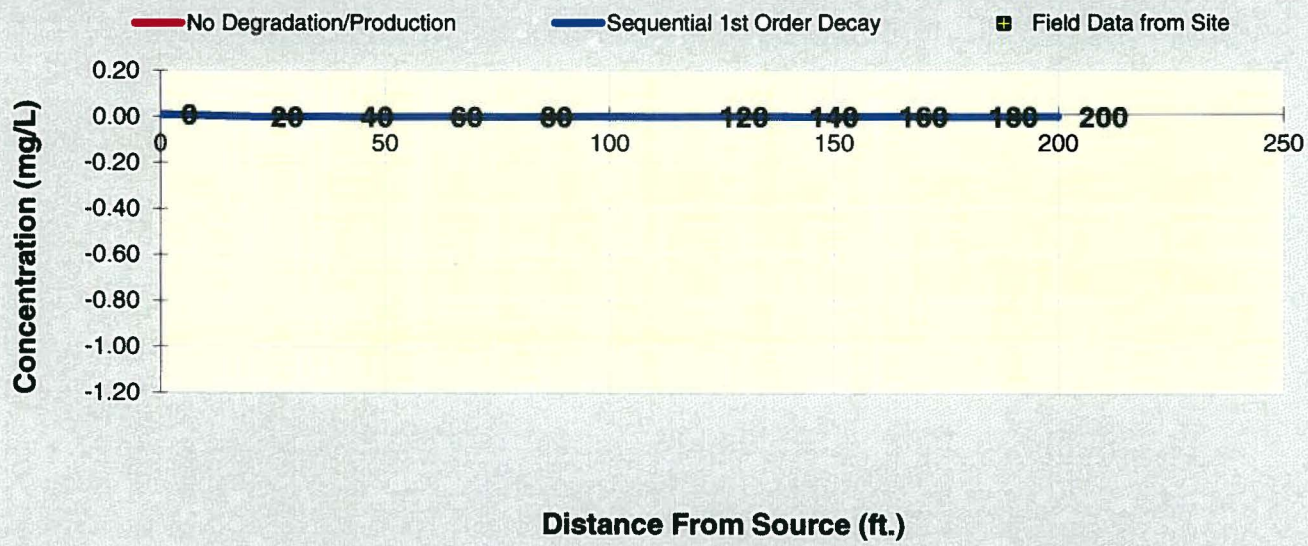
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0098	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
1.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Bio-barrier Deep Bedrock - Run 1

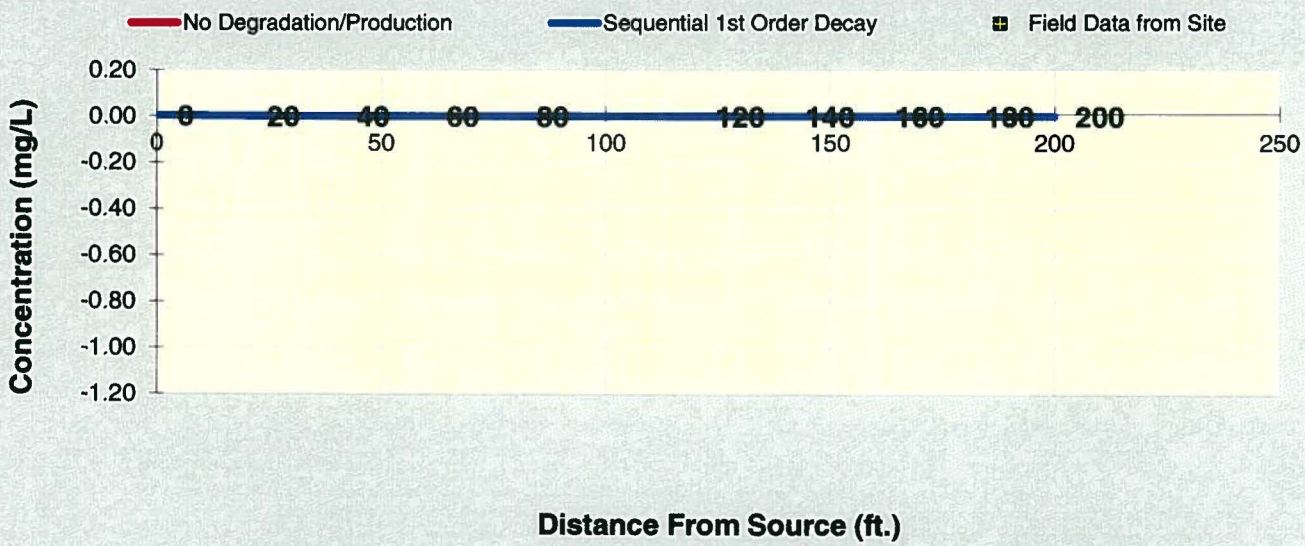
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

VC	0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
1.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

Bio-barrier Deep Bedrock - Run 2

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

South Weymouth B81
Deep Bedrock
Run Name

Data Input Instructions:

115 1. Enter value directly....or
↑ or 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	31.5	(ft/yr)
or			
Hydraulic Conductivity	K	3.1E-05	(cm/sec)
Hydraulic Gradient	i	0.0199	(ft/ft)
Effective Porosity	n	0.02	(-)

2. DISPERSION

Alpha x*	11.099	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R
or

Soil Bulk Density, rho	2.6	(kg/L)		
FractionOrganicCarbon, foc	2.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	111.76	(-)
TCE	130	(L/kg)	34.80	(-)
DCE	125	(L/kg)	33.50	(-)
VC	30	(L/kg)	8.70	(-)
ETH	302	(L/kg)	79.52	(-)
Common R (used in model)* =			**34.80**	

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

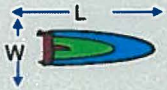
Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	5.000		0.79
TCE → DCE	1.200		0.74
DCE → VC	1.350		0.64
VC → ETH	4.900		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	44	(yr)
Modeled Area Width*	100	(ft)
Modeled Area Length*	200	(ft)
Zone 1 Length*	200	(ft)
Zone 2 Length*	0	(ft)



Zone 2=

6. SOURCE DATA TYPE: Decaying Single Planar

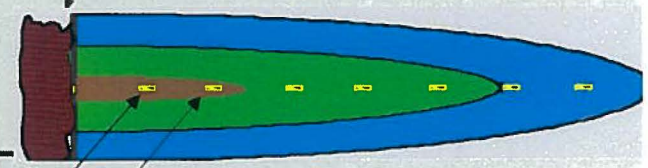
Source Options

Source Thickness in Sat. Zone* 20 (ft)

Width* (ft) Y1 20

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.22	0.016
TCE	.17	0.016
DCE	.02	0.016
VC	0.0	0.016
ETH		0.016

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)											
DCE Conc. (mg/L)											
VC Conc. (mg/L)											
ETH Conc. (mg/L)											
Distance from Source (ft)											
Date Data Collected											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESE | SEE | Paste

Bio-barrier Deep Bedrock - Run 2

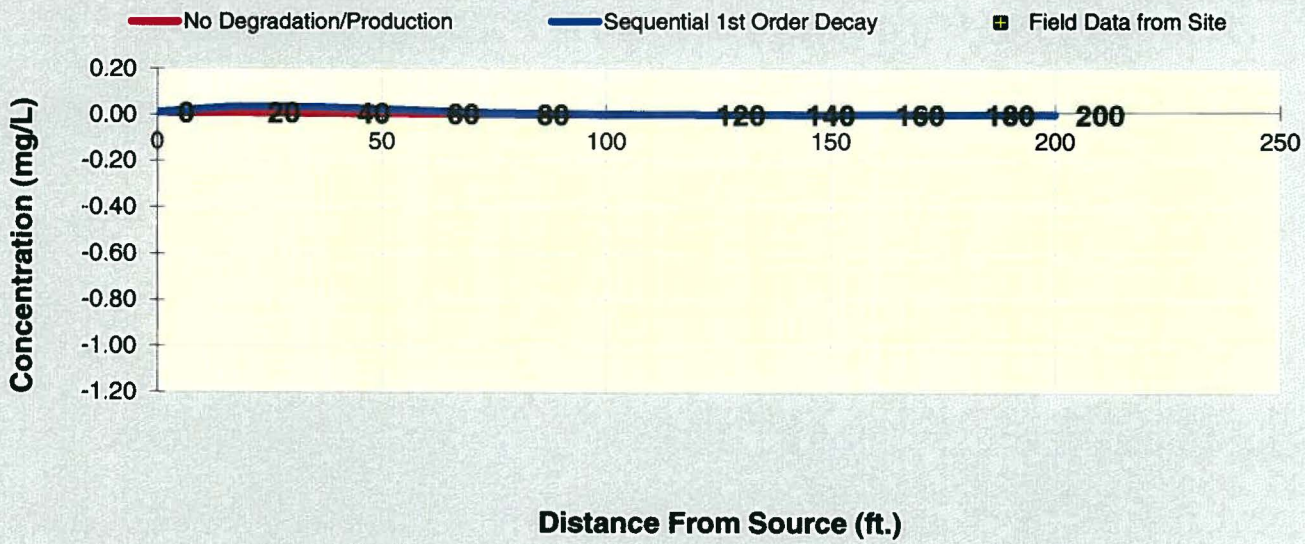
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.010	0.010	0.007	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0099	0.034	0.029	0.015	0.005	0.001	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
44.0 Years
Log ⟺ Linear

Return to Input

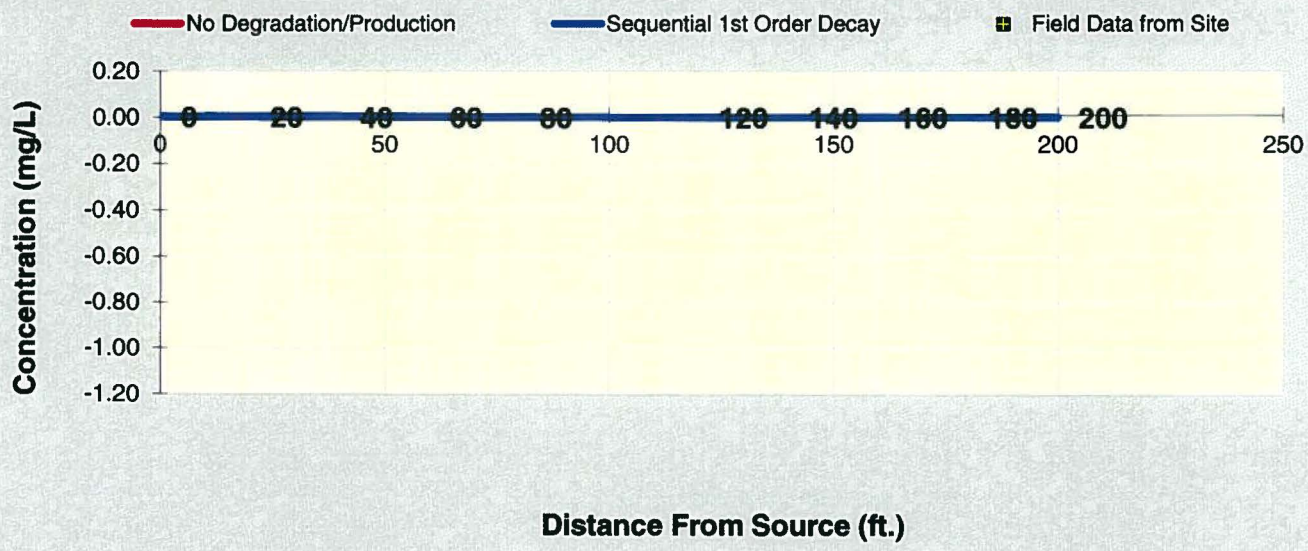
To All

To Array

Bio-barrier Deep Bedrock - Run 2

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.003	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0026	0.005	0.005	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000
	Monitoring Well Locations (ft)										
Field Data from Site											



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:
44.0 Years
Log ⟺ Linear

Return to Input

To All

To Array

APPENDIX F

ENVIRONMENTAL FOOTPRINT EVALUATION

APPENDIX F-1 ENVIRONMENTAL FOOTPRINT REPORT

APPENDIX F

Environmental Footprint Evaluation
Feasibility Study
Building 81
Naval Air Station South Weymouth
Weymouth, Massachusetts
January 2013

OBJECTIVE

This Environmental Footprint Evaluation of remedial alternatives is provided as an Appendix to the Feasibility Study (FS) for Building 81 located at the Naval Air Station South Weymouth located in Weymouth, MA. The purpose of the footprint evaluation is to assess the environmental impacts of the three remedial alternatives using the metrics of greenhouse gas (GHG) and criteria pollutant emissions, energy use, water consumption, and worker safety. The results of this footprint evaluation are intended to provide additional information for consideration during remedy selection, design, and to enhance the understanding of the environmental impacts throughout the remedy life-cycle for each of the proposed alternatives.

POLICY BACKGROUND

Department of Defense (DOD) and Navy policies require continual optimization of remedies in every phase from remedy selection through site closeout (NAVFAC, 2010a).

In January 2007, Executive Order 13423 set targets for sustainable practices for (i) energy efficiency, greenhouse gas emissions avoidance or reduction, and petroleum products use reduction, (ii) renewable energy, including bioenergy, (iii) water conservation, (iv) acquisition, (v) pollution and waste prevention and recycling, etc. In October 2009, Executive Order 13514 was issued, which reinforced these sustainability requirements and established specific goals for federal agencies to meet by 2020.

In August 2009 DOD issued a policy for “Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program.” The DOD policy and related Navy guidance state that opportunities to increase sustainability should be considered throughout all phases of remediation (i.e., site investigation, remedy selection, remedy design and construction, operation, monitoring, and site closeout). In response to this policy, the Department of the Navy (DON) issued an updated Navy Guidance for “Optimizing Remedy Evaluation, Selection, and Design” (NAVFAC, 2010), which includes

environmental footprint evaluations as part of the traditional DON optimization review process for remedy selection, design, and remedial action operation. In August 2010, the Naval Facilities Engineering Command (NAVFAC) issued policy requiring use of the SiteWise™ tool to perform environmental impact reviews as part of all Feasibility Studies. As such, this environmental footprint evaluation of remedial alternatives is being performed to estimate the environmental footprint associated with each alternative in the interest of reducing the environmental impact of remedial action at Building 81, NAS South Weymouth.

Applying the DON optimization concepts with an environmental footprint evaluation within the remedy selection and design phases allows for the following benefits:

- Determining factors in each remedial alternative with the greatest environmental impacts and gathering insight into how to reduce these impacts;
- Evaluating remedial alternatives with optimized or reduced environmental footprints in conjunction with other selection criteria;
- Designing and implementing a more robust remedy while balancing the impact to the environment; and
- Ensuring efficient, cost-effective and sustainable site closeout.

EVALUATION TOOLS

This evaluation was performed using a hybrid model of the Navy's SiteWise™ tool supplemented with Tetra Tech developed model as appropriate for some site-specific items.

SiteWise™ is a life-cycle footprint assessment tool developed jointly by the U.S. Navy, U.S. Army Corps of Engineers (USACE), and Battelle. SiteWise™ assesses the environmental footprint of a remedial alternative/technology using a consistent set of metrics. The assessment is conducted using a building block approach, where each remedial alternative is first broken down into modules that follow the phases for most remedial actions, including remedial investigation (RI), remedial action construction (RA-C), remedial action operation (RA-O), and long-term monitoring (LTM). Once broken down by remedial phase, the footprint of each phase is calculated. The phase-specific footprints are then combined to estimate the overall footprint of the remedial alternative. This building block approach reduces redundancy in the footprint assessment and facilitates the identification of specific impact drivers that contribute to the environmental footprint. The inputs that need to be considered include (1) production of material required by the activity; (2) transportation of the required materials to the site, transportation of personnel; (3) all site activities to be performed; and (4) management of the waste produced by the activity.

GSRx builds off of SiteWise™ and allows for a flexible, detailed analysis, particularly for materials and equipment use. GSRx was used to account for materials and activities not readily input into SiteWise™ and where equipment usage assumptions built into SiteWise™ were not consistent with site-specific requirements.

ENVIRONMENTAL FOOTPRINT EVALUATION FRAMEWORK AND LIMITATIONS

The environmental footprint evaluation performed for the FS of Building 81 at NAS South Weymouth considered life-cycle quantitative metrics for global warming potential (through greenhouse gas emissions), criteria air pollutant emissions (through NO_X, SO_X and PM_{10} emissions), energy consumption, water usage, and worker safety.

Life cycle impacts were calculated for energy consumption, emissions of GHG (carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_2O]) and criteria pollutants (nitrogen oxides [NO_x], sulfur oxides [SO_x] and particulate matter [PM_{10}]), water usage, and energy consumption, and worker safety.

Life cycle inventory inputs in SiteWise™ were divided into four categories – 1) materials production; 2) transportation of personnel, materials and equipment; 3) equipment use and miscellaneous; and 4) residual handling and disposal. Cost estimates from the RI/FS and design calculations were used as a basis for inventory quantities and related assumptions. Emission factors, energy consumption, and water usage data were correlated to material quantities, equipment, transportation distances, and installation time frames in order to calculate life-cycle emissions, energy consumption, water usage, and worker safety. Default SiteWise™ emission, energy usage, water consumption, and worker fatality and accident risk factors were utilized.

Although GSRx was used to minimize limitations resulting within SiteWise™, elimination of all limitations was not possible while using a hybrid model of SiteWise™ and GSRx. For example, several materials and construction equipment inventoried were input into GSRx and these impacts were incorporated into SiteWise™ within the “Equipment Use and Miscellaneous” sector. This sector in SiteWise™ does not differentiate into the specific equipment usage or material consumption items that are input in GSRx, but rather are considered miscellaneous items. However, impact drivers for items input in GSRx can be identified and evaluated directly within the respective GSRx evaluation and output summary sheets. In addition, worker safety results in general do not include worker safety related to equipment usage that was input within GSRx because GSRx was not developed to evaluate worker safety.

EVALUATION RESULTS

The following are the alternatives that were analyzed with SiteWise™ and GSRx for the Building 81 NAS South Weymouth FS:

- Alternative G2: Bio-Barriers, MNA, LUCs
- Alternative G3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, LUCs
- Alternative G4: In-Situ Chemical Oxidation, Bio-Barriers, MNA, LUCs

The following sections summarize the relative environmental impacts and primary impact drivers for the three alternatives and their respective metrics. In addition, the attachment includes the inventory and output sheets that were used for the SiteWise™/GSRx hybrid model. An evaluation of SiteWise™ and GSRx output summary sheets and related figures included in the footprint evaluation attachments (Appendix F-2 and F-3), provides detailed information on the contribution to each metric from each phase of the remedial process (RI, RAC, RAO, and LTM) and for each respective input category (materials production, transportation, equipment usage, etc). Further inspection of related inventory sheets provide information on the specific contribution to a metric from each item of material, transportation, equipment, etc. This level of detail also helps clarify results that could be misinterpreted based on SiteWise™ data entry limitations mentioned previously. The environmental impacts of the alternatives analyzed are summarized quantitatively in Table F1.

Greenhouse Gas Emissions

Emissions of CO_2, CH_4, and N_2O were normalized to CO_2 equivalents (CO_2e), which is a cumulative method of weighing GHG emissions relative to global warming potential. Figure F1 shows the overall GHG emissions of each of the alternatives analyzed; the x-axis represents the three alternatives evaluated and the y-axis represents the GHG emissions in metric ton of CO_2e.

The total amount of GHG emissions from Alternative G-2 is 165.51 metric tons of CO_2e. The main contributor the GHG emissions is the laboratory analytical services; the amount of emissions resulting from this activity is 49.53 metric ton of CO_2e, corresponding to approximately 30 percent of the total GHG emissions. The production of concrete, to be used in the material handling pad, is the activity with the second highest contribution to GHG emissions, 43.63 metric ton of CO_2e are released to the atmosphere, corresponding to 26 percent of the total GHG emissions. The production of vegetable oil is the activity with the third highest contribution to the CO_2e emissions, with 24.67 metric ton, corresponding to approximately 15 percent of the total emissions.

The total amount of GHG emissions from Alternative G-3 is 172.69 metric ton of CO_2e. The main contributor the GHG emissions is the laboratory analytical service, the amount of emissions resulting from this activity is 49.53 metric ton of CO_2e, corresponding to 29 percent of the total GHG emissions. The activity with the second highest GHG emissions is the production of concrete, which is used as part of the material handling pad, emits 43.63 metric ton of CO_2e, corresponding to 25 percent of the total GHG emissions associated with Alternative G-3. The production of vegetable oil, which is used as EOS during the treatment stage, is the activity with the third highest contribution to GHG emissions, 25.55 metric ton of CO_2e are released to the atmosphere through the lifetime of the project, corresponding to approximately 15 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative G-4 is 169.31 metric ton of CO_2e. The main contributor the GHG emissions is the laboratory analytical service, the amount of emissions resulting from this activity is 52.48 metric ton of CO_2e, corresponding to 31 percent of the total GHG emissions. The activity with the second highest GHG emissions is the production of concrete, which is used as part of the material handling pad, emits 43.63 metric ton of CO_2e, corresponding to 26 percent of the total GHG emissions associated with Alternative G-3. The production of vegetable oil, which is used as EOS during the treatment stage, is the activity with the third highest contribution to GHG emissions, 24.67 metric ton of CO_2e are released to the atmosphere through the lifetime of the project, corresponding to approximately 15 percent of the total GHG emissions.

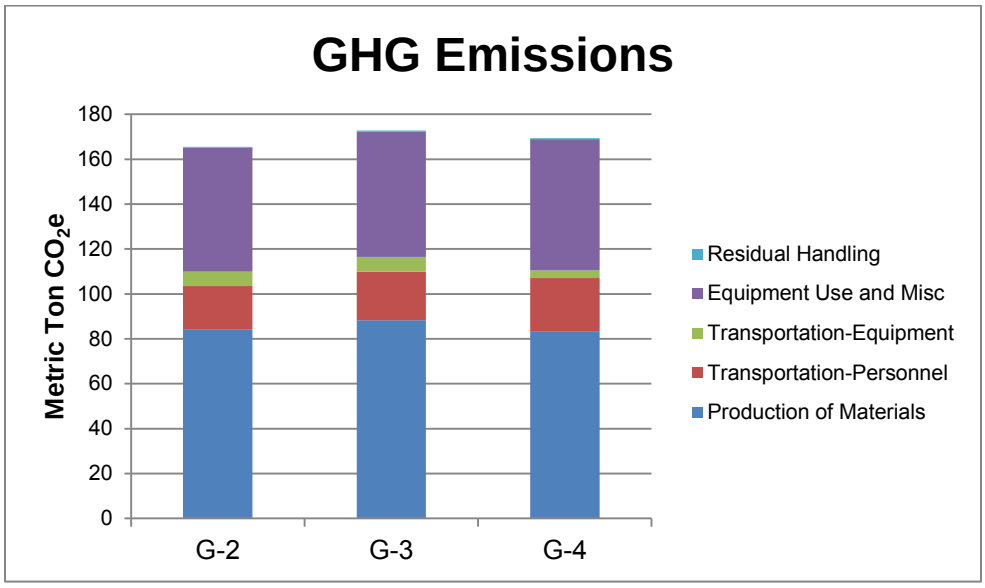


Figure F1: GHG Emissions for Groundwater Alternatives at Building 81, NAS South Weymouth

Criteria Pollutant Emissions

NO_X

Figure F2 shows the breakdown of the NO_X emissions for the two alternatives evaluated. The x–axis of this figure represents Alternative G-2, Alternative G-3 and Alternative G-4, the y-axis represents the NO_X emissions in metric ton.

The total amount of NO_X emissions from Alternative G-2 is 1.96×10^{-1} metric ton. The activity with the highest contribution to NO_X emissions is the use of laboratory analytical services, emitting 1.71×10^{-1} metric ton of NO_X, corresponding to approximately 88 percent of the total NO_X emissions. The use of the DPT drill rig emits 1.06×10^{-2} metric ton of NO_X, corresponding to approximately five percent of the total emissions. The activity with the third highest contribution to NO_X emissions is the transportation of personnel, emitting 7.13×10^{-3} metric ton of NO_X corresponding to approximately four percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative G-3 is 2.02×10^{-1} metric ton. The activity with the highest contribution to NO_X emissions is the use of laboratory analytical services, emitting 1.71×10^{-1} metric ton of NO_X, corresponding to approximately 85 percent of the total NO_X emissions. The use of the DPT drill rig emits 1.57×10^{-2} metric ton of NO_X, corresponding to approximately eight percent of the total emissions. The activity with the third highest contribution to NO_X emissions is the transportation of personnel, emitting 7.99×10^{-3} metric ton of NO_X corresponding to approximately four percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative G-4 is 2.15×10^{-1} metric ton. The activity with the highest contribution to NO_X emissions is the use of laboratory analytical services, emitting 1.82×10^{-1} metric ton of NO_X, corresponding to approximately 85 percent of the total NO_X emissions. The use of the DPT drilling rig emits 1.16×10^{-2} metric ton of NO_X, corresponding to approximately five percent of the total emissions. The activity with the third highest contribution to NO_X emissions is the transportation of personnel, emitting 8.75×10^{-3} metric ton of NO_X corresponding to approximately four percent of the total NO_X emissions.

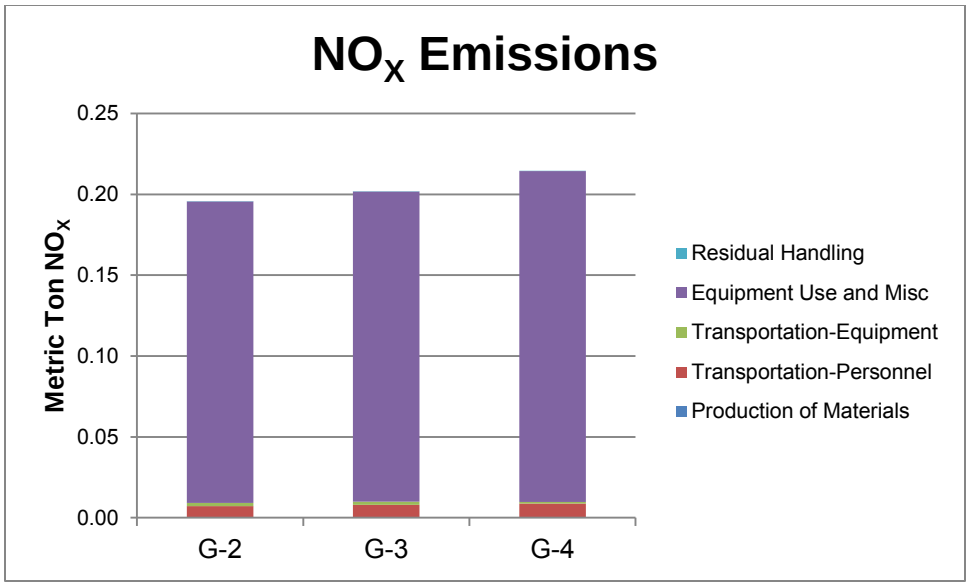


Figure F2 NO_X Emissions for Groundwater Alternatives at Building 81, NAS South Weymouth

SO_X

Figure F3 contains the distribution of the SO_X emissions resulting from the activities related to Alternatives G-2, G-3 and G-4. The x-axis of this graph represents the alternatives evaluated; the y-axis represents the SO_X emissions in metric ton.

The total amount of SO_X emissions from Alternative G-2 is 1.83×10^{-1} metric ton. Laboratory analytical services is the activity with the highest SOX emissions, where 1.14×10^{-1} metric ton of SO_X are released to the atmosphere, corresponding to approximately 62 percent of the total emissions. The activity with the second highest contribution to SO_X emissions is the production of vegetable oil which is used during the treatment, emitting 2.45×10^{-2} metric ton of SO_X, corresponding to approximately 13 percent of the total SO_X emissions. The activity with the third highest contribution to SO_X emissions is the production of HDPE, emitting 2.2×10^{-2} metric ton of SO_X corresponding to approximately 12 percent of the total SO_X emissions.

The total amount of SO_X emissions from Alternative G-3 is 1.90×10^{-1} metric ton. The activity with the highest contribution to SO_X emissions is the laboratory analytical services, emitting 1.14×10^{-1} metric ton of SO_X, corresponding to approximately 60 percent of the total SO_X emissions. The activity with the second highest contribution to SO_X emissions is the production of vegetable oil which is used during the treatment, emitting 2.45×10^{-2} metric ton of SO_X, corresponding to approximately 13 percent of the total SO_X emissions. The activity with the third highest contribution to SO_X emissions is the production of

HDPE, emitting $2.2x10^{-2}$ metric ton of SO_X corresponding to approximately 12 percent of the total SO_X emissions.

The total amount of SO_X emissions from Alternative G-4 is $1.77x10^{-1}$ metric ton. The activity with the highest contribution to SO_X emissions is the laboratory analytical services, emitting $1.21x10^{-1}$ metric ton of SO_X, corresponding to approximately 68 percent of the total SO_X emissions. Production of vegetable oil, used as EOS used during the treatment stage emits $2.45x10^{-2}$ metric ton of SO_X, corresponding to approximately 14 percent of the total emissions. The activity with the third highest contribution to SO_X emissions is the production of PVC for the wells, emitting $1.08x10^{-2}$ metric ton of SO_X corresponding to approximately four percent of the total SO_X emissions.

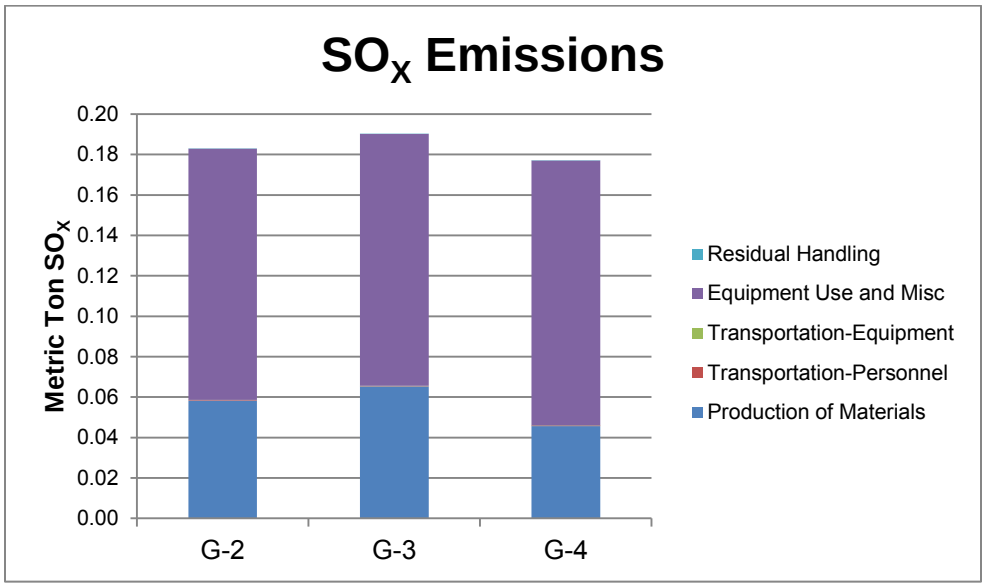


Figure F3: SO_X Emissions for Groundwater Alternatives at Building 81, NAS South Weymouth

PM_{10}

The breakdown of the distribution of the PM_{10} emissions resulting from the activities involved in Alternatives G-2, G-3 and G-4 are shown in Figure F4. The x-axis of this figure represents the three alternatives evaluated, while the y-axis represents the PM_{10} emissions in metric ton.

The total PM_{10} emissions resulting from Alternative G-2 is $1.35x10^{-2}$ metric ton. The activity with the highest PM_{10} release is the laboratory analytical services; this activity contributes with 32 percent of the total PM_{10} emissions, corresponding to $4.34x10^{-3}$ metric ton of PM_{10}. The activity with the second highest contribution to these emissions is the production of HDPE, emitting $3.30x10^{-3}$ metric ton of PM_{10},

approximately 24 percent of the total PM_{10} emissions. The treatment for injection water is the activity with the third highest contribution, approximately 12 percent of the total PM_{10} emissions (1.65×10^{-3} metric ton of PM_{10}).

The total PM_{10} emissions resulting from Alternative G-3 is 1.51×10^{-2} metric ton. The activity with the highest contribution to these emissions is the laboratory analytical services, emitting 4.34×10^{-3} metric ton of PM_{10}, approximately 29 percent of the total PM_{10} emissions. The activity with the second highest PM_{10} release is the production of HDPE; this activity contributes with approximately 22 percent of the total PM_{10} emissions, approximately 3.30×10^{-3} metric ton of PM_{10}. Production of PVC, used for the treatment wells, is the activity with the third highest contribution, approximately 15 percent of the total PM_{10} emissions (2.32×10^{-3} metric ton of PM_{10}).

The total PM_{10} emissions resulting from Alternative G-4 is 1.28×10^{-2} metric ton. The activity with the highest PM_{10} release is the laboratory analytical services; this activity contributes with 36 percent of the total PM_{10} emissions, approximately 4.6×10^{-3} metric ton of PM_{10}. Transportation of personnel is the activity with the second highest contribution, approximately 14 percent of the total PM_{10} emissions (1.77×10^{-3} metric ton of PM_{10}). The treatment for injection water is the activity with the third highest contribution, approximately 13 percent of the total PM_{10} emissions (1.65×10^{-3} metric ton of PM_{10}).

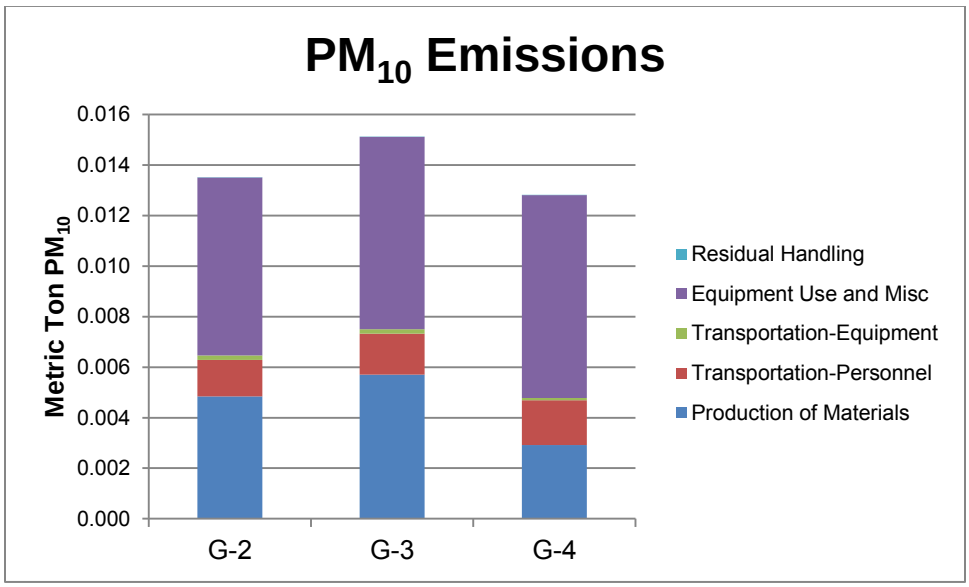


Figure F4: PM_{10} Emissions for Groundwater Alternatives at Building 81, NAS South Weymouth

Energy Consumption

The energy consumption for each of the alternatives evaluated is shown in Figure F5. The x-axis shows the three alternatives evaluated, and the y-axis shows the amount of energy consumed in units of million British Thermal Units (MMBTU).

The total amount of energy consumed by Alternative G-2 is 1,387 MMBTU. The activity with the highest energy consumption is the laboratory analytical services, consuming 739.2 MMBTU, corresponding to approximately 53 percent of the total energy consumption. The activity with the second highest energy use is the transportation of personnel, consuming 242.32 MMBTU, approximately 17 percent of the total energy consumption of this alternative. The third highest energy consumption corresponds to the production of PVC, where 153.66 MMBTUs are consumed, approximately 11 percent of the total energy used during this alternative.

The total amount of energy consumed by Alternative G-3 is 6,507 MMBTU. The activity with the highest energy consumption is the production of vegetable oil, used as EOS during the treatment sate, utilizing 3,033 MMBTU, corresponding to approximately 47 percent of the total energy consumption. The activity with the second highest energy consumption corresponds to the production of concrete, where 1,469 MMBTUs are consumed, approximately 23 percent of the total energy used during this alternative. The activity with the third highest energy use is laboratory analytical services, consuming 739 MMBTU, approximately 11 percent of the total energy consumption of this alternative.

The total amount of energy consumed by Alternative G-4 is 6,477 MMBTU. The activity with the highest energy consumption corresponds to the production of vegetable oil, used as EOS during the treatment stage, where 2,928 MMBTUs are consumed, approximately 47 percent of the total energy used during this alternative. The activity with the second highest energy consumption is the production of concrete, utilizing 1,469 MMBTU, corresponding to approximately 24 percent of the total energy consumption. The activity with the third highest energy use is laboratory analytical services, consuming 783 MMBTU, approximately 13 percent of the total energy consumption of this alternative.

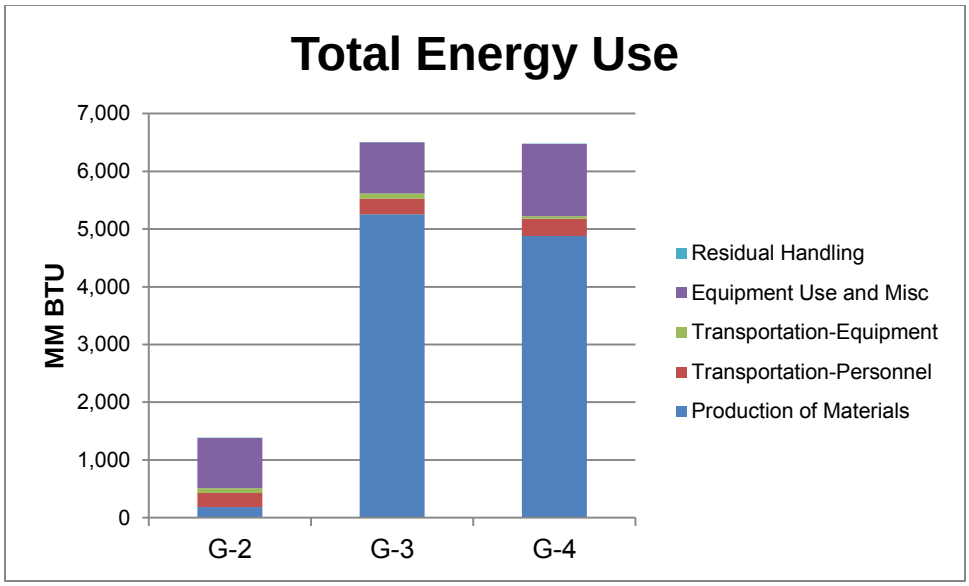


Figure F5: Energy Consumption for Groundwater Alternatives at Building 81, NAS South Weymouth

Water Usage

The water consumption of the evaluated alternatives is shown in Figure F6. The x-axis shows the three evaluated alternatives, and the y-axis show the amount of water consumed in thousands of gallons.

The total water consumption for Alternative G-2 is 304.6 thousand gallons of water. The amount of water used for injection purposes during the remedial alternative is approximately 84 percent of the total amount of water consumed (255 thousand gallons of water). The consumption of water during the production of vegetable oil corresponds to approximately 11 percent of the total water used during this Alternative; 33.7 thousand gallons of water were used for this purpose. Decontamination water corresponds to two percent of the total water used (approximately seven thousand gallons of water).

The total water consumption for Alternative G-3 is 359.2 thousand gallons of water. The amount of water used for injection during the treatment is approximately 73 percent of the total amount of water consumed (261.3 thousand gallons of water). The water consumed during the production of vegetable oil represents 21 percent of the total water used (approximately 77.1 thousand gallons of water). The water consumed during the production of PVC represents two percent of the total water consumed during this Alternative (7.5 thousand gallons of water).

The total water consumption for Alternative G-4 is 349.5 thousand gallons of water. Injection water corresponds to the highest consumption of water, with 73 percent of the total amount of water used

during this alternative (255 thousand gallons of water). The production of vegetable oil is the activity with the second highest water consumption with 74.4 thousand gallons of water, approximately 21 percent of the total amount of water utilized. Decontamination water has the third highest water consumption, eight thousand gallons of water, approximately two percent of the total amount of water.

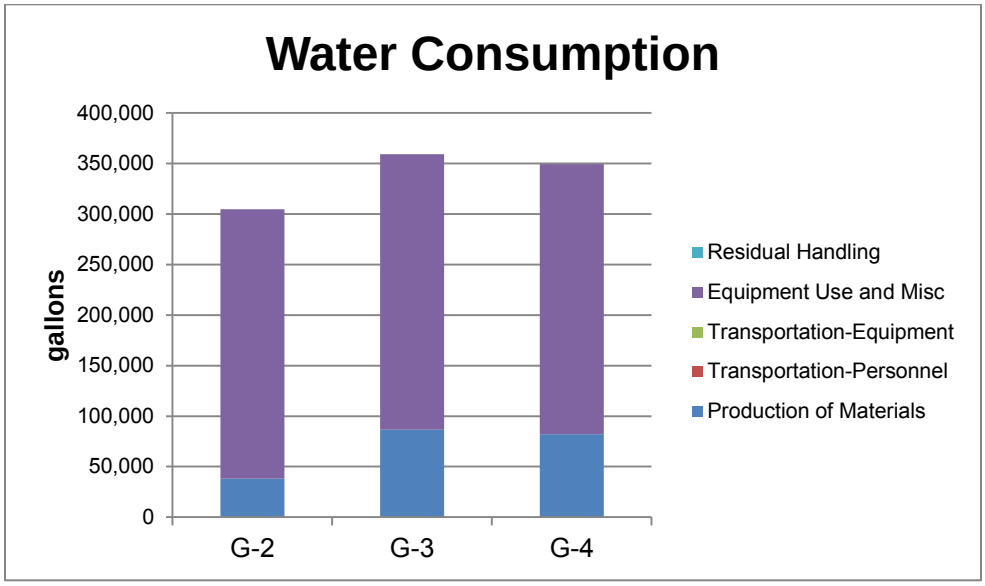


Figure F6: Water Consumption for Groundwater Alternatives at Building 81, NAS South Weymouth

Accident Risk

Accident Risk Fatality

Figure F7 shows the risk of fatality between the evaluated alternatives. The x-axis represents the three alternatives evaluated, and the y-axis represents the risk of fatality.

For all Alternatives, the activity with the highest risk of fatality is the transportation of personnel. For Alternatives G-2 and G-4, the activity with the second highest risk of fatality is the transportation of equipment and materials. For Alternative G-3, the activity with the second highest risk of fatality is the equipment use.

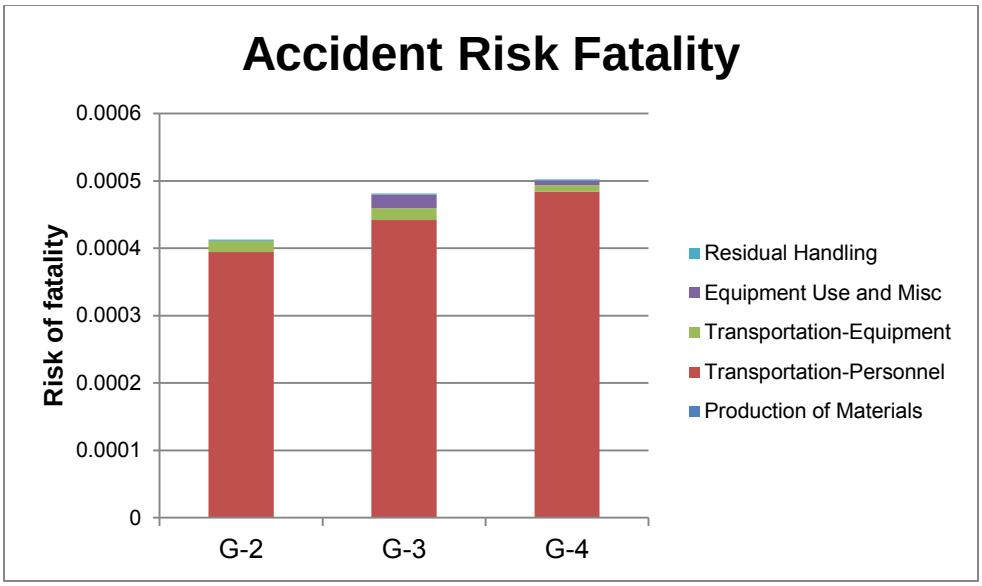


Figure F7 Risk of Fatality for Groundwater Alternatives Building 81, NAS South Weymouth

Accident Risk Injury

Figure F8 shows the risk of injury between the evaluated alternatives. The x-axis represents the three alternatives evaluated, and the y-axis represents the risk of injury.

For all Alternatives, the activity with the highest risk of injury is the transportation of personnel. For Alternative G-2, the activity with the second highest risk of injury is the transportation of equipment and materials. For Alternatives G-3 and G-4, the activity with the second highest risk of injury is the equipment use.

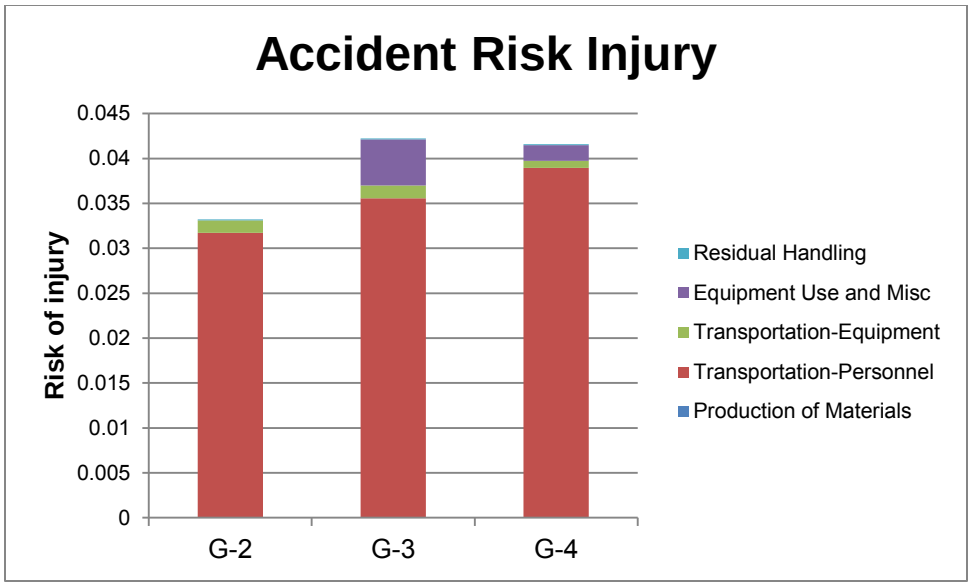


Figure F8 Risk of Injury for Groundwater Alternatives Building 81, NAS South Weymouth

CONCLUSIONS AND RECOMMENDATIONS

During selection and design of the remedy, a sensitivity analysis considering elements of the remedy that have the greatest impact on remedy effectiveness, life-cycle cost, and environmental footprint metrics may provide additional insight into appropriate optimization. To aid in the sensitivity analysis, an impact analysis summary was created to qualitatively highlight the relative impact of respective metrics for the two alternatives and to identify the primary drivers of emissions, energy consumption, and water usage for each alternative (see Table F2 for details).

Measures identified in the evaluation that may reduce the environmental footprint of the alternatives are listed below for consideration.

- All Alternatives: Consider revision of the amount of concrete used for the preparation of the site to support the equipment used during this alternative; this would reduce significantly the amount of GHG emissions released to the atmosphere as well as the amount of energy utilized.
- All Alternatives: Some reduction of the environmental footprint, particularly GHG emissions and energy consumption, could be realized for all alternatives through the possible use of emission control measures such as alternate fuel sources (e.g. biodiesel), equipment exhaust controls (e.g. diesel), and equipment idle reduction.
- All Alternatives: Consider optimizing of the use of equipment, particularly the use of the DPT drill rig, and even the type of equipment used during operations.

- All Alternatives: Consider the optimization of the use of EOS during the treatment stage. The environmental impact of this chemical has an influence in most of the impact categories evaluated.
- All Alternatives: Design an optimized sampling schedule that minimizes the number of samples that need to be analyzed and maximizes the results, for this alternative laboratory analytical services are the main driver for most of the impact categories evaluated.
- All Alternatives: Optimize the number of samples analyzed during the operation and monitoring stages given that the laboratory analytical services is one of the major drivers in some of the impact categories.
- All Alternatives: Consider ways to reduce vehicle mileage to reduce worker risk as well as energy use and emissions. Encourage site workers to carpool daily to the site to reduce total vehicle mileage.

REFERENCES

(a) NAVFAC, DON Guidance for Optimizing Remedy Evaluation, Selection, and Design, March 2010
(b) NAVFAC, DON Policy on SiteWise™ Optimization/GSR Tool Usage, email received from Brian Harrison/NAVFAC HQ dated 10 AUG 2010

Table F-1
Environmental Impact Results
Building 81, NAS South Weymouth
Weymouth, Massachusetts

Alternative	Activities	GHG Emissions	Total Energy Used	Water Impacts	NOx Emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
G-2	Materials Production	84.30	187.04	38,274.64	0.00E+00	5.83E-02	4.84E-03	NA	NA
	Transportation-Personnel	19.26	242.32	NA	7.13E-03	2.51E-04	1.45E-03	3.94E-04	3.17E-02
	Transportation-Equipment	6.38	83.30	NA	2.01E-03	3.55E-05	1.78E-04	1.70E-05	1.37E-03
	Equipment Use and Misc	55.20	870.64	266,381.14	1.86E-01	1.24E-01	7.05E-03	0.00E+00	0.00E+00
	Residual Handling	0.36	4.65	NA	1.12E-04	1.98E-06	9.96E-06	1.56E-06	1.26E-04
	Total	165.51	1,387.96	304,655.78	1.96E-01	1.83E-01	1.35E-02	0.000	0.033
G-3	Materials Production	88.29	5,258.05	86,439.33	1.60E-07	6.52E-02	5.70E-03	NA	NA
	Transportation-Personnel	21.59	271.56	NA	7.99E-03	2.81E-04	1.62E-03	4.42E-04	3.56E-02
	Transportation-Equipment	6.61	86.23	NA	2.08E-03	3.67E-05	1.85E-04	1.76E-05	1.41E-03
	Equipment Use and Misc	55.85	886.82	272,827.17	1.92E-01	1.25E-01	7.61E-03	2.04E-05	5.13E-03
	Residual Handling	0.36	4.65	NA	1.12E-04	1.98E-06	9.96E-06	1.56E-06	1.26E-04
	Total	172.69	6,507.32	359,266.50	2.02E-01	1.90E-01	1.51E-02	0.000	0.042
G-4	Materials Production	83.43	4,880.27	82,231.61	1.37E-06	4.56E-02	2.91E-03	NA	NA
	Transportation-Personnel	23.65	297.44	NA	8.75E-03	3.08E-04	1.77E-03	4.84E-04	3.90E-02
	Transportation-Equipment	3.40	44.43	NA	1.07E-03	1.89E-05	9.51E-05	9.61E-06	7.73E-04
	Equipment Use and Misc	58.46	1,250.61	267,278.89	2.05E-01	1.31E-01	8.03E-03	6.95E-06	1.75E-03
	Residual Handling	0.37	4.80	NA	1.15E-04	2.04E-06	1.03E-05	1.56E-06	1.26E-04
	Total	169.31	6,477.55	349,510.51	2.15E-01	1.77E-01	1.28E-02	0.001	0.042

Table F-2
Environmental Impact Analysis
Building 81, NAS South Weymouth
Weymouth, Massachusetts

	GHG Emissions	Total Energy Used	Water Impacts	NOx Emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
Alternative G-2	High	Low to Moderate	High	High	High	High	High	Moderate to High
	Analytical Laboratory Services	Analytical Laboratory Services	Injection water	Analytical Laboratory Services	Analytical Laboratory Services	Analytical Laboratory Services	Transportation of personnel	Transportation of personnel
Alternative G-3	Low to Moderate	High	High	High	Low	Low	High	High
	Analytical Laboratory Services	Production of Vegetable Oil	Injection water	Analytical Laboratory Services	Analytical Laboratory Services	Analytical Laboratory Services	Transportation of personnel	Transportation of personnel
Alternative G-4	Low to Moderate	High	High	High	Low	Low	High	High
	Analytical Laboratory Services	Production of Vegetable Oil	Injection water	Analytical Laboratory Services	Analytical Laboratory Services	Production of HDPE	Transportation of personnel	Transportation of personnel

APPENDIX F-2 INPUT INVENTORIES

Alternative G-2

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad	441.16	lb	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3
Decontamination water	2,000.00	gallons	
Material handling pad	740,083.48	lb	5000 sf, 1 ft deep, assume concrete, density 2371 kg/m3
Material handling pad	343.75	lb	HDPE Liner, 5000 sf, 10 oz/sy, 16 oz/lb
Injection wells	1,088.64	lb	1512 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft
Injection well heads	1,225.00	lb	49 well heads, assume PVC, assume 25 lb per well head
AquaBupH	27,473.60	lb	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg
Injection water	42,500.00	gallons	
Seeding, mulch	750	lb	15 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	300	lb	15 msf, assume fertilizer, assume 20 lb per smf

Transportation-Personnel

Item	Quantity	Units	Comments
Site Superintendent transportation	2,250.00	miles	45 days, 50 miles per day, 1 person
Site Health and safety, QA/QC	2,250.00	miles	45 days, 50 miles per day, 1 person
Site Labor: biobarrier	4,000.00	miles	40 days, 50 miles per day, 2 people
Suvery Support	200.00	miles	4 days, 50 miles per day, 1 person
Utility Clearance Worker	50.00	miles	1 day, 50 miles per day, 1 person

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 ln per 500 gal capacity tank
Clean Water Storage Tank	0.60	ton	4000 gallons capacity HPDE, 100 miles round trip
Pumps	0.20	ton	10 pumps (1 pump per every 5 wells), 39 lb per pump, 100 miles round trip
Drill Rig, DPT	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Injection well heads	0.61	ton	49 well heads, assume PVC, assume 25 lb per well head

Transportation-materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad	0.22	ton	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3
Material handling pad	370.04	ton	5000 sf, 1 ft deep, assume concrete, density 2371 kg/m3
Material handling pad	0.17	ton	HDPE Liner, 5000 sf, 10 oz/sy, 16 oz/lb
Injection wells	0.54	ton	1512 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft

AquaBupH	13.74	ton	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg
Injection water	176.80	ton	Assume 50 miles to site per trip.
Seeding, mulch	0.375	ton	15 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.15	ton	15 msf, assume fertilizer, assume 20 lb per smf

Equipment Use			
Item	Quantity	Units	Comments
Drill Rig, DPT	62.72	hours	5 wells per day, 49 wells, 8 hours a day, 80% utilization
Pumps	1,280.00	hours	10 pumps, 20 days, 8 hours per day, 80% utilization

Residual Handling			
Item	Quantity	Units	Comments
Disposal Decon Water	8.32	ton	2000 gallons, 8.32 ppg, 2000 lb per pound

Transportation-residual handling			
Item	Quantity	Units	Comments
Disposal Decon Water	100.00	miles	2000 gallons, 8.32 ppg, 2000 lb per pound

RAO

Materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	3,502.36	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3, for years 5,10,15,20,25
Temporary Equipment Decon Pad	2,205.79	lb	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3, for years 5,10,15,20,25
Decontamination water	5,000.00	gallons	1000 gallons, for years 5,10,15,20,25
AquaBupH	137,368.00	lb	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg, for years 5,10,15,20,25
Injection water	212,500.00	gallons	42500 gallons, for years 5,10,15,20,25

Transportation-Personnel			
Item	Quantity	Units	Comments
Site Health and safety, QA/QC	6,000.00	miles	24 days, 50 miles per day, 1 person, for years 5,10,15,20,25
Site Labor: biobarrier	20,000.00	miles	40 days, 50 miles per day, 2 people, for years 5,10,15,20,25

Transportation-equipment			
Item	Quantity	Units	Comments
Decon Water Storage Tank	4.50	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 ln per 500 gal capacity tank, for years 5,10,15,20,25
Clean Water Storage Tank	3.00	ton	4000 gallons capacity HPDE, 100 miles round trip, for years 5,10,15,20,25
Pumps	0.98	ton	10 pumps, 39 lb per pump, 100 miles round trip, for years 5,10,15,20,25

Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	1.75	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3, for years 5,10,15,20,25

Temporary Equipment Decon Pad	1.10	ton	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3, for years 5,10,15,20,25
AquaBupH	68.68	ton	Assume Vegetable Oil, 50 drums, 55 gallons per drum, 8.92 ppg, for years 5,10,15,20,25
Injection water	884.00	ton	42500 gallons, for years 5,10,15,20,25

Equipment Use			
Item	Quantity	Units	Comments
Pumps	6,400.00	hours	10 pumps, 20 days, 8 hours per day, 80% utilization, for years 5,10,15,20,25

Residual Handling			
Item	Quantity	Units	Comments
Disposal Decon Water	20.80	ton	1000 gallons, 8.32 ppg, 2000 lb per pound, for years 5,10,15,20,25

Transportation-residual handling			
Item	Quantity	Units	Comments
Disposal Decon Water	100.00	miles	

LTM

Transportation-Personnel			
Item	Quantity	Units	Comments
Site Inspection	1,500.00	miles	1 visit per 1 year, 1 day per visit, 50 miles per day, 1 person, for years 1 through 30
Water sampling	14,000.00	miles	4 visits for year 1, 4 days per visit, 50 miles per day, 2 people; 2 visits for year 2 and 3, 4 days per visit, 50 miles per day; 1 visit for years 4 through 30, 4 days per visit, 50 miles per day, 2 people
Five year review site visit	300.00	miles	1 day per visit, 50 miles per day, 1 person, for years 5, 10, 15, 20, 25 and 30

Laboratory Analytical Services			
Item	Quantity	Units	Comments
Water Sampling	84,000.00	dollars	12 samples per visit, 4 visits for year 1; 2 visits for years 2 and 3; 1 visit per year for years 4 through 30; $200 per sample

Alternative G-3

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad	441.16	lb	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3
Decontamination water	2,000.00	gallons	
Material handling pad	740,083.48	lb	5000 sf, 1 ft deep, assume concrete, density 2371 kg/m3
Material handling pad	343.75	lb	HDPE Liner, 5000 sf, 10 oz/sy, 16 oz/lb
Injection wells	743.04	lb	1032 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft
Injection well heads	600.00	lb	24 well heads, assume PVC, assume 25 lb per well head
AquaBupH	3,924.80	lb	Assume Vegetable Oil, 8 drums, 55 gallons per drum, 8.92 ppg
Injection water	4,200.00	gallons	
Injection wells	1,088.64	lb	1,512 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft
Injection well heads	1,225.00	lb	49 well heads, assume PVC, assume 25 lb per well head
AquaBupH	27,473.60	lb	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92ppg
Injection water	42,500.00	gallons	
Seeding, mulch	850	lb	17 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	340	lb	17 msf, assume fertilizer, assume 20 lb per smf

Transportation-Personnel

Item	Quantity	Units	Comments
Site Superintendent transportation	2,750.00	miles	55 days, 50 miles per day, 1 person
Site Health and safety, QA/QC	3,250.00	miles	55 days, 50 miles per day, 1 person
Utility Clearance Worker	50.00	miles	1 day, 50 miles per day, 1 person
Labor transportation: In-situ bioremediation	1,000.00	miles	10 days, 50 miles per day, 2 people
Site Labor: biobarrier	4,000.00	miles	40 days, 50 miles per day, 2 people
Survey Support	200.00	miles	4 days, 50 miles per day, 1 person

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 ln per 500 gal capacity tank
Clean Water Storage Tank	0.60	ton	4000 gallons capacity HPDE, 100 miles round trip
Pumps	0.10	ton	5 pumps (1 pump for every 5 wells), 39 lb per pump, 100 miles round trip
Pumps	0.20	ton	10 pumps (1 pump for every 5 wells), 39 lb per pump, 100 miles round trip
DPT Drill Rig	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip

Transportation-materials

Item	Quantity	Units	Comments

Temporary Equipment Decon Pad	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad	0.22	ton	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3
Material handling pad	370.04	ton	5000 sf, 1 ft deep, assume concrete, density 2371 kg/m3
Material handling pad	0.17	ton	HDPE Liner, 5000 sf, 10 oz/sy, 16 oz/lb
Injection wells	0.37	ton	1,032 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft
Injection well heads	0.30	ton	24 well heads, assume PVC, assume 25 lb per well head
AquaBupH	1.96	ton	Assume Vegetable Oil, 8 drums, 55 gallons per drum, 8.92 ppg
Injection water	17.47	ton	
Injection wells	0.54	ton	1512 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft
Injection well heads	0.61	ton	49 well heads, assume PVC, assume 25 lb per well head
AquaBupH	13.74	ton	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg
Injection water	176.80	ton	
Seeding, mulch	0.425	ton	17 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.17	ton	17 msf, assume fertilizer, assume 20 lb per smf

Equipment Use			
Item	Quantity	Units	Comments
Drill Rig, DPT	30.72	hours	5 wells per day, 24 wells, 8 hours per day, 80% utilization
Pumps	160.00	hours	5 pumps, 5 days, 8 hours per day, 80% utilization
Pumps	1,280.00	hours	10 pumps, 20 days, 8 hours per day, 80% utilization
Drill Rig, DPT	62.72	hours	5 wells per day, 49 wells, 8 hours per day, 80% utilization

Residual Handling			
Item	Quantity	Units	Comments
Disposal Decon Water	8.32	ton	2,000 gallons, 8.32 ppg, 2000 lb per pound

Transportation-residual handling			
Item	Quantity	Units	Comments
Disposal Decon Water	100.00	miles	20000 gallons, 8.32 ppg, 2000 lb per pound

RAO

Materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	3,502.36	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3, for years 5,10,15,20,25
Temporary Equipment Decon Pad	2,205.79	lb	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3, for years 5,10,15,20,25
Decontamination water	5,000.00	gallons	1000 gallons, for years 5,10,15,20,25
AquaBupH	137,368.00	lb	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg, for years 5,10,15,20,25
Injection water	212,500.00	gallons	42500 gallons for years 5,10,15,20,25

AquaBupH	1,962.40	lb	Assume Vegetable Oil, 4 drums, 55 gallons per drum, 8.92 ppg for year 5 only
Injection water	2,100.00	gallons	Year 5 only

Transportation-Personnel			
Item	Quantity	Units	Comments
Site Superintendent and QA/QC transportation for bio-barrier	12,000.00	miles	24 days, 50 miles per day, 2 people, for years 3,6,9,12,15,18,21,24,27
Site Labor: biobarrier	20,000.00	miles	40 days, 50 miles per day, 2 people, for years 5,10,15,20,25
Site Superintendent and QA/QC transportation for in-situ treatment	500.00	miles	5 days, 50 miles per day, 2 people, for year 5 only
site labor: in-situ treatment	600.00	miles	6 days, 50 miles per day, 2 people, for year 5 only

Transportation-equipment			
Item	Quantity	Units	Comments
Decon Water Storage Tank	4.50	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 ln per 500 gal capacity tank, for years 5,10,15,20,25
Clean Water Storage Tank	3.00	ton	4000 gallons capacity HPDE, 100 miles round trip, for years 5,10,15,20,25
Pumps	0.98	ton	10 pumps, 39 lb per pump, 100 miles round trip, for years 5,10,15,20,25
Pumps	0.10	ton	5 pumps, 39 lb per pump, 100 miles round trip, for year 5 only

Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	1.75	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3, for years 5,10,15,20,25
Temporary Equipment Decon Pad	1.10	ton	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3, for years 5,10,15,20,25
AquaBupH	84.23	ton	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 10.939 ppg, for years 5,10,15,20,25
Injection water	884.00	ton	42500 gallons, for years 5,10,15,20,25
AquaBupH	1.20	ton	Assume Vegetable Oil, 4 drums, 55 gallons per drum, 10.939 ppg, for year 5 only
Injection water	8.74	ton	

Equipment Use			
Item	Quantity	Units	Comments
Pumps	6,400.00	hours	10 pumps, 20 days, 8 hours per day, 80% utilization, for years 5,10,15,20,25
Pumps	96.00	hours	5 pumps, 3 days, 8 hours per day, 80% utilization, for year 5 only

Residual Handling			
Item	Quantity	Units	Comments
Disposal Decon Water	20.80	ton	1000 gallons, 8.32 ppg, 2000 lb per pound, for years 5,10,15,20,25

Transportation-residual handling			
Item	Quantity	Units	Comments

Disposal Decon Water	100.00	miles	1000 gallons, 8.32 ppg, 2000 lb per pound, for years 5,10,15,20,25

LTM

Materials

Item	Quantity	Units	Comments
Yearly Site Inspection	1,500.00	miles	1 visit per year, 1 day per visit, 50 miles per day, 1 person, for years 1 through 30
Water sampling	10,500.00	miles	4 visits for year 1, 3 days per visit, 50 miles per day, 2 people; 2 visits for year 2 and 3, 3 days per visit, 50 miles per day; 1 visit for years 4 through 30, 3 days per visit, 50 miles per day, 2 people
Five year review site visit	300.00	miles	1 day per visit, 50 miles per day, 1 person, for years 5, 10, 15, 20, 25 and 30

Transportation-residual handling

Item	Quantity	Units	Comments
Sampling	84,000.00	dollars	12 samples per visit, 4 visits for year 1; 2 visits for years 2 and 3; 1 visit per year for years 4 through 30; $200 per sample

Alternative G-4

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad	441.16	lb	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3
Decontamination water	3,000.00	gallons	
Material handling pad	740,083.48	lb	5000 sf, 1 ft deep, assume concrete, density 2371 kg/m3
Material handling pad	343.75	lb	HDPE Liner, 5000 sf, 10 oz/sy, 16 oz/lb
Injection wells	51.84	lb	72 lf, Assume PVC, assume 2 in diameter, 0.72 lb/ft
Injection well head	100.00	lb	4 units, assume 25 lb per unit
Reagents: sodium permanganate	778.00	lb	Assume pottasium permanganate
Reagents: potassium permanganate	1,500.00	lb	Assume 10 percent to be pottasium permanganate (coating of the sand), 15,000 lb total
Reagents: sand blend	13,500.00	lb	Assume 90% sand blend, 15,000 lb total
Injection wells	1,088.64	lb	1,512 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft
Injection well heads	1,225.00	lb	49 well heads, assume PVC, assume 25 lb per well head
AquaBupH	27,473.60	lb	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg
Injection water	42,500.00	gallons	
Seeding, mulch	850	lb	17 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	340	lb	17 msf, assume fertilizer, assume 20 lb per smf

Transportation-Personnel

Item	Quantity	Units	Comments
Site Superintendent transportation	3,250.00	miles	65 days, 50 miles per day, 1 person
Site Health and safety, QA/QC	3,250.00	miles	65 days, 50 miles per day, 1 person
Labor for in -situ chemical oxidation	2,250.00	miles	15 days, 50 miles per day, 3 people
Site Labor: biobarrier	4,000.00	miles	40 days, 50 miles per day, 2 people
Surveyor	200.00	miles	4 days, 1 person, 50 miles per day
Utility Clearance Worker	50.00	miles	1 person, 1 day, 50 miles per day

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 ln per 500 gal capacity tank
Clean Water Storage Tank	0.60	ton	4000 gallons capacity HPDE, 100 miles round trip
pumps	0.04	ton	2 pumps, 39 lb per pump, 100 miles round trip
DPT Drill Rig	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Sonic Drill Rig	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Injection system for fracturing	3.00	ton	Assume 3 tons, 100 miles round trip
Pumps	0.20	ton	10 pumps, 39 lb per pump, 100 miles round trip

Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad	0.22	ton	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3
Material handling pad	370.04	ton	5000 sf, 1 ft deep, assume concrete, density 2371 kg/m3
Material handling pad	0.17	ton	HDPE Liner, 5000 sf, 10 oz/sy, 16 oz/lb
Injection wells	0.03	ton	72 lf, Assume PVC, assume 2 in diameter, 0.72 lb/ft
Injection well head	0.05	ton	4 units, assume 25 lb per unit
Reagents: sodium permanganate	0.39	ton	Assume pottasium permanganate
Reagents: potassium permanganate	0.75	ton	Assume 10 percent to be pottasium permanganate (coating of the sand), 15,000 lb total
Reagents: sand blend	6.75	ton	Assume 90% sand blend, 15,000 lb total
Injection wells	0.54	ton	1,512 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft
Injection well heads	0.61	ton	49 well heads, assume PVC, assume 25 lb per well head
AquaBupH	13.74	ton	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg
Injection water	176.80	ton	
Seeding, mulch	0.425	ton	17 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.17	ton	17 msf, assume fertilizer, assume 20 lb per smf

Equipment Use			
Item	Quantity	Units	Comments
Drill Rig, DPT	6.40	hours	5 wells per day, 4 wells, 8 hours per day, 80% utilization
Pumps for the sodium permanganate	25.60	hours	2 pumps, 2 days, 8 hours per day, 80% utilization
Drill Rig, sonic (fracturing)	6.40	hours	5 borings per day, 5 borings, 8 hours per day, 80% utilization
Injection system for fracturing	76.80	hours	12 days, 8 hours per day, 80% utilization
Pumps	1,280.00	hours	10 pumps, 20 days, 8 hours per day, 80% utilization
Drill Rig, DPT	62.72	hours	5 wells per day, 49 wells, 8 hours per day, 80% utilization

Residual Handling			
Item	Quantity	Units	Comments
Disposal Decon Water	12.48	ton	3000 gallons, 8.32 ppg, 2000 lb per pound

Transportation-residual handling			
Item	Quantity	Units	Comments
Disposal Decon Water	100.00	miles	3000 gallons, 8.32 ppg, 2000 lb per pound

Laboratory Analytical services			
Item	Quantity	Units	Comments

Insitu chemical oxidation sampling	5,000.00	dollars	5 events, 5 samples per event, $200 per sample

RAO

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	700.47	lb	Assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3, for 1 year in-situ
Temporary Equipment Decon Pad	441.16	lb	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3, for 1 year in-situ
Decontamination water	5,000.00	gallons	1000 gallons, for years 5,10,15,20,25
AquaBupH	137,368.00	lb	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg, for years 5,10,15,20,25
Injection water	212,500.00	gallons	42,500 gallons, for years 5,10,15,20,25
Decontamination water	0.00	gallons	
Reagents: sodium permanganate	389.00	lb	Assume pottasium permanganate

Transportation-Personnel

Item	Quantity	Units	Comments
Site Superintendent and QA/QC transportation for bio-barrier	12,000.00	miles	24 days, 50 miles per day, 2 people, for years 5,10,15,20,25
Site Labor: biobarrier	20,000.00	miles	40 days, 50 miles per day, 2 people, for years 5,10,15,20,25
Site Superintendent and QA/QC transportation for In-situ oxidation	500.00	miles	5 days, 50 miles per day, 2 people, for year 1 for in-situ chemical oxidation
Labor for in -situ chemical oxidation	750.00	miles	5 days, 50 miles per day, 3 people

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	4.50	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 ln per 500 gal capacity tank, for years 5,10,15,20,25
Clean Water Storage Tank	3.00	ton	4000 gallons capacity HPDE, 100 miles round trip, for years 5,10,15,20,25
pumps	0.04	ton	2 pumps, 39 lb per pump, 100 miles round trip
Pumps	0.98	ton	10 pumps, 39 lb per pump, 100 miles round trip, for years 5,10,15,20,25

Transportation-materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3, for 1 year in-situ
Temporary Equipment Decon Pad	0.22	ton	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3, for 1 year in-situ
AquaBupH	68.68	ton	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg, for years 5,10,15,20,25
Injection water	106.25	ton	42,500 gallons, for years 5,10,15,20,25
Reagents: sodium permanganate	0.19	ton	Assume pottasium permanganate

Equipment Use

Item	Quantity	Units	Comments
Pumps	6,400.00	hours	10 pumps, 20 days, 8 hours per day, 80% utilization, for years 5,10,15,20,25
Pumps for the sodium permanganate	64.00	hours	2 pumps, 5 days, 8 hours per day, 80% utilization

Residual Handling

Item	Quantity	Units	Comments
Disposal Decon Water	20.80	ton	1000 gallons, 8.32 ppg, 2000 lb per pound, for years 5,10,15,20,25

Transportation-residual handling

Item	Quantity	Units	Comments
Disposal Decon Water	100.00	miles	1000 gallons, 8.32 ppg, 2000 lb per pound, for years 5,10,15,20,25

LTM

Transportation-Personnel

Item	Quantity	Units	Comments
Yearly Site Inspection	1,500.00	miles	1 visit per year, 1 day per visit, 50 miles per day, 1 person, for years 1 through 30
Water sampling	14,000.00	miles	4 visits for year 1, 4 days per visit, 50 miles per day, 2 people; 2 visits for year 2 and 3, 4 days per visit, 50 miles per day; 1 visit for years 4 through 30, 4 days per visit, 50 miles per day, 2 people
Five year review site visit	300.00	miles	1 day per visit, 50 miles per day, 1 person, for years 5, 10, 15, 20, 25 and 30

Laboratory Analytical Services

Item	Quantity	Units	Comments
Water Sampling	84,000.00	dollars	12 samples per visit, 4 visits for year 1; 2 visits for years 2 and 3; 1 visit per year for years 4 through 30; $200 per sample

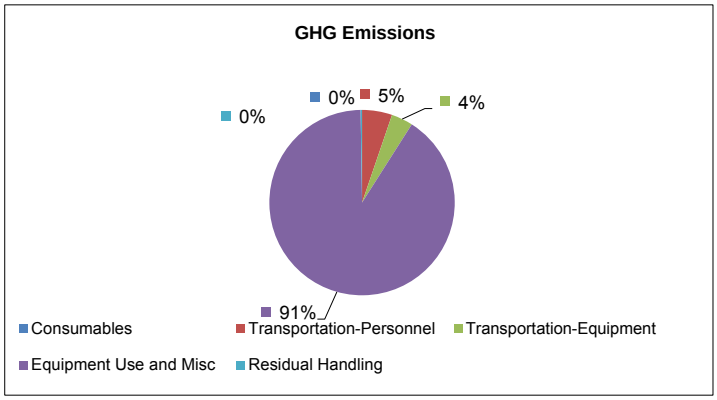
APPENDIX F-3 SITEWISE™ RESULTS

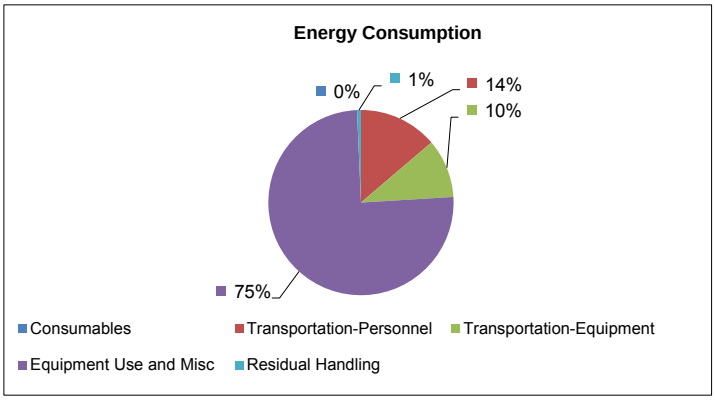
Sustainable Remediation - Environmental Footprint Summary
G-2

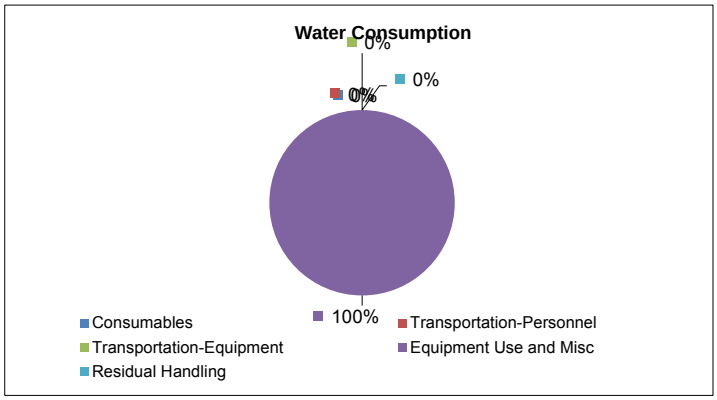
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	3.33	4.2E+01	NA	1.2E-03	4.3E-05	2.5E-04	6.8E-05	5.5E-03
	Transportation-Equipment	2.40	3.1E+01	NA	7.5E-04	1.3E-05	6.7E-05	6.5E-06	5.2E-04
	Equipment Use and Misc	57.69	2.3E+02	5.5E+04	1.1E-02	2.2E-02	3.6E-03	0.0E+00	0.0E+00
	Residual Handling	0.16	2.1E+00	NA	5.0E-05	8.8E-07	4.4E-06	7.8E-07	6.3E-05
	Sub-Total	63.58	3.05E+02	5.48E+04	1.33E-02	2.23E-02	3.94E-03	7.55E-05	6.08E-03
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	9.91	1.2E+02	NA	3.7E-03	1.3E-04	7.4E-04	2.0E-04	1.6E-02
	Transportation-Equipment	3.98	5.2E+01	NA	1.3E-03	2.2E-05	1.1E-04	1.0E-05	8.4E-04
	Equipment Use and Misc	32.29	8.9E+01	2.5E+05	3.7E-03	4.6E-02	3.9E-03	0.0E+00	0.0E+00
	Residual Handling	0.20	2.6E+00	NA	6.2E-05	1.1E-06	5.5E-06	7.8E-07	6.3E-05
	Sub-Total	46.38	2.68E+02	2.50E+05	8.69E-03	4.62E-02	4.79E-03	2.14E-04	1.72E-02
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	6.02	7.6E+01	NA	2.2E-03	7.8E-05	4.5E-04	1.2E-04	9.9E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	49.53	7.4E+02	0.0E+00	1.7E-01	1.1E-01	4.3E-03	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	55.55	8.15E+02	0.00E+00	1.74E-01	1.14E-01	4.80E-03	1.23E-04	9.92E-03
Total		**1.7E+02**	**1.4E+03**	**3.0E+05**	**2.0E-01**	**1.8E-01**	**1.4E-02**	**4.1E-04**	**3.3E-02**

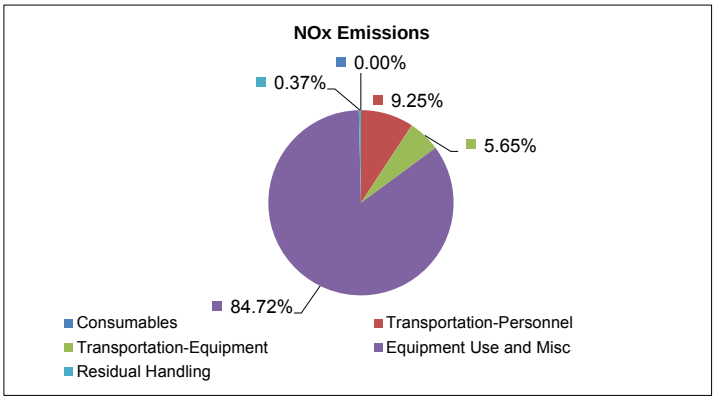
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	4.9E-02
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	1.4E-01
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	7.9E-02
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**2.7E-01**

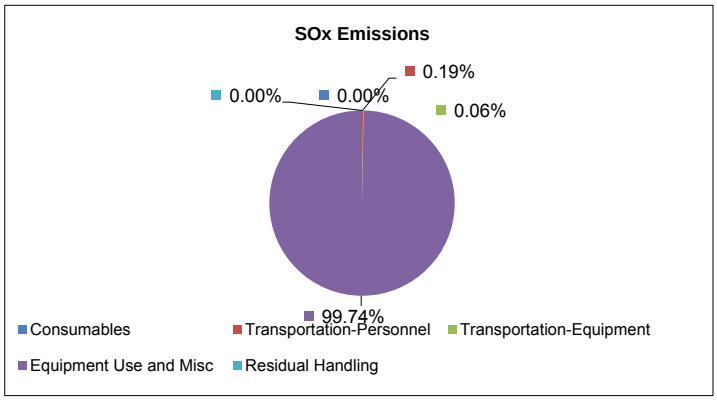
Total Cost with Footprint Reduction
$0

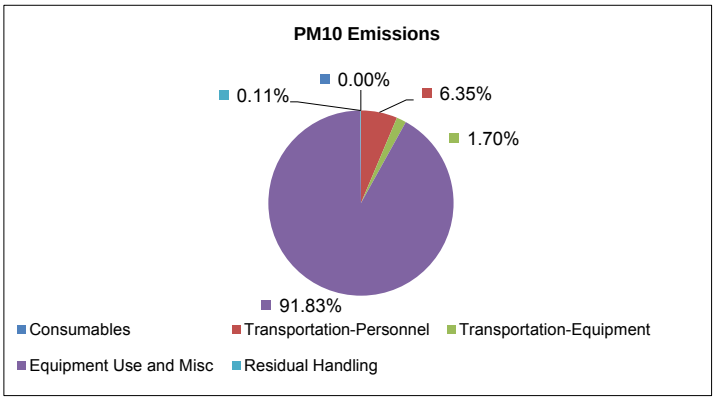

GHG Emissions
0%
5%
4%
0%
91%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

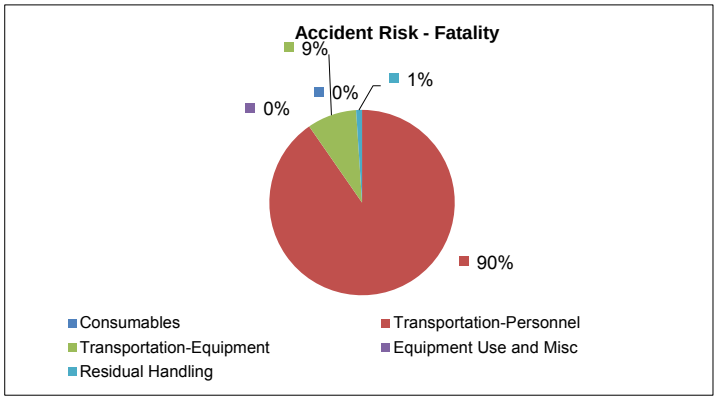

Energy Consumption
0%
1%
14%
10%
75%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

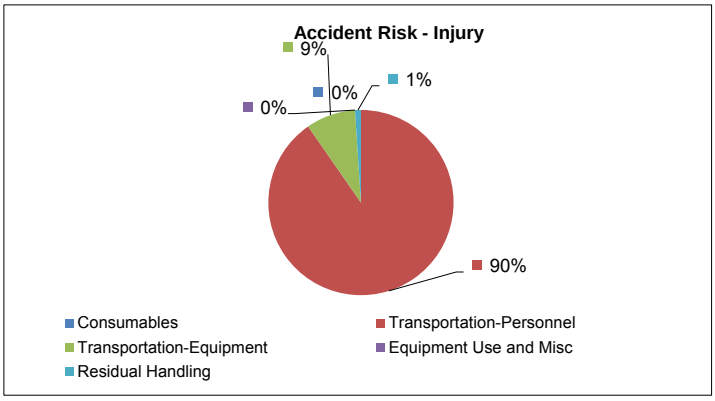

Water Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

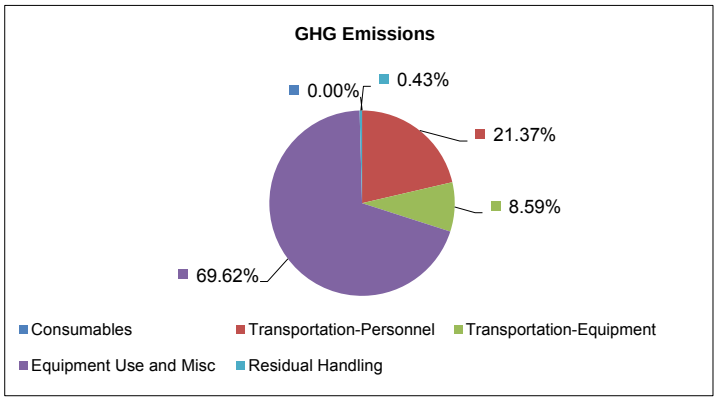

NOx Emissions
0.00%
0.37%
9.25%
5.65%
84.72%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

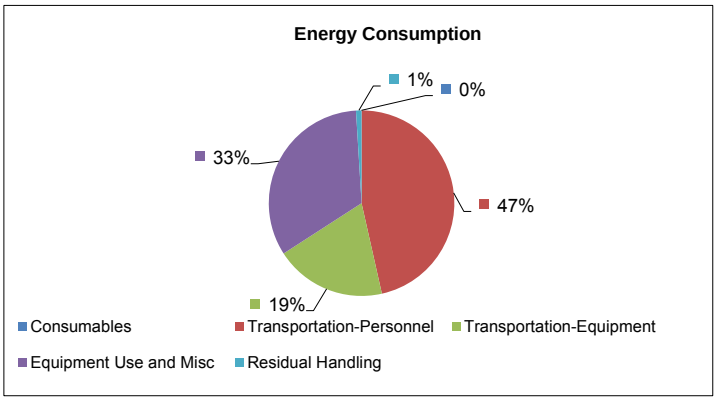

SOx Emissions
0.19%
0.00%
0.00%
0.06%
99.74%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

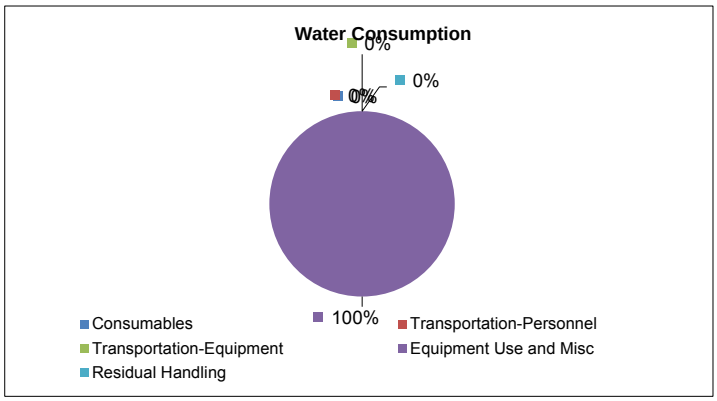

PM10 Emissions
0.00%
0.11%
6.35%
1.70%
91.83%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

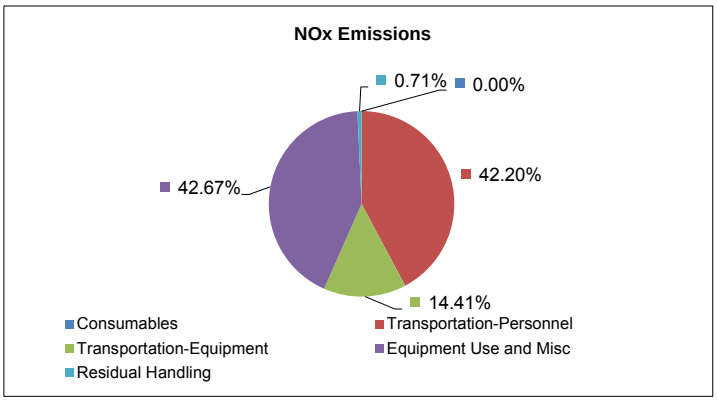

Accident Risk - Fatality
9%
0%
1%
0%
90%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

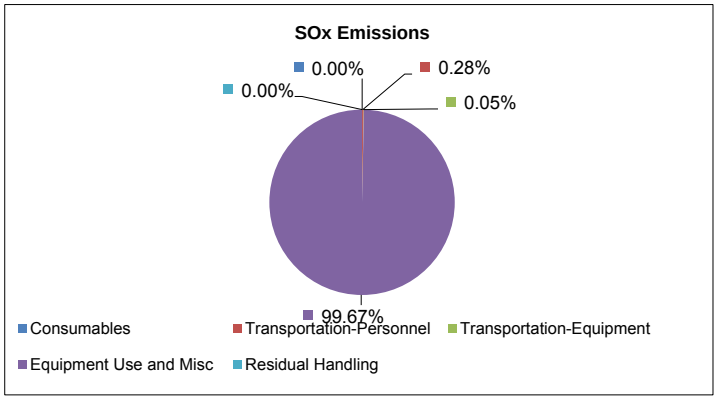

Accident Risk - Injury
9%
0%
1%
0%
90%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

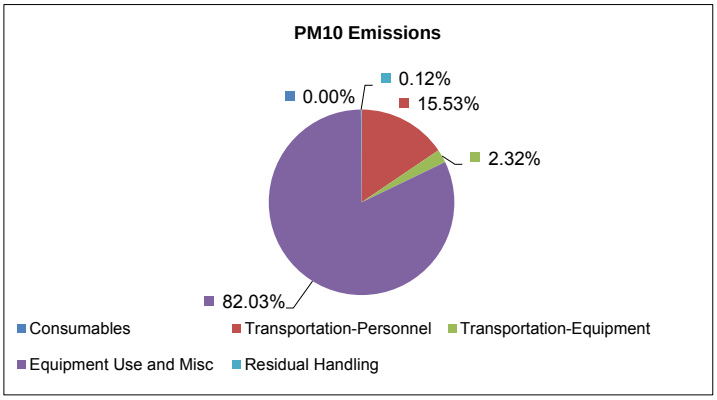

GHG Emissions
0.00%
0.43%
21.37%
8.59%
69.62%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

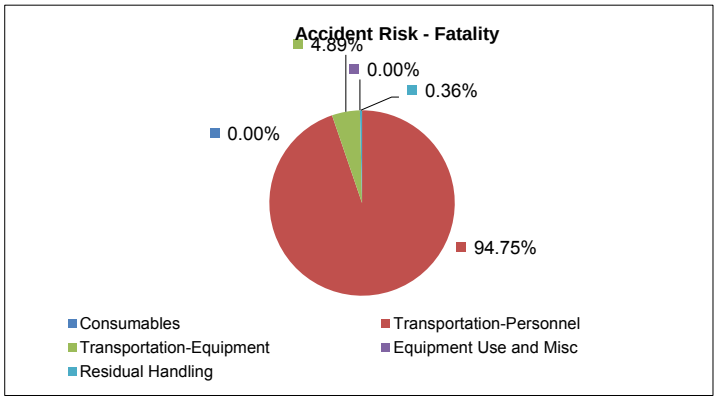

Energy Consumption
1%
0%
33%
47%
19%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

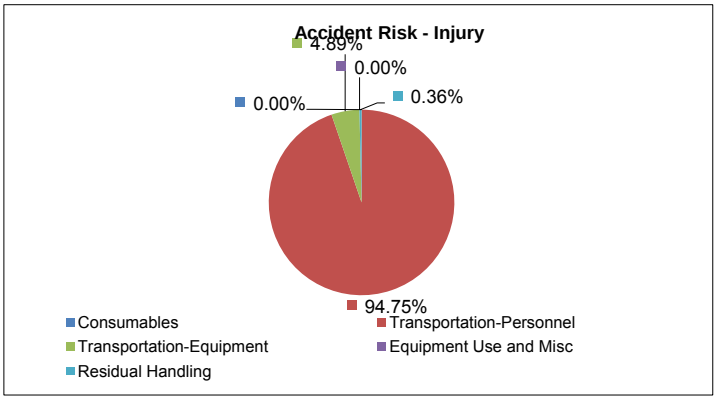

Water Consumption
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

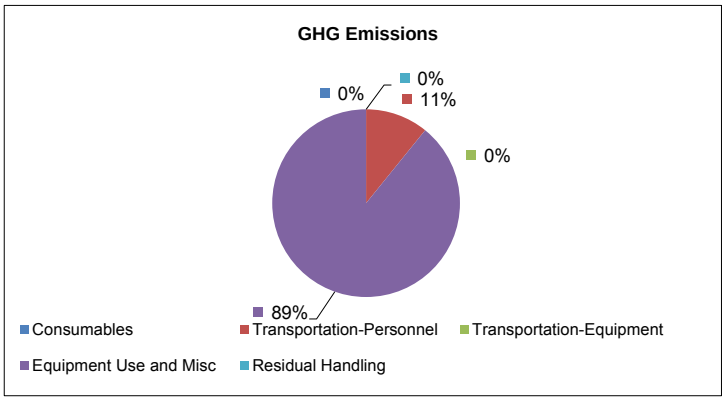

NOx Emissions
0.71%
0.00%
42.20%
42.67%
14.41%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

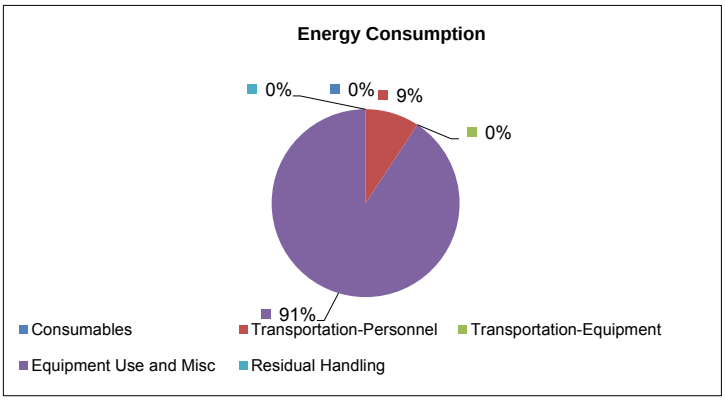

SOx Emissions
0.00%
0.28%
0.00%
0.05%
99.67%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

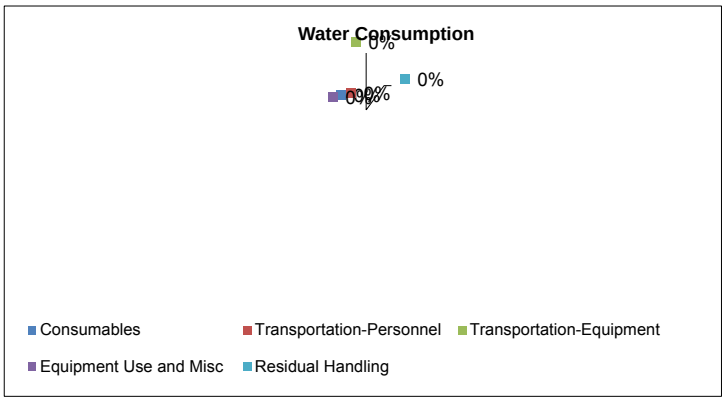

PM10 Emissions
0.12%
0.00%
15.53%
2.32%
82.03%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

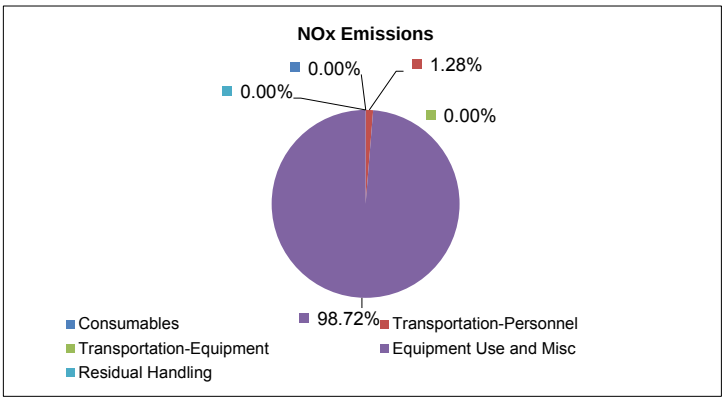

Accident Risk - Fatality
4.89%
0.00%
0.36%
0.00%
94.75%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

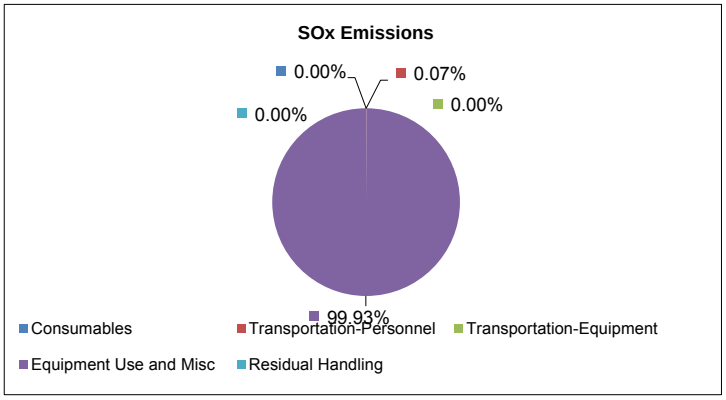

Accident Risk - Injury
4.89%
0.00%
0.00%
0.36%
94.75%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

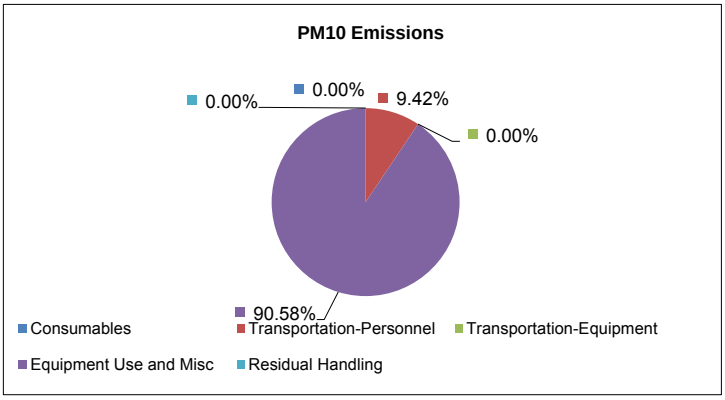

GHG Emissions
0%
0%
11%
0%
89%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

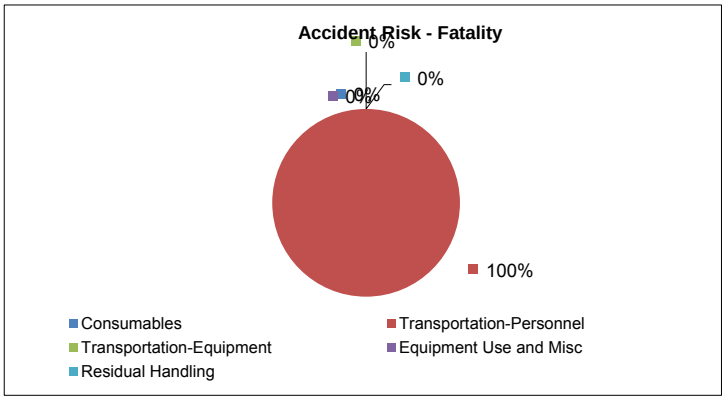

Energy Consumption
0%
0%
9%
0%
91%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

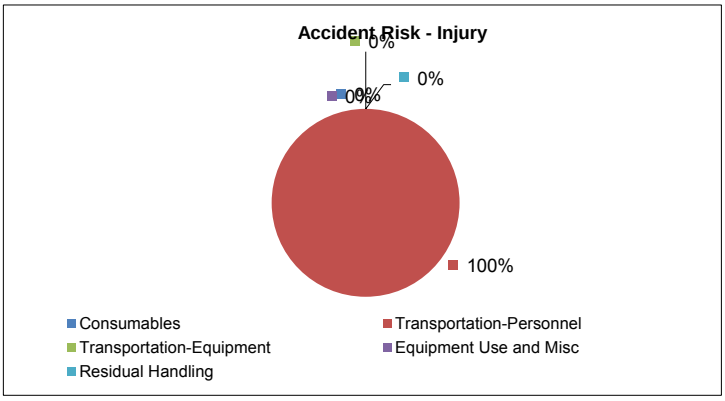

Water Consumption
0%
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

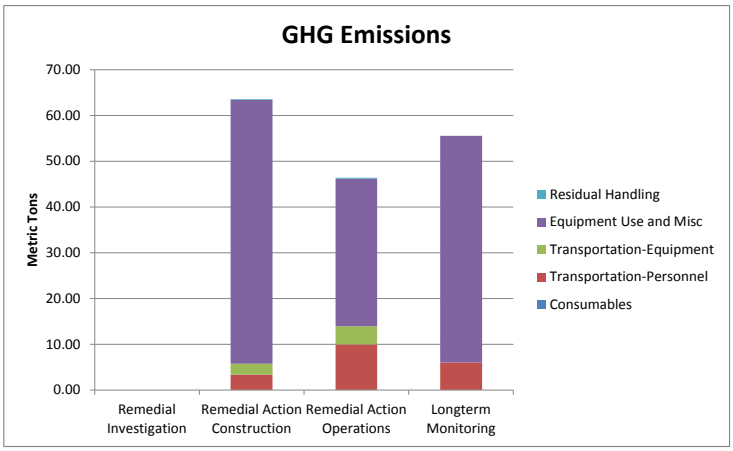

NOx Emissions
0.00%
1.28%
0.00%
0.00%
98.72%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

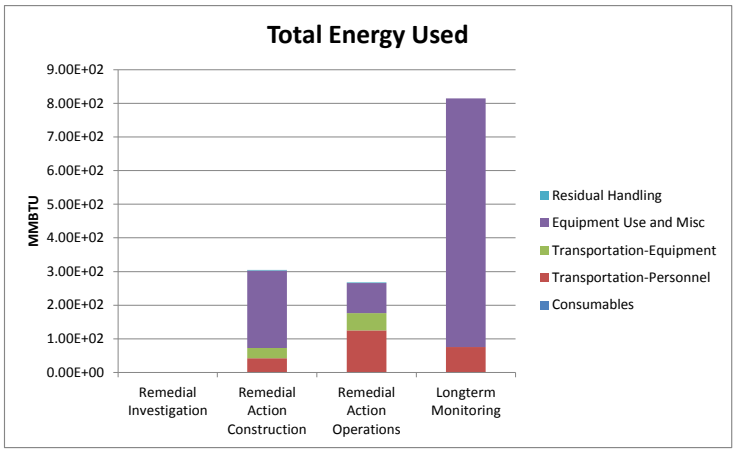

SOx Emissions
0.00%
0.07%
0.00%
0.00%
99.93%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

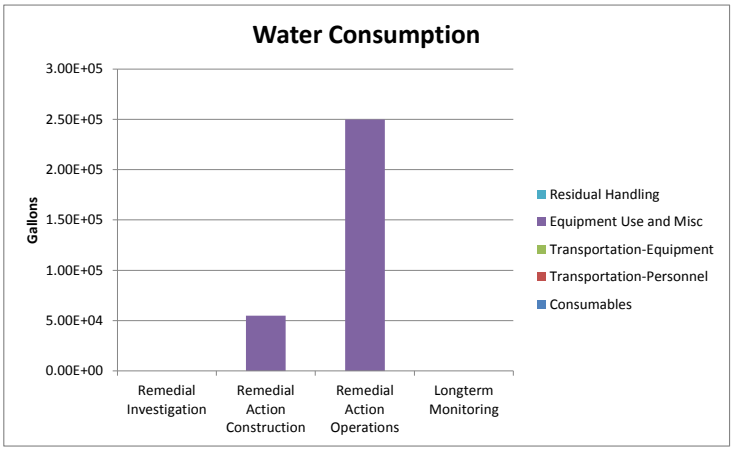

PM10 Emissions
0.00%
0.00%
9.42%
0.00%
90.58%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

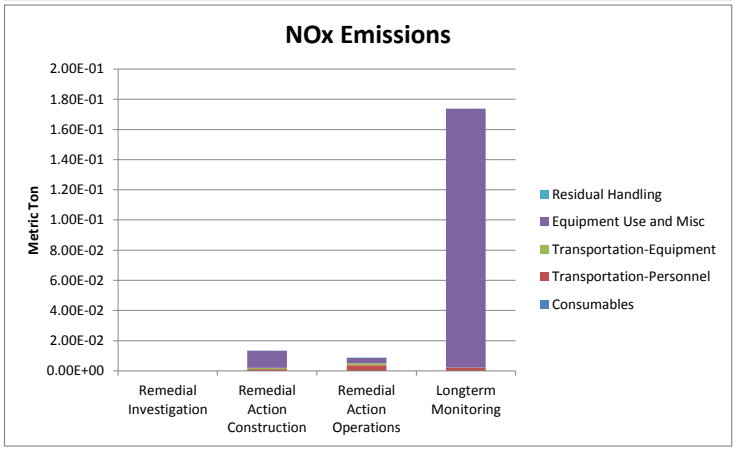

Accident Risk - Fatality
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

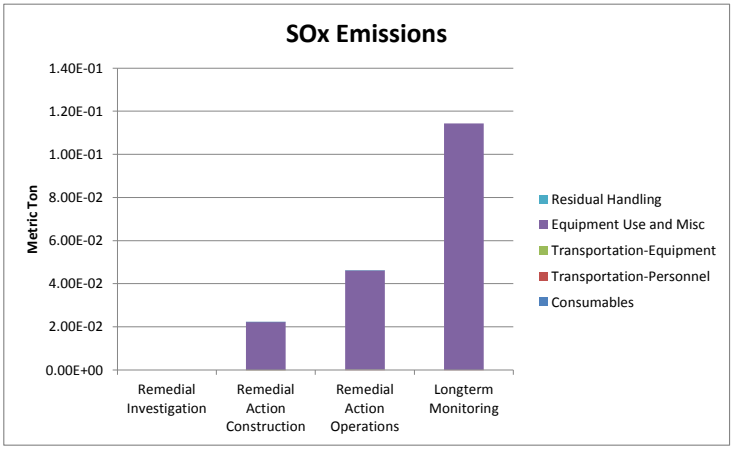

Accident Risk - Injury
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

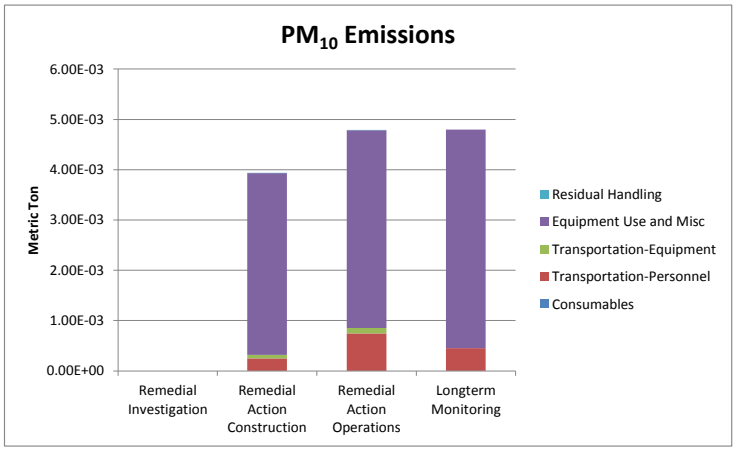

GHG Emissions
Metric Tons
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

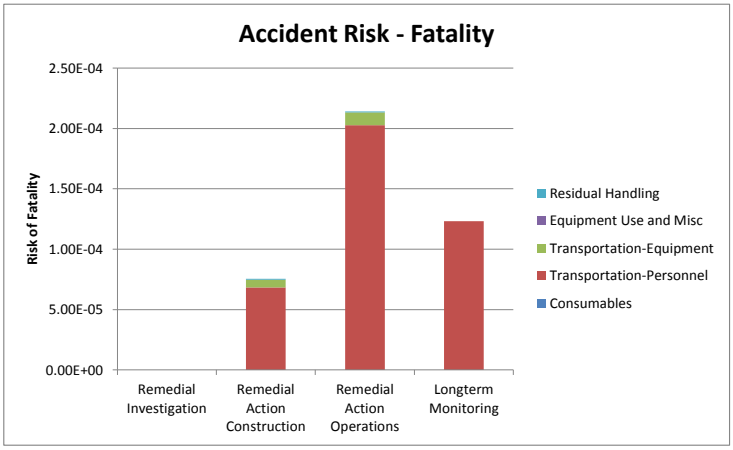

Total Energy Used
MMBTU
9.00E+02
8.00E+02
7.00E+02
6.00E+02
5.00E+02
4.00E+02
3.00E+02
2.00E+02
1.00E+02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

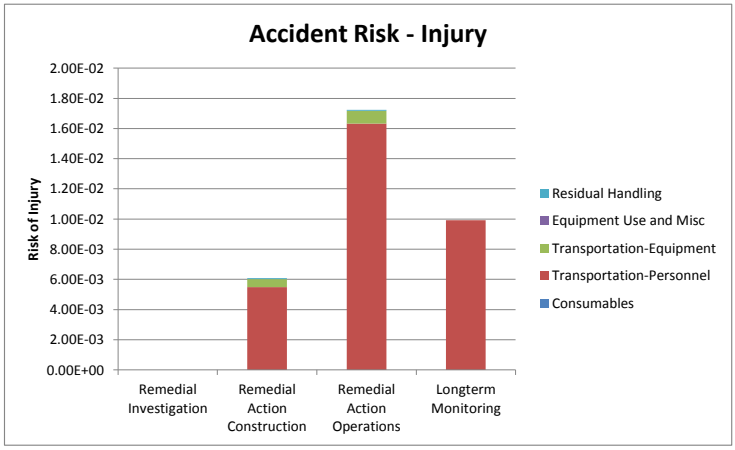

Water Consumption
Gallons
3.00E+05
2.50E+05
2.00E+05
1.50E+05
1.00E+05
5.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
2.00E-01
1.80E-01
1.60E-01
1.40E-01
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
1.40E-01
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM10 Emissions
Metric Ton
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
2.00E-02
1.80E-02
1.60E-02
1.40E-02
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

GSRx Results Alternative G-2
Building 81, NAS South Weymouth
Weymouth, Massachusetts

	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						$CO_{2\ equiv}$	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Injection wells	PVC	1,512 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft	1,512.00	lft	2.45	1.23	0.00	0.01	0.00	0.00	0.00	45.01	2.60
RAC	Temporary Equipment Decon Pad	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad	Wood	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3	441.16	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Material handling pad	General Concrete	5000 sf, 1 ft deep, assume concrete, density 2371 kg/m3	740,083.48	lbs	43.63	43.63	0.00	0.00	0.00	0.00	0.00	0.20	0.00
RAC	Material handling pad	HDPE	HDPE Liner, 5000 sf, 10 oz/sy, 16 oz/lb	343.75	lbs	0.77	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.06
RAC	Injection well heads	PVC	49 well heads, assume PVC, assume 25 lb per well head	1,225.00	lbs	2.76	1.39	0.00	0.02	0.00	0.01	0.00	0.02	0.96
RAC	AquaBupH	Vegetable Oil	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg	27,473.60	lbs	4.11	4.11	0.00	0.00	0.00	0.00	0.00	0.06	5.63
RAC	Seeding, Mulch	Mulch	15 msf, assume mulch assume, 50 lb per msf	750.00	lbs	0.24	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	Seeding, Fertilizer	Fertilizer	15 msf, assume fertilizer, assume 20 lb per smf	300.00	lbs	0.37	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.06
RAO	Temporary Equipment Decon Pad	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3, for years 5,10,15,20,25	3,502.36	lbs	7.82	4.13	0.01	0.03	0.00	0.02	0.00	0.02	0.57
RAO	Temporary Equipment Decon Pad	Wood	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3, for years 5,10,15,20,25	2,205.79	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RAO	AquaBupH	Vegetable Oil	Assume Vegetable Oil, 50 drums, 55 gallons per drum, 8.92 ppg, for years 5, 10, 15, 20, 25	137,368.00	lbs	20.56	20.56	0.00	0.00	0.00	0.02	0.00	0.32	28.14
	Subtotal					**84.30**	**76.77**	**0.02**	**0.07**	**0.00**	**0.06**	**0.00**	**54.82**	**38.27**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Drill Rig, DPT	Drill Rig, DPT (diesel)	5 wells per day, 49 wells, 8 hours a day, 80% utilization	62.72	hrs	1.01	0.98	0.00	0.00	0.01	0.00	0.00	7.67	
	Subtotal					**1.01**	**0.98**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**7.67**	**0**
				Total		**85**	**78**	**0.02**	**0.07**	**0.01**	**0.06**	**0.01**	**62**	**38**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	$CO_{2\ equiv}$	CO_2	N_20 (CO2e)	CH_4 (CO2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	56.91	53.04	3.01	0.86	0.01	0.02	0.00	212.02	9,555.53
RAO	28.40	24.71	3.05	0.63	-	0.04	0.00	1.18	28,719.11
LTM	-	-	-	-	-	-	-	-	-

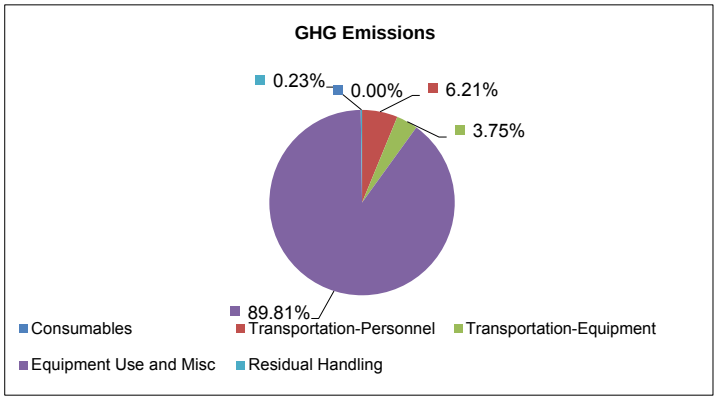
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

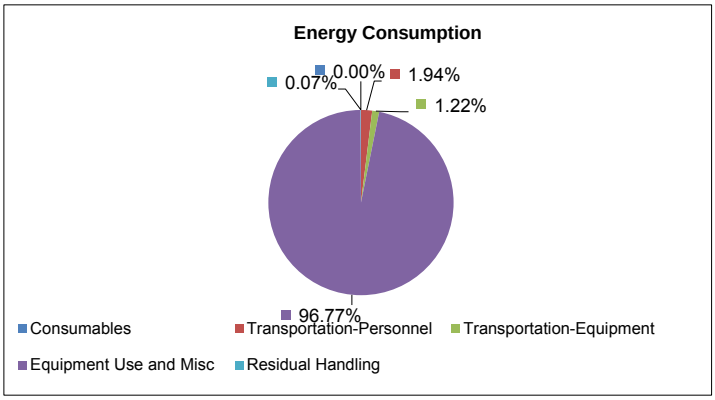
Sustainable Remediation - Environmental Footprint Summary
G-3

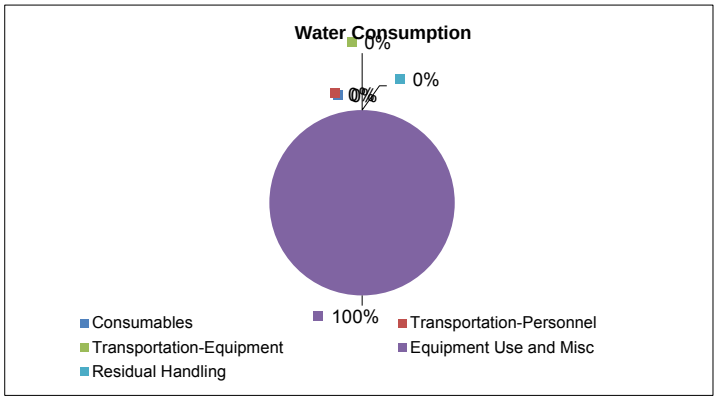
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	4.29	5.4E+01	NA	1.6E-03	5.6E-05	3.2E-04	8.8E-05	7.1E-03
	Transportation-Equipment	2.59	3.4E+01	NA	8.1E-04	1.4E-05	7.2E-05	7.2E-06	5.8E-04
	Equipment Use and Misc	61.97	2.7E+03	7.2E+04	1.7E-02	2.9E-02	5.0E-03	2.0E-05	5.1E-03
	Residual Handling	0.16	2.1E+00	NA	5.0E-05	8.8E-07	4.4E-06	7.8E-07	6.3E-05
	Sub-Total	69.00	2.77E+03	7.17E+04	1.90E-02	2.93E-02	5.42E-03	1.16E-04	1.28E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	12.61	1.6E+02	NA	4.7E-03	1.6E-04	9.5E-04	2.6E-04	2.1E-02
	Transportation-Equipment	4.02	5.2E+01	NA	1.3E-03	2.2E-05	1.1E-04	1.0E-05	8.3E-04
	Equipment Use and Misc	32.64	2.7E+03	2.9E+05	3.8E-03	4.6E-02	3.9E-03	0.0E+00	0.0E+00
	Residual Handling	0.20	2.6E+00	NA	6.2E-05	1.1E-06	5.5E-06	7.8E-07	6.3E-05
	Sub-Total	49.47	2.93E+03	2.88E+05	9.75E-03	4.67E-02	5.01E-03	2.69E-04	2.17E-02
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	4.69	5.9E+01	NA	1.7E-03	6.1E-05	3.5E-04	9.6E-05	7.7E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	49.53	7.4E+02	0.0E+00	1.7E-01	1.1E-01	4.3E-03	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	54.22	7.98E+02	0.00E+00	1.73E-01	1.14E-01	4.70E-03	9.59E-05	7.72E-03
Total		**1.7E+02**	**6.5E+03**	**3.6E+05**	**2.0E-01**	**1.9E-01**	**1.5E-02**	**4.8E-04**	**4.2E-02**

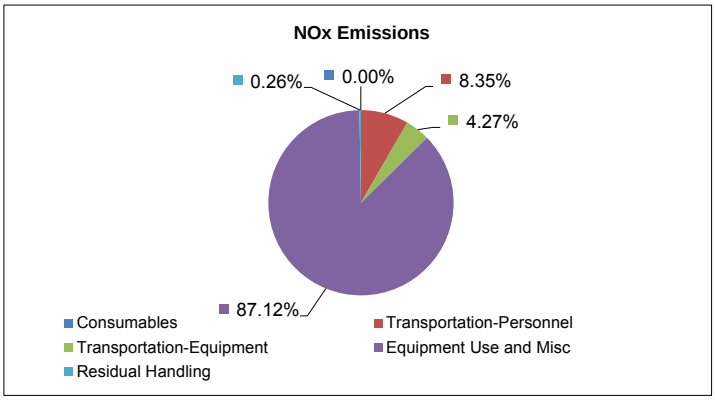
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	1.0E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	1.7E-01
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	6.2E-02
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**3.4E-01**

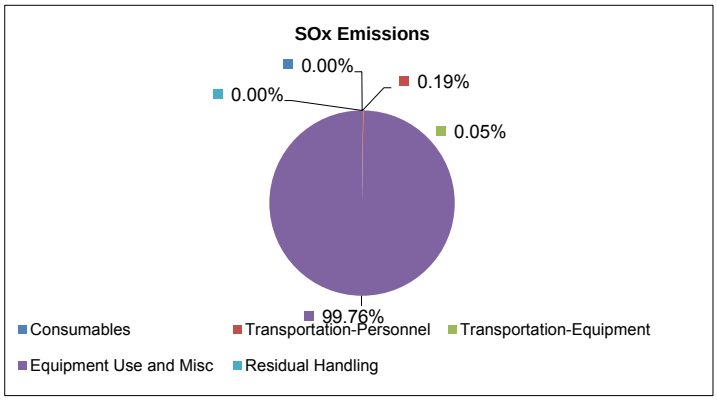
Total Cost with Footprint Reduction
$0

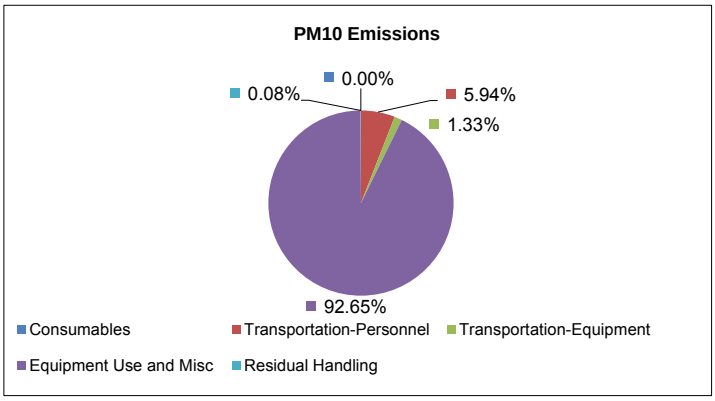

GHG Emissions
0.23%
0.00%
6.21%
3.75%
89.81%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

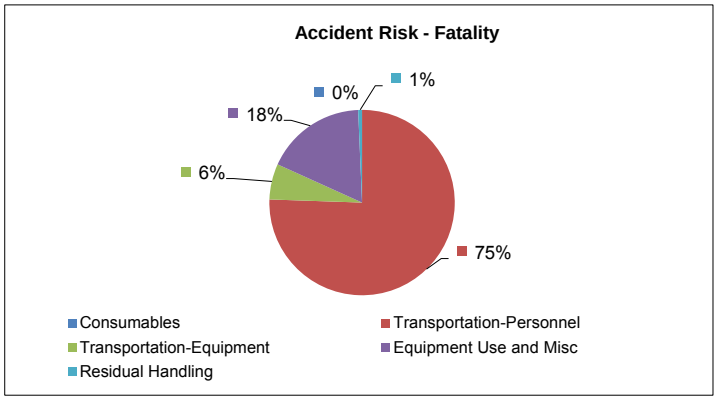

Energy Consumption
0.07%
0.00%
1.94%
1.22%
96.77%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

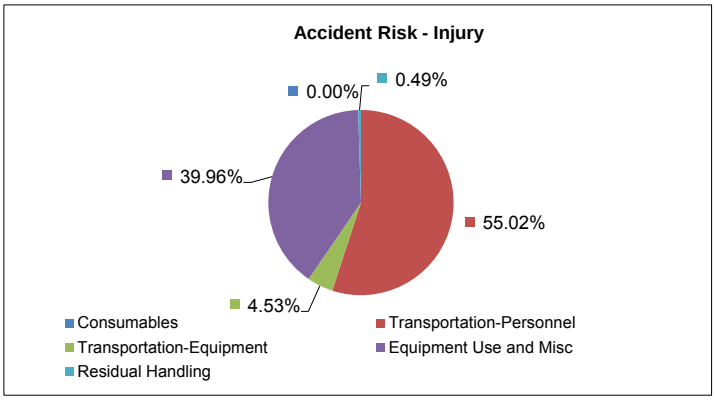

Water Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

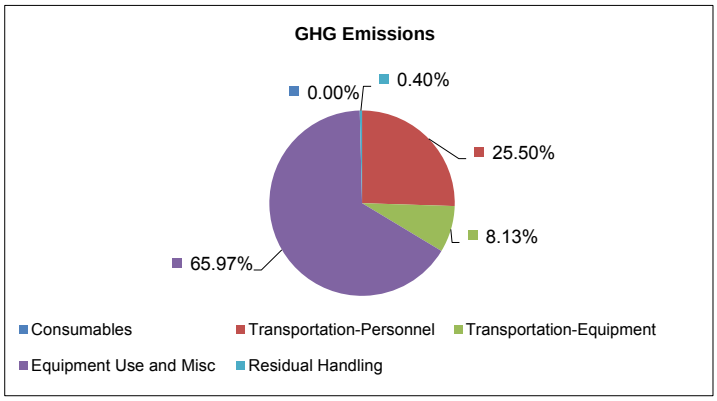

NOx Emissions
0.26%
0.00%
8.35%
4.27%
87.12%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

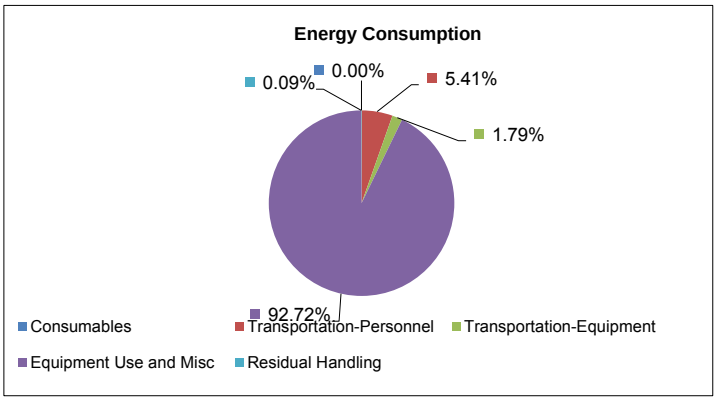

SOx Emissions
0.00%
0.00%
0.19%
0.05%
99.76%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

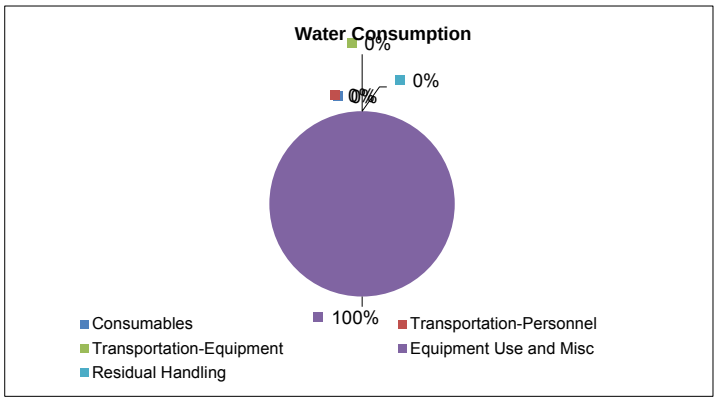

PM10 Emissions
0.08%
0.00%
5.94%
1.33%
92.65%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

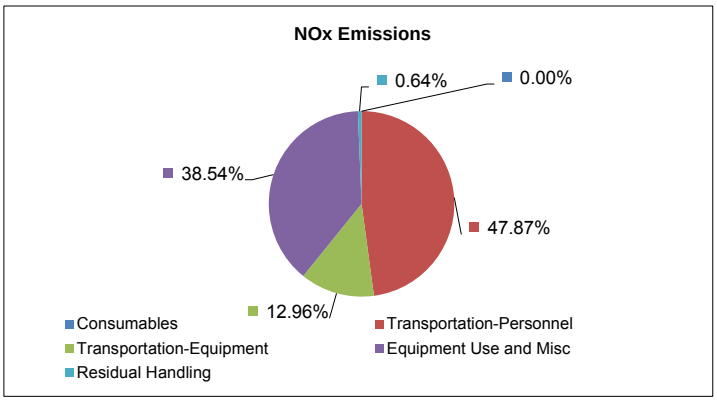

Accident Risk - Fatality
0%
1%
18%
6%
75%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

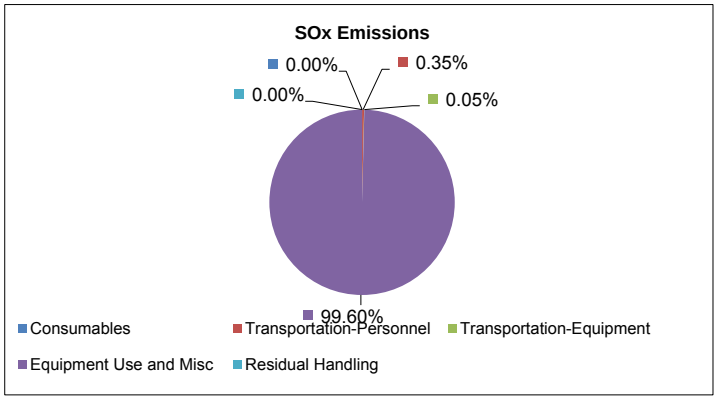

Accident Risk - Injury
0.00%
0.49%
39.96%
55.02%
4.53%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

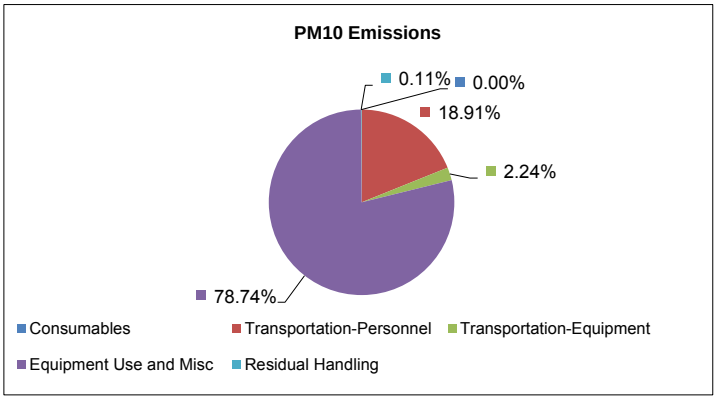

GHG Emissions
0.00%
0.40%
25.50%
8.13%
65.97%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

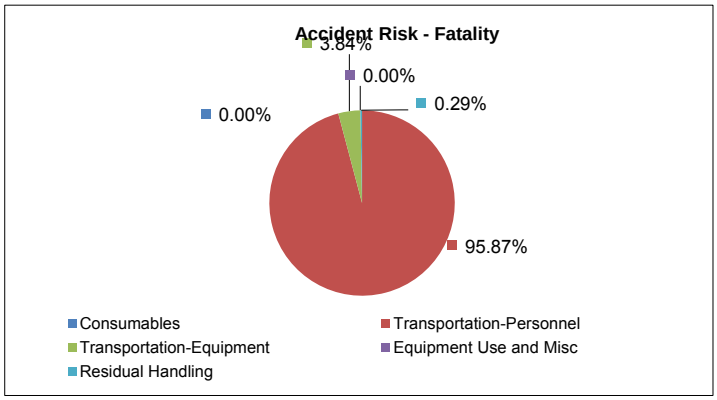

Energy Consumption
0.09%
0.00%
5.41%
1.79%
92.72%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

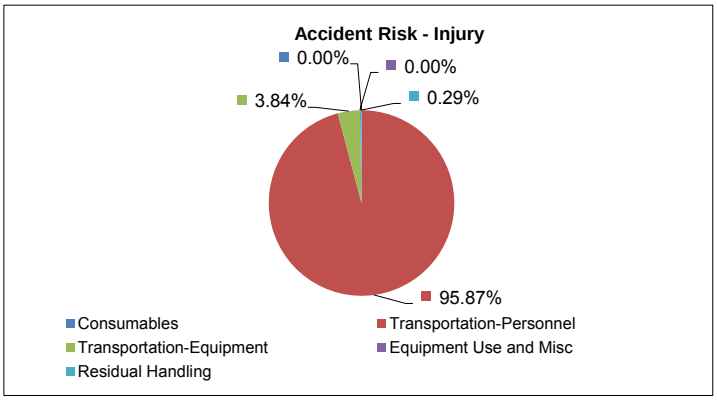

Water Consumption
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

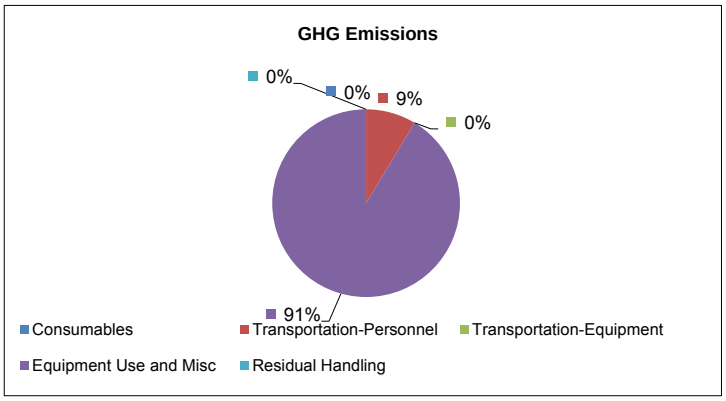

NOx Emissions
0.64%
0.00%
38.54%
47.87%
12.96%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

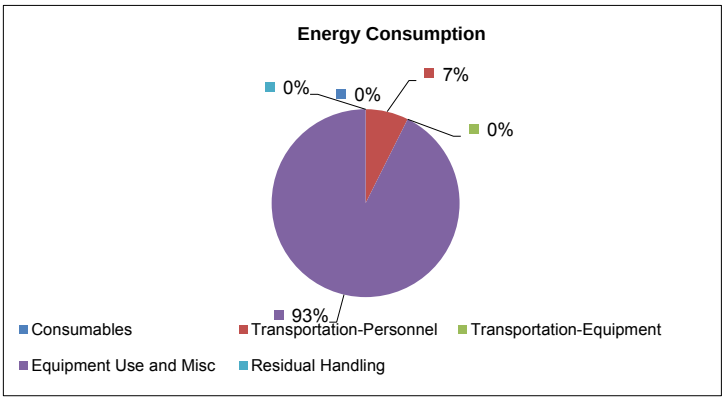

SOx Emissions
0.00%
0.35%
0.00%
0.05%
99.60%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

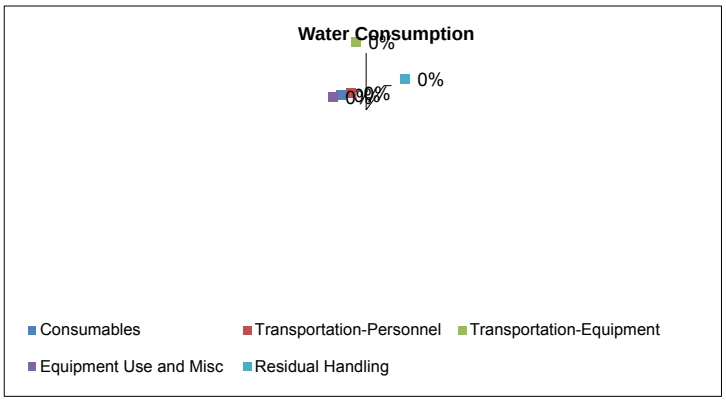

PM10 Emissions
0.11%
0.00%
18.91%
2.24%
78.74%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

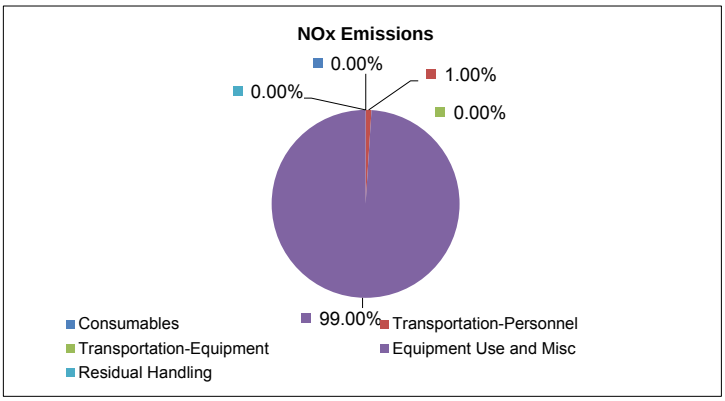

Accident Risk - Fatality
3.84%
0.00%
0.00%
0.29%
95.87%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

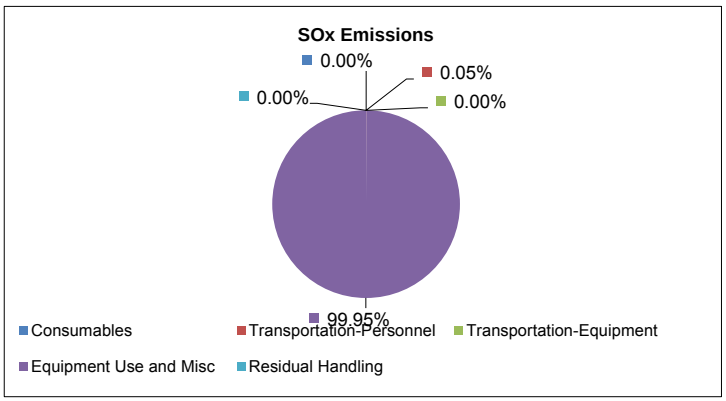

Accident Risk - Injury
0.00%
0.00%
3.84%
0.29%
95.87%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

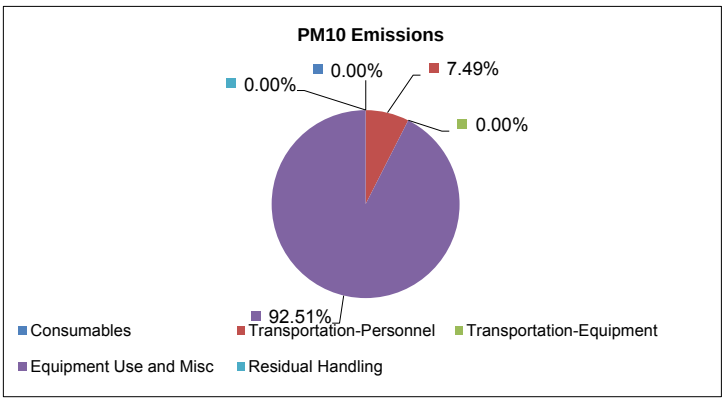

GHG Emissions
0%
0%
9%
0%
91%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

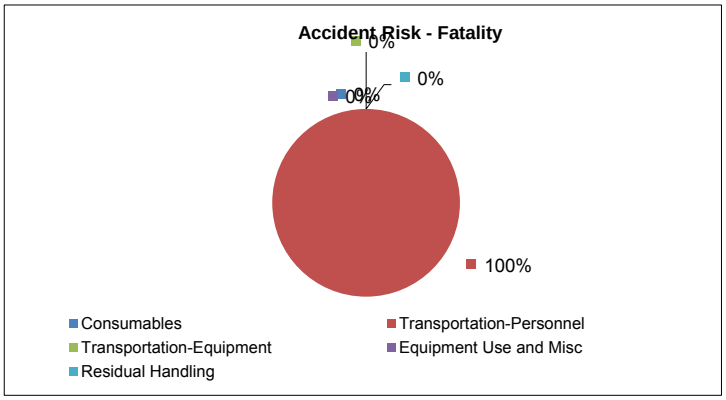

Energy Consumption
0%
0%
7%
0%
93%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

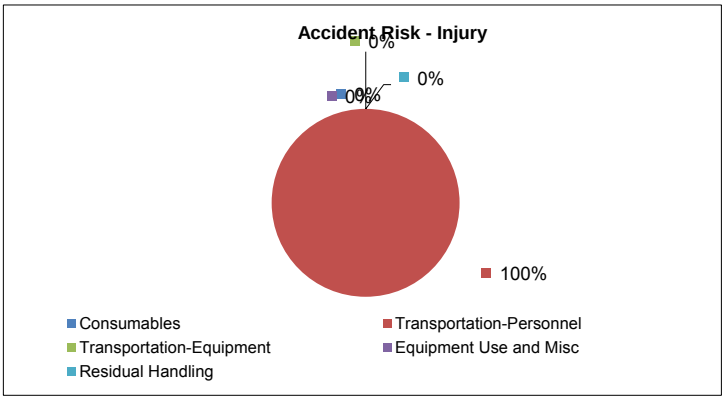

Water Consumption
0%
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

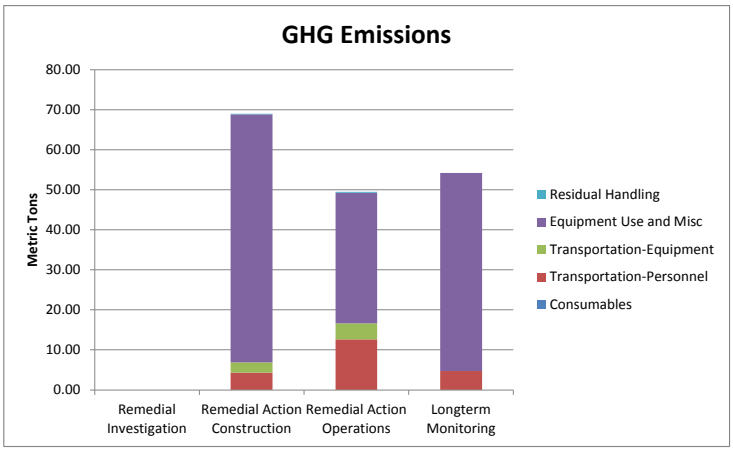

NOx Emissions
0.00%
1.00%
0.00%
0.00%
99.00%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

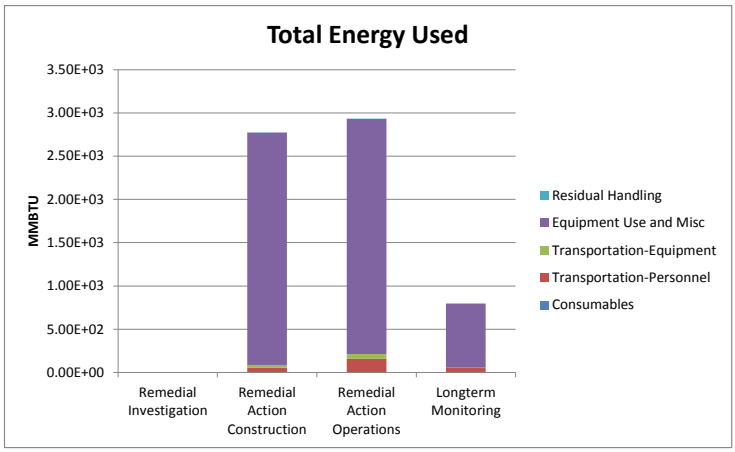

SOx Emissions
0.00%
0.05%
0.00%
0.00%
99.95%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

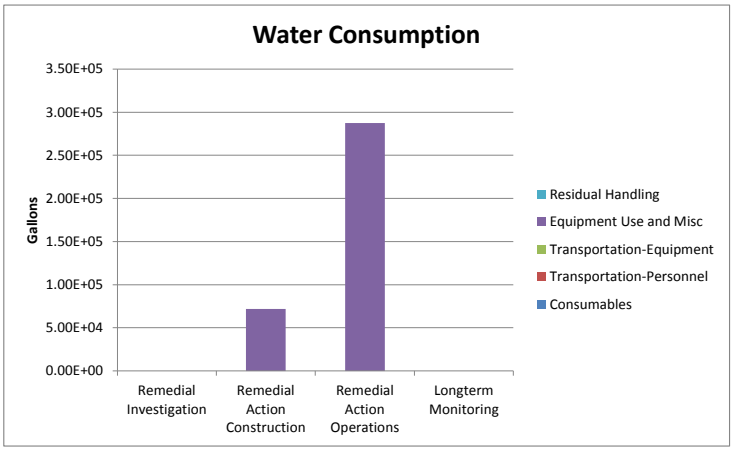

PM10 Emissions
0.00%
0.00%
7.49%
0.00%
92.51%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

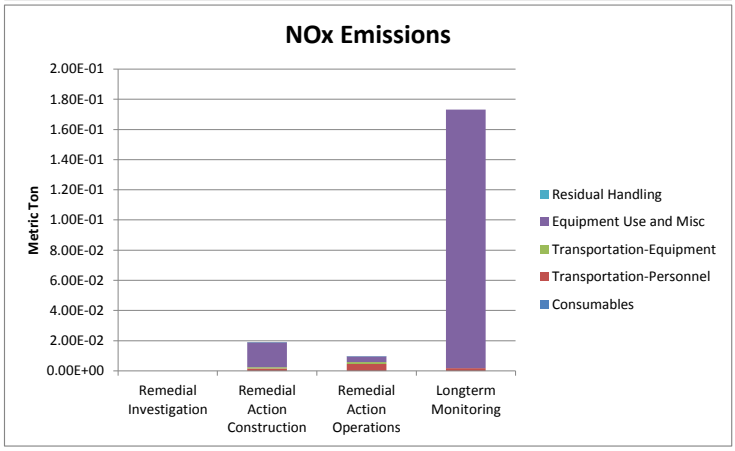

Accident Risk - Fatality
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

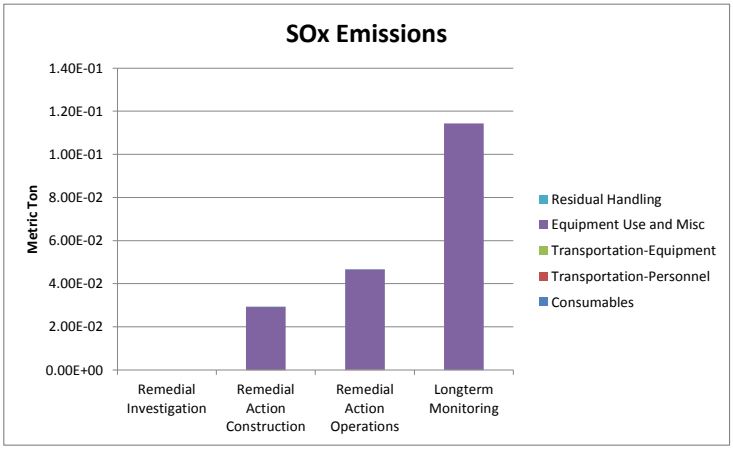

Accident Risk - Injury
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

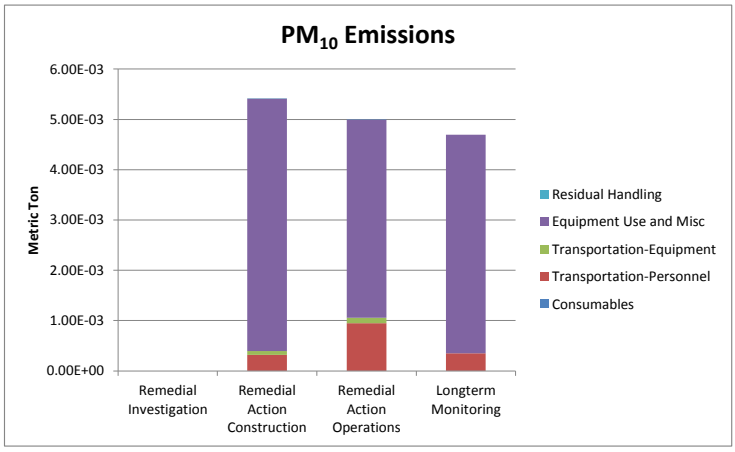

GHG Emissions
Metric Tons
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

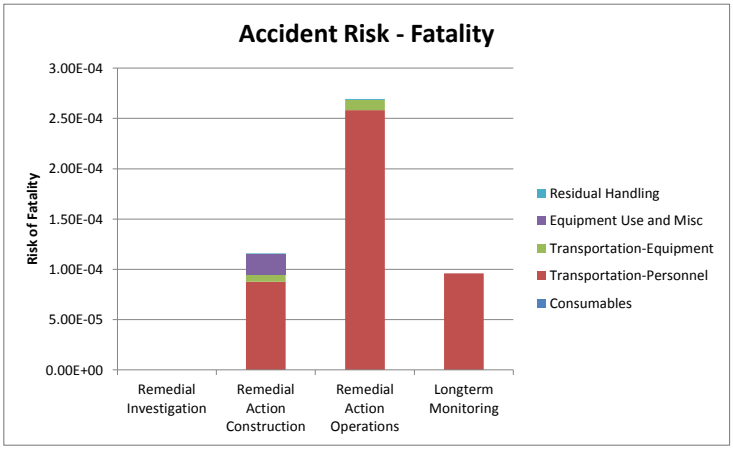

Total Energy Used
MMBTU
3.50E+03
3.00E+03
2.50E+03
2.00E+03
1.50E+03
1.00E+03
5.00E+02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

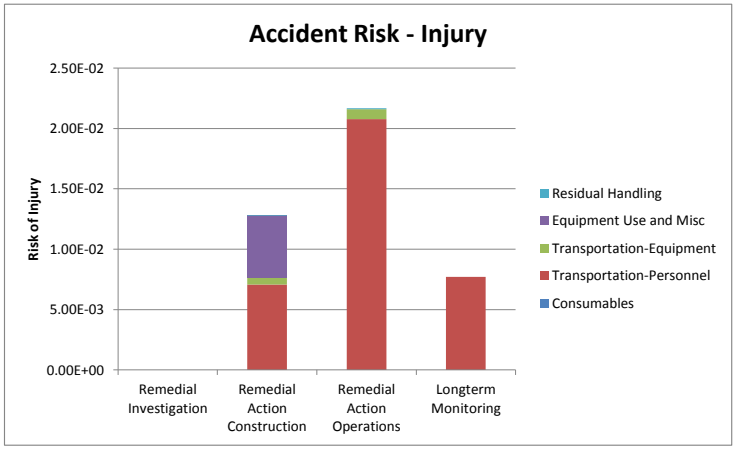

Water Consumption
Gallons
3.50E+05
3.00E+05
2.50E+05
2.00E+05
1.50E+05
1.00E+05
5.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
2.00E-01
1.80E-01
1.60E-01
1.40E-01
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
1.40E-01
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM10 Emissions
Metric Ton
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

GSRx Results Alternative G-3
Building 81, NAS South Weymouth
Weymouth, Massachusetts

	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						$CO_{2\ equiv}$	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Injection wells	PVC	1032 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft	1,032.00	lft	1.67	0.84	0.00	0.01	0.00	0.00	0.00	30.72	1.77
RAC	Injection wells	PVC	3220 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft	1,512.00	lft	2.45	1.23	0.00	0.01	0.00	0.00	0.00	45.01	2.60
RAC	Temporary Equipment Decon Pad	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad	Wood	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3	441.16	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Material handling pad	General Concrete	5000 sf, 1 ft deep, assume concrete, density 2371 kg/m3	740,083.48	lbs	43.63	43.63	0.00	0.00	0.00	0.00	0.00	430.67	0.00
RAC	Material handling pad	HDPE	HDPE Liner, 5000 sf, 10 oz/sy, 16 oz/lb	343.75	lbs	0.77	0.41	0.00	0.00	0.00	0.00	0.00	4.50	0.12
RAC	Injection well heads	PVC	24 well heads, assume PVC, assume 25 lb per well head	600.00	lbs	1.35	0.68	0.00	0.01	0.00	0.00	0.00	24.81	1.03
RAC	AquaBupH	Vegetable Oil	Assume Vegetable Oil, 8 drums, 55 gallons per drum, 8.92 ppg	3,924.80	lbs	0.59	0.59	0.00	0.00	0.00	0.00	0.00	20.44	1.77
RAC	Injection well heads	PVC	49 well heads, assume PVC, assume 25 lb per well head	1,225.00	lbs	2.76	1.39	0.00	0.02	0.00	0.01	0.00	50.65	2.11
RAC	AquaBupH	Vegetable Oil	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92ppg	27,473.60	lbs	4.11	4.11	0.00	0.00	0.00	0.00	0.00	143.05	12.41
RAC	Seeding, mulch	Mulch	17 msf, assume mulch assume, 50 lb per msf	850.00	lbs	0.27	0.09	0.00	0.00	0.00	0.00	0.00	3.04	0.00
RAC	Seeding, fertilizer	Fertilizer	17 msf, assume fertilizer, assume 20 lb per smf	340.00	lbs	0.42	0.42	0.00	0.00	0.00	0.00	0.00	7.69	0.15
RAO	Temporary Equipment Decon Pad	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3, for years 5,10,15,20,25	3,502.36	lbs	7.82	4.13	0.01	0.03	0.00	0.02	0.00	45.83	1.26
RAO	Temporary Equipment Decon Pad	Wood	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3, for years 5,10,15,20,25	2,205.79	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.03	0.02
RAO	AquaBupH	Vegetable Oil	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg, for years 5,10,15,20,25	137,368.00	lbs	20.56	20.56	0.00	0.00	0.00	0.02	0.00	715.23	62.05
RAO	AquaBupH	Vegetable Oil	Assume Vegetable Oil, 4 drums, 55 gallons per drum, 8.92 ppg	1,962.40	lbs	0.29	0.29	0.00	0.00	0.00	0.00	0.00	10.22	0.89
	Subtotal					**88.29**	**79.24**	**0.02**	**0.09**	**0.00**	**0.07**	**0.01**	**1541.05**	**86.44**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Drill Rig, DPT	Drill Rig, DPT (diesel)	5 wells per day, 24 wells, 8 hours per day, 80% utilization	30.72	hrs	0.49	0.48	0.00	0.00	0.01	0.00	0.00	3.75	
RAC	Drill Rig, DPT	Drill Rig, DPT (diesel)	5 wells per day, 49 wells, 8 hours per day, 80% utilization	62.72	hrs	1.01	0.98	0.00	0.00	0.01	0.00	0.00	7.67	
	Subtotal					**1.50**	**1.46**	**0.00**	**0.00**	**0.02**	**0.00**	**0.00**	**11.42**	**0**
				Total		**90**	**81**	**0.02**	**0.09**	**0.02**	**0.07**	**0.01**	**1,552**	**86**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	$CO_{2\ equiv}$	CO_2	N_20 (CO2e)	CH_4 (CO2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	61.10	55.69	4.16	1.24	0.02	0.03	0.00	2,665.32	22,227.24
RAO	28.69	25.01	3.05	0.63	-	0.04	0.00	2,631.69	64,212.08
LTM	-	-	-	-	-	-	-	-	-

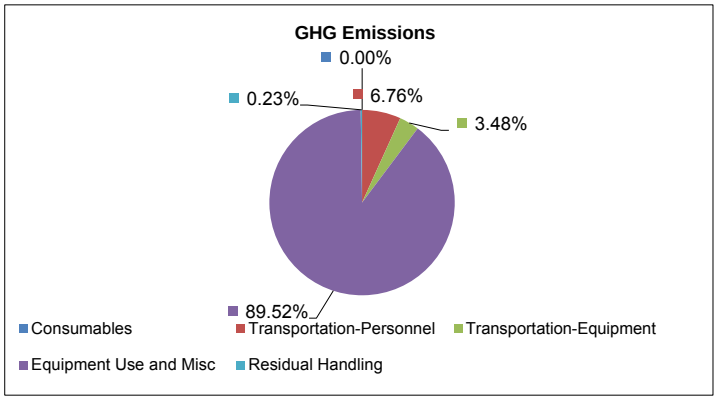
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

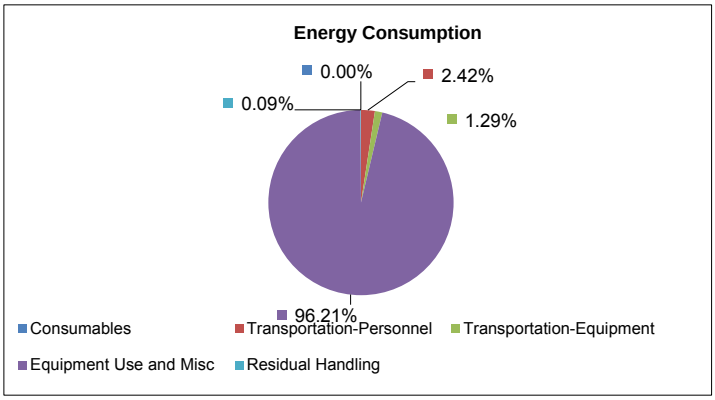
Sustainable Remediation - Environmental Footprint Summary
G-4

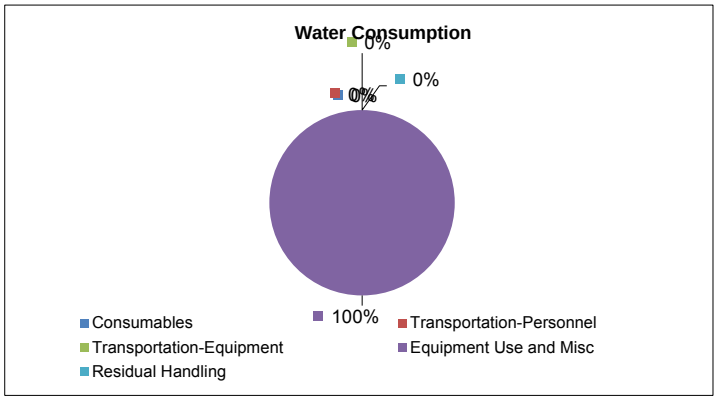
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	4.95	6.2E+01	NA	1.8E-03	6.5E-05	3.7E-04	1.0E-04	8.2E-03
	Transportation-Equipment	2.55	3.3E+01	NA	8.0E-04	1.4E-05	7.1E-05	7.1E-06	5.7E-04
	Equipment Use and Misc	65.59	2.5E+03	6.6E+04	2.9E-02	3.0E-02	4.7E-03	7.0E-06	1.7E-03
	Residual Handling	0.17	2.2E+00	NA	5.3E-05	9.5E-07	4.8E-06	7.8E-07	6.3E-05
	Sub-Total	73.27	2.58E+03	6.57E+04	3.22E-02	3.02E-02	5.16E-03	1.16E-04	1.05E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	12.67	1.6E+02	NA	4.7E-03	1.7E-04	9.5E-04	2.6E-04	2.1E-02
	Transportation-Equipment	0.85	1.1E+01	NA	2.7E-04	4.7E-06	2.4E-05	2.5E-06	2.0E-04
	Equipment Use and Misc	26.77	2.6E+03	2.8E+05	3.7E-03	3.2E-02	1.9E-03	0.0E+00	0.0E+00
	Residual Handling	0.20	2.6E+00	NA	6.2E-05	1.1E-06	5.5E-06	7.8E-07	6.3E-05
	Sub-Total	40.49	2.74E+03	2.84E+05	8.75E-03	3.24E-02	2.88E-03	2.63E-04	2.11E-02
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	6.02	7.6E+01	NA	2.2E-03	7.8E-05	4.5E-04	1.2E-04	9.9E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	49.53	7.4E+02	0.0E+00	1.7E-01	1.1E-01	4.3E-03	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	55.55	8.15E+02	0.00E+00	1.74E-01	1.14E-01	4.80E-03	1.23E-04	9.92E-03
Total		**1.7E+02**	**6.1E+03**	**3.5E+05**	**2.1E-01**	**1.8E-01**	**1.3E-02**	**5.0E-04**	**4.2E-02**

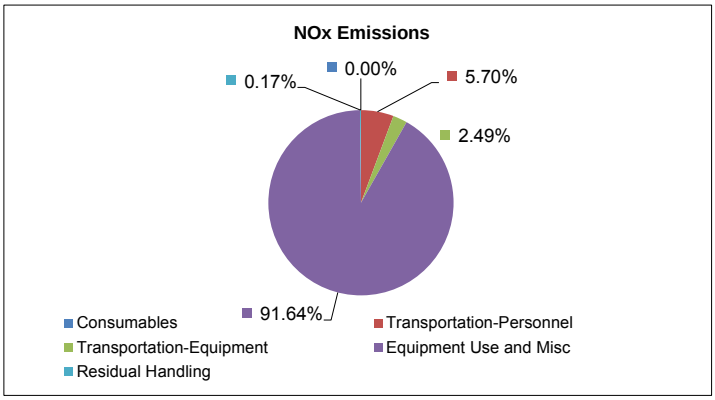
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	8.4E-02
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	1.7E-01
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	7.9E-02
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**3.3E-01**

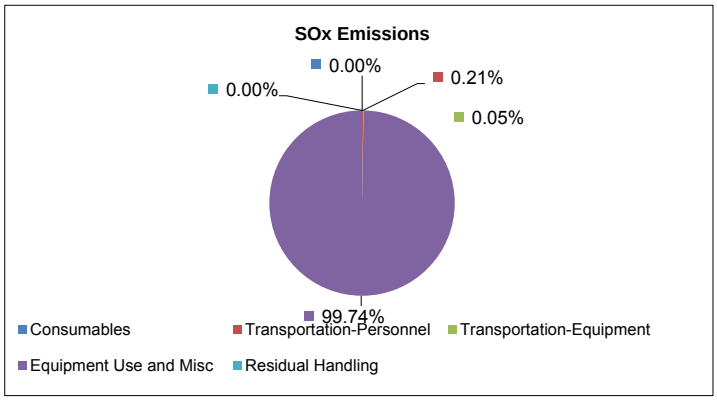
Total Cost with Footprint Reduction
$0

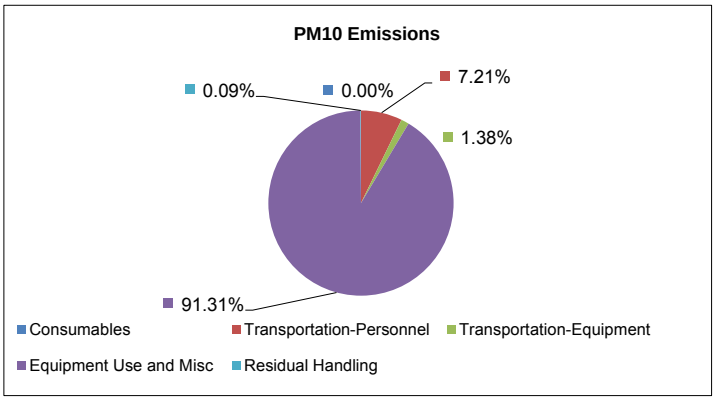

GHG Emissions
0.00%
6.76%
0.23%
3.48%
89.52%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

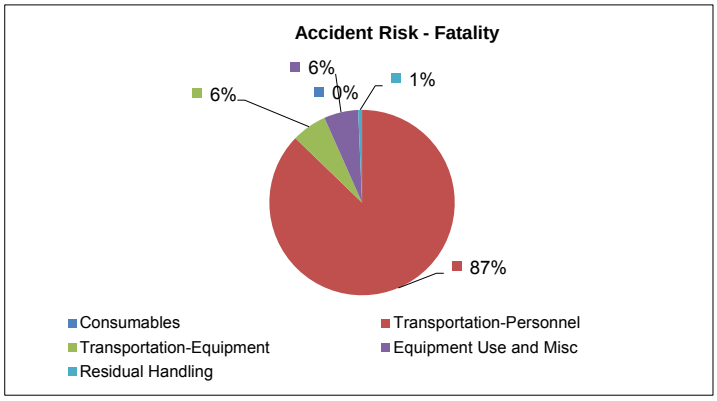

Energy Consumption
0.00%
2.42%
0.09%
1.29%
96.21%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

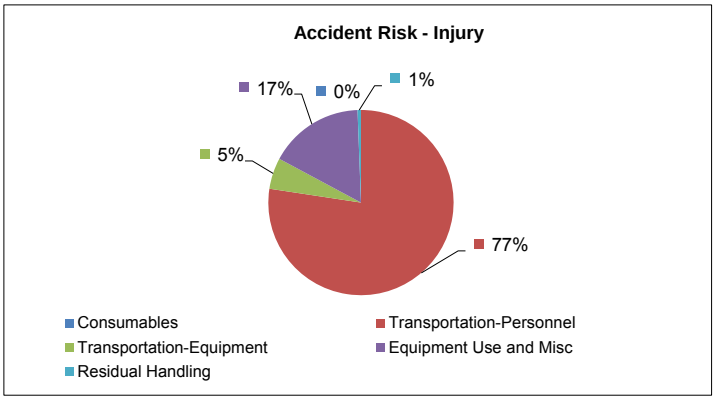

Water Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

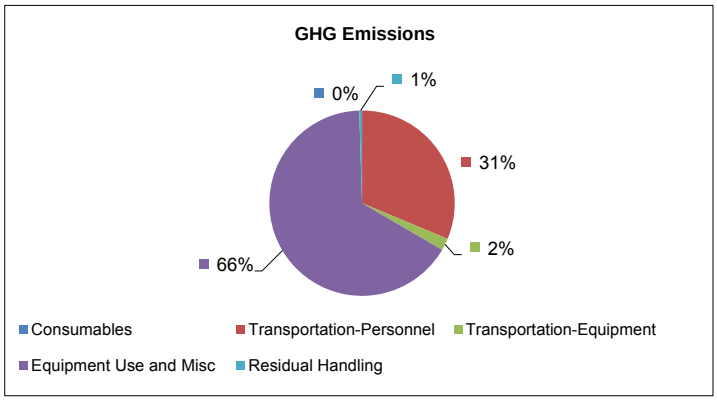

NOx Emissions
0.17%
0.00%
5.70%
2.49%
91.64%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

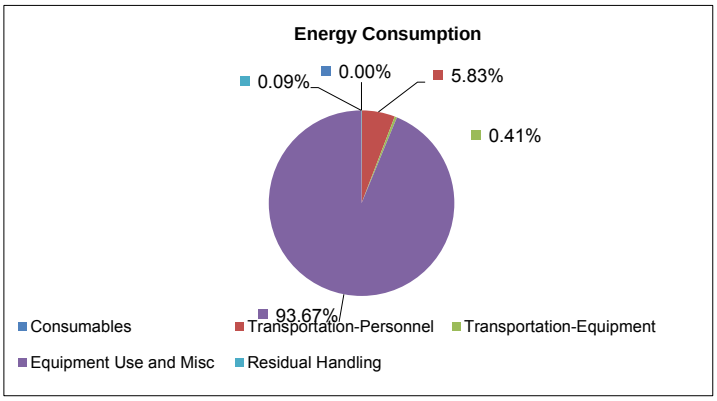

SOx Emissions
0.00%
0.00%
0.21%
0.05%
99.74%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

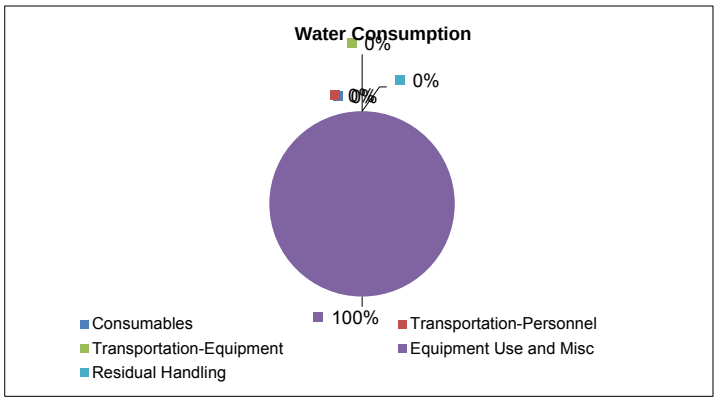

PM10 Emissions
0.09%
0.00%
7.21%
1.38%
91.31%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

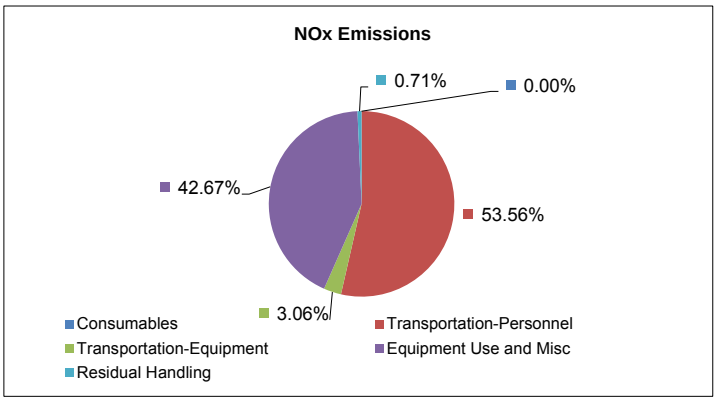

Accident Risk - Fatality
6%
6%
0%
1%
87%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

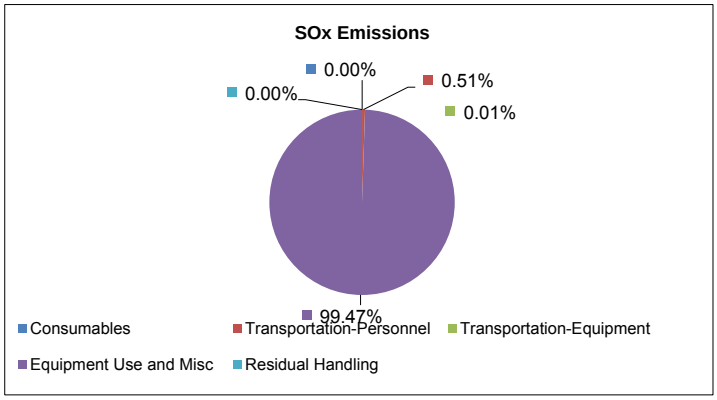

Accident Risk - Injury
17%
0%
1%
5%
77%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

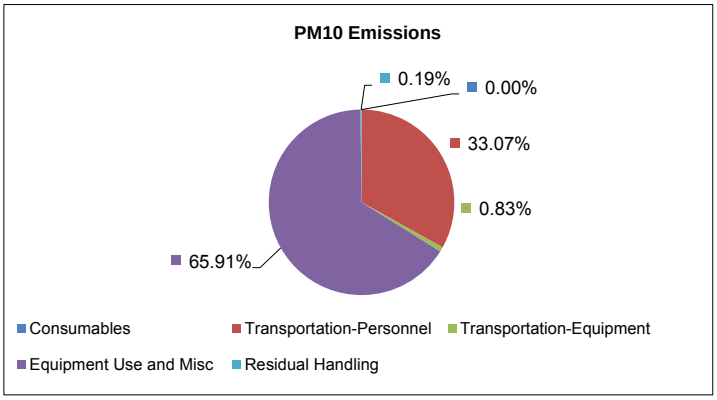

GHG Emissions
0%
1%
31%
2%
66%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

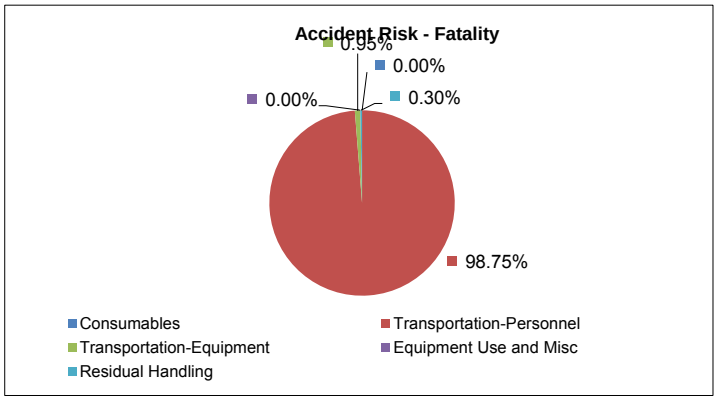

Energy Consumption
0.09%
0.00%
5.83%
0.41%
93.67%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

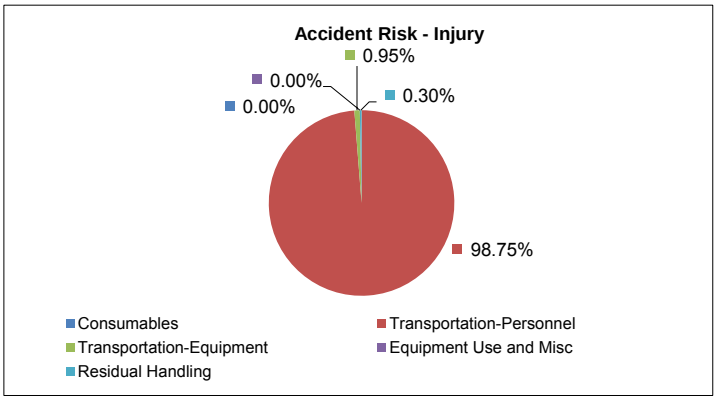

Water Consumption
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

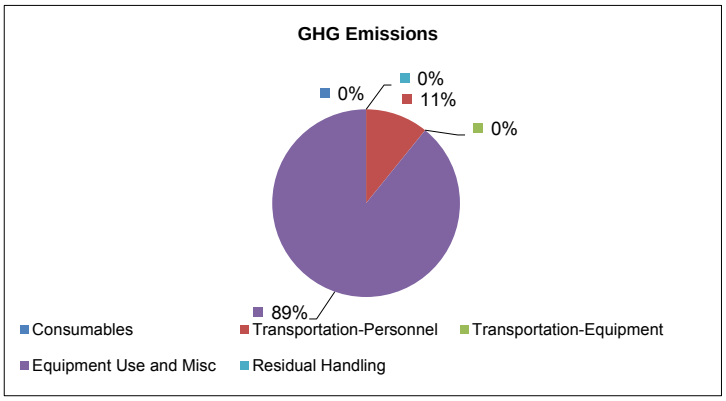

NOx Emissions
0.71%
0.00%
42.67%
53.56%
3.06%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

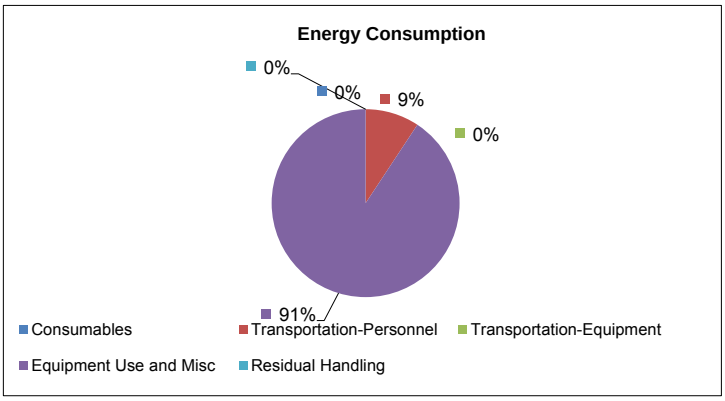

SOx Emissions
0.00%
0.00%
0.51%
0.01%
99.47%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

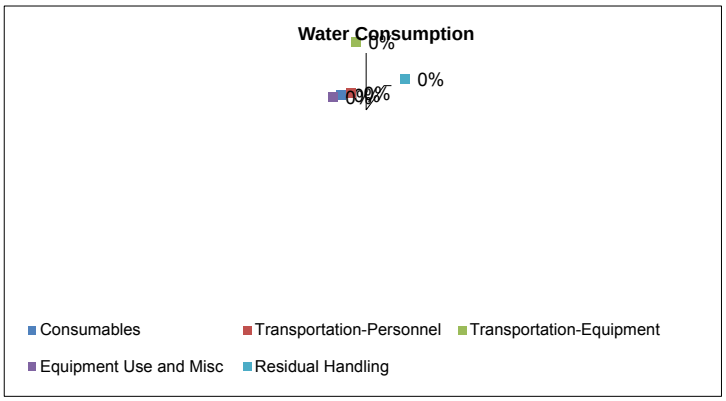

PM10 Emissions
0.19%
0.00%
33.07%
0.83%
65.91%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

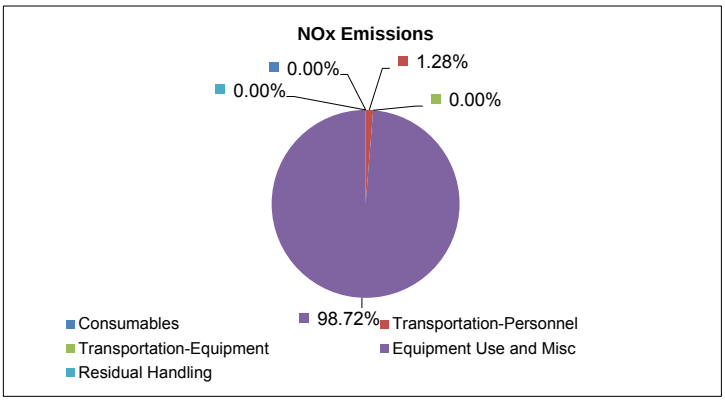

Accident Risk - Fatality
0.95%
0.00%
0.00%
0.30%
98.75%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

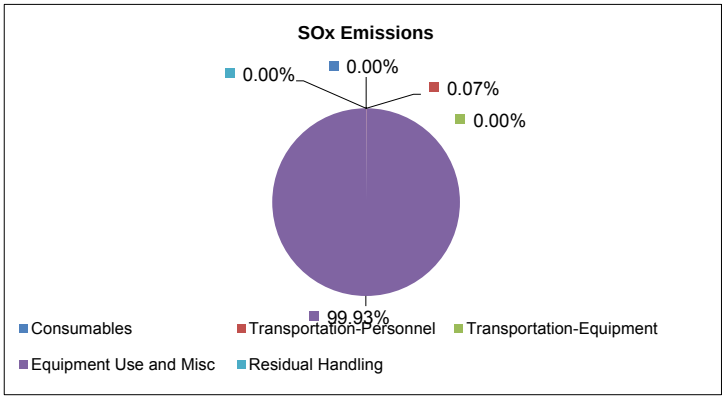

Accident Risk - Injury
0.95%
0.00%
0.00%
0.30%
98.75%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

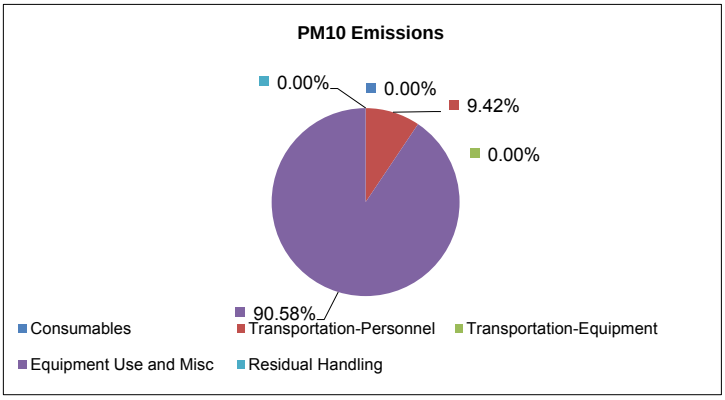

GHG Emissions
0%
0%
11%
0%
89%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

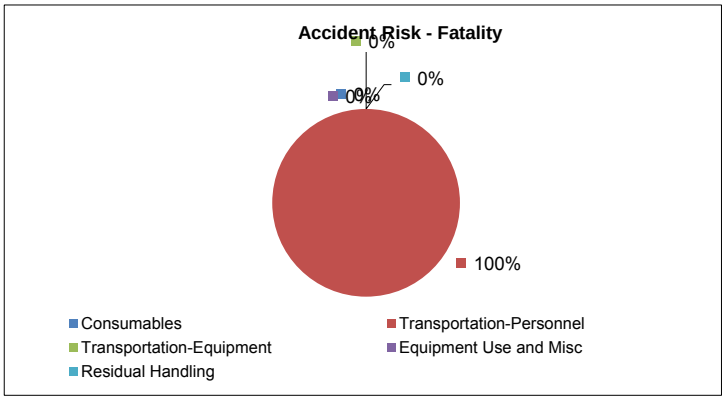

Energy Consumption
0%
0%
9%
0%
91%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

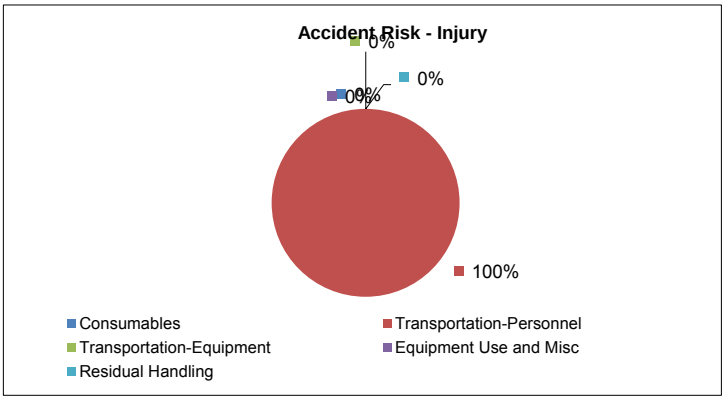

Water Consumption
0%
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

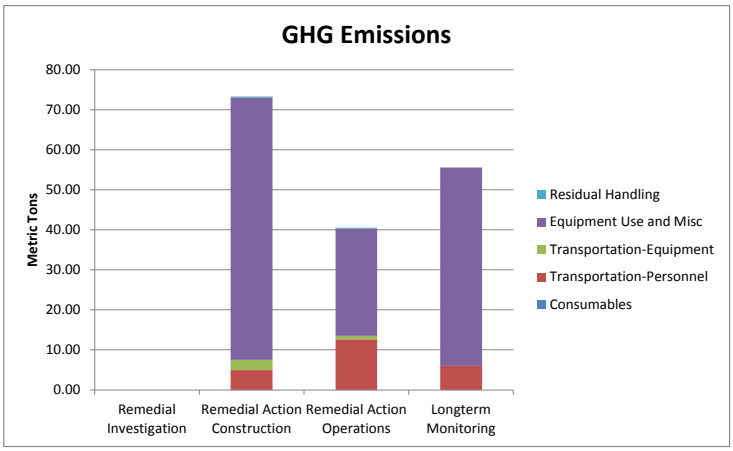

NOx Emissions
0.00%
1.28%
0.00%
0.00%
98.72%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

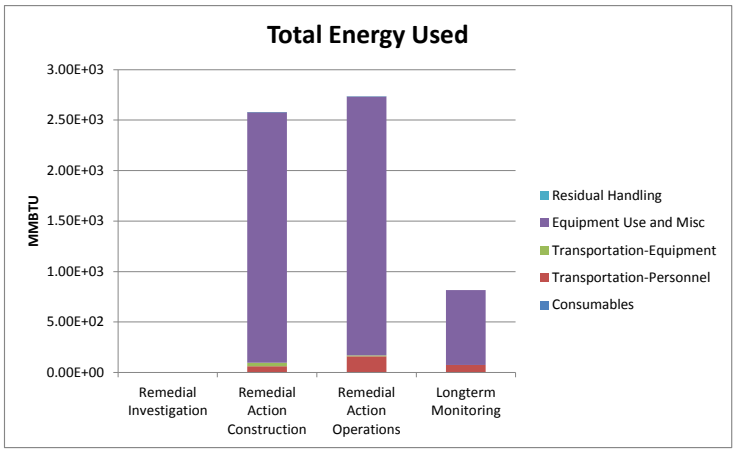

SOx Emissions
0.00%
0.00%
0.07%
0.00%
99.93%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

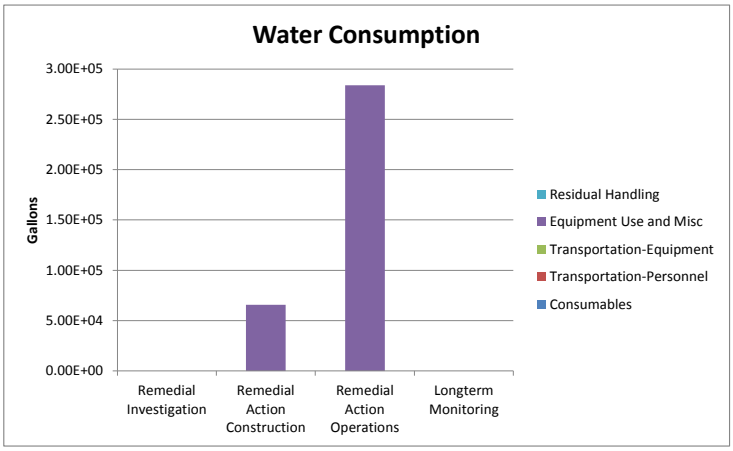

PM10 Emissions
0.00%
0.00%
9.42%
0.00%
90.58%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

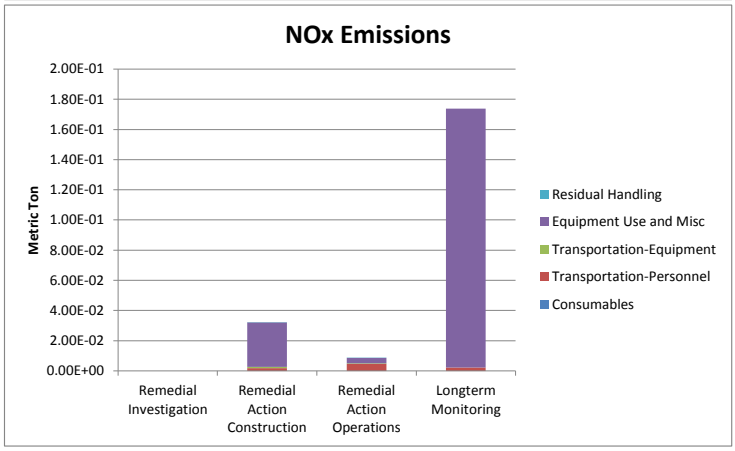

Accident Risk - Fatality
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

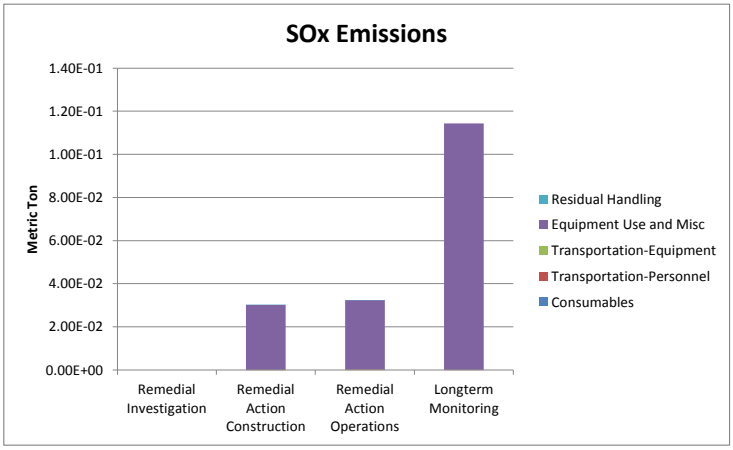

Accident Risk - Injury
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

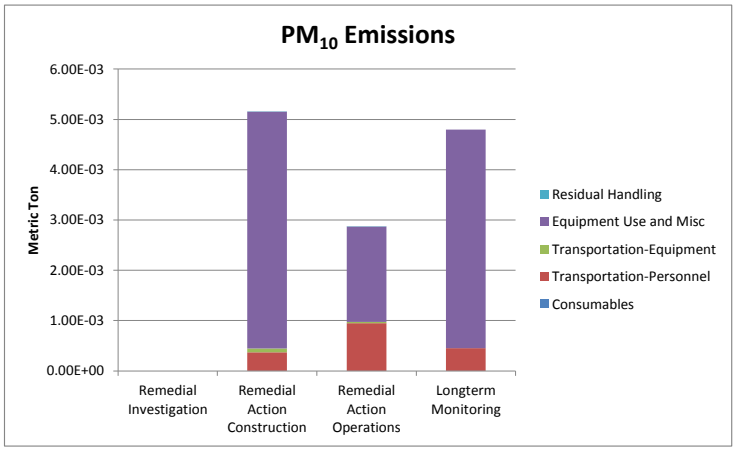

GHG Emissions
Metric Tons
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

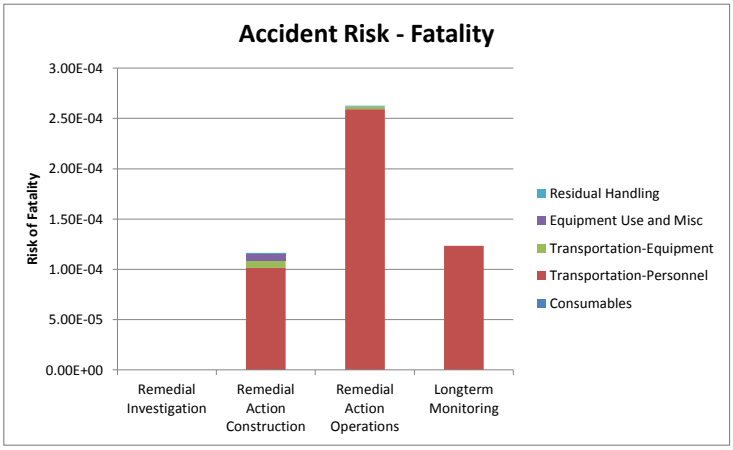

Total Energy Used
MMBTU
3.00E+03
2.50E+03
2.00E+03
1.50E+03
1.00E+03
5.00E+02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

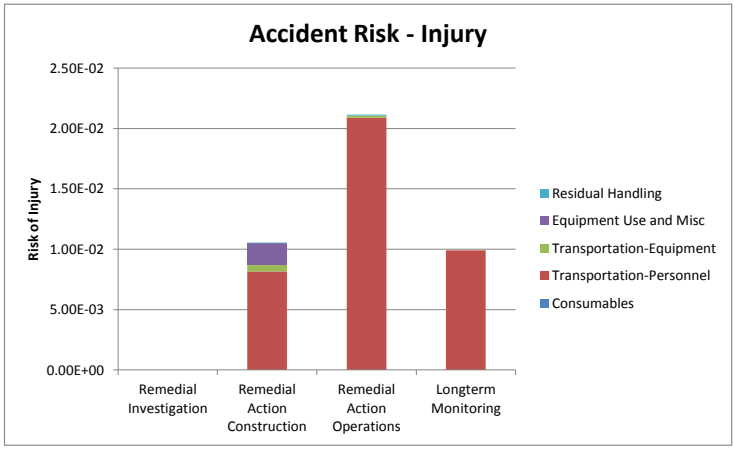

Water Consumption
Gallons
3.00E+05
2.50E+05
2.00E+05
1.50E+05
1.00E+05
5.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
2.00E-01
1.80E-01
1.60E-01
1.40E-01
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
1.40E-01
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM10 Emissions
Metric Ton
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

GSRx Results Alternative G-4
Building 81, NAS South Weymouth
Weymouth, Massachusetts

	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Injection wells	PVC	72 lf, Assume PVC, assume 2 in diameter, 0.72 lb/ft	72.00	lft	0.12	0.06	1.41E-04	6.82E-04	0.00E+00	2.28E-04	3.29E-05	2.14	0.12
RAC	Injection wells	PVC	1,512 lf, assume PVC, 2 in diameter, Schedule 40, 0.72 lb/ft	1512	lft	2.45	1.23	2.96E-03	1.43E-02	0.00E+00	4.79E-03	6.91E-04	45.01	2.60
RAC	Temporary Equipment Decon Pad	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	1.97E-03	6.04E-03	0.00E+00	3.49E-03	5.08E-04	9.17	0.25
RAC	Temporary Equipment Decon Pad	Wood	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3	441.16	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Material handling pad	General Concrete	5000 sf, 1 ft deep, assume concrete, density 2371 kg/m3	740,083.48	lbs	43.63	43.63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	430.67	0.00
RAC	Material handling pad	HDPE	HDPE Liner, 5000 sf, 10 oz/sy, 16 oz/lb	343.75	lbs	0.77	0.41	9.67E-04	2.96E-03	0.00E+00	1.71E-03	2.49E-04	4.50	0.12
RAC	Injection well heads	PVC	4 units, assume 25 lb per unit	100.00	lbs	0.23	0.11	2.72E-04	1.32E-03	0.00E+00	4.40E-04	6.35E-05	4.13	0.17
RAC	Reagents: sodium permanganate	Potassium Permanganate	Assume pottasium permanganate	778.00	lbs	1.44	1.41	7.41E-05	3.53E-04	3.53E-07	1.41E-04	4.23E-07	1.47	0.58
RAC	Reagents: potassium permanganate	Potassium Permanganate	Assume 10 percent to be pottasium permanganate (coating of the sand), 15,000 lb total	1,500.00	lbs	2.78	2.72	1.43E-04	6.80E-04	6.80E-07	2.72E-04	8.16E-07	2.84	1.11
RAC	Reagents: sand blend	Sand	Assume 90% sand blend, 15,000 lb total	13,500.00	lbs	0.03	0.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.83	0.00
RAC	Injection well heads	PVC	49 well heads, assume PVC, assume 25 lb per well head	1,225.00	lbs	2.76	1.39	3.33E-03	1.61E-02	0.00E+00	5.39E-03	7.78E-04	50.65	2.11
RAC	AquaBupH	Vegetable Oil	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg	27,473.60	lbs	4.11	4.11	2.88E-07	0.00E+00	0.00E+00	4.09E-03	1.62E-06	143.05	12.41
RAC	Seeding, Mulch	Mulch	17 msf, assume mulch assume, 50 lb per msf	850.00	lbs	0.27	0.09	5.44E-04	2.89E-04	1.60E-07	9.17E-04	6.94E-05	3.04	0.00
RAC	Seeding, Fertilizer	Fertilizer	17 msf, assume fertilizer, assume 20 lb per smf	340.00	lbs	0.42	0.42	5.58E-10	0.00E+00	0.00E+00	1.54E-04	3.10E-07	7.69	0.15
RAO	Temporary Equipment Decon Pad	HDPE	Assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3, for 1 year in-situ	700.47	lbs	1.56	0.83	1.97E-03	6.04E-03	0.00E+00	3.49E-03	5.08E-04	9.17	0.25
RAO	Temporary Equipment Decon Pad	Wood	Assume wood, 4x4 in, 120 ft of timber, density for pine 530 kg/m3, for 1 year in-situ	441.16	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAO	AquaBupH	Vegetable Oil	Assume Vegetable Oil, 56 drums, 55 gallons per drum, 8.92 ppg, for years 5,10,15,20,25	137368	lbs	20.56	20.56	1.44E-06	0.00E+00	0.00E+00	2.04E-02	8.10E-06	715.23	62.05
RAO	Reagents: sodium permanganate	Potassium Permanganate	Assume pottasium permanganate	389.00	lbs	0.72	0.71	3.70E-05	1.76E-04	1.76E-07	7.06E-05	2.12E-07	0.74	0.29
	Subtotal					**83.43**	**78.55**	**0.01**	**0.05**	**1.37E-06**	**0.05**	**0.00**	**1430.32**	**82.23**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	DPT Drill Rig	Drill Rig, DPT (diesel)	5 wells per day, 4 wells, 8 hours per day, 80% utilization	6.40	hrs	0.10	0.10	0.00	1.17E-04	1.08E-03	2.15E-05	1.07E-04	0.78	
RAC	Sonic Drill Rig	Drill Rig, Sonic (diesel)	5 borings per day, 5 borings, 8 hours per day, 80% utilization	6.40	hrs	0.20	0.19	0.00	1.83E-04	2.33E-03	4.13E-05	1.49E-04	1.49	
RAC	Drill Rig, DPT	Drill Rig, DPT (diesel)	5 wells per day, 49 wells, 8 hours per day, 80% utilization	62.72	hrs	1.01	0.98	0.00	1.15E-03	1.06E-02	2.11E-04	1.05E-03	7.67	
	Subtotal					**1.30**	**1.27**	**0.00E+00**	**1.45E-03**	**0.01**	**2.74E-04**	**1.31E-03**	**9.93**	**0**
				Total		**85**	**80**	**0.01**	**0.05**	**0.01**	**0.05**	**0.00**	**1,440**	**82**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	61.19	57.21	3.06	0.92	0.01	0.02	0.00	2,403.40	19,482.71
RAO	22.85	22.09	0.62	0.13	0.00	0.02	0.00	2,474.17	62,595.32
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

APPENDIX G

COST ESTIMATES

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-1: No Action
Capital Cost

12/31/2012 7:39 AM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare 5-Year Review Plan	100	hr			$60.00		$0	$0	$6,000	$0	$6,000
Subtotal							$0	$0	$6,000	$0	$6,000
Overhead on Labor Cost @ 30%									$1,800		$1,800
G & A on Cost @ 10%							$0	$0	$600	$0	$600
Tax on Materials and Equipment Cost @ 6.25%								$0		$0	$0
Total Direct Cost							$0	$0	$8,400	$0	$8,400
Indirects on Total Direct Cost @ 25%											$2,100
Profit on Total Direct Cost @ 10%											$840
Total Field Cost											$11,340
Contingency on Total Field Costs @ 0%											$0
Engineering on Total Field Costs @ 0%											$0
TOTAL CAPITAL COST											**$11,340**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-1: No Action
Annual Cost

12/31/2012 7:39 AM

Item	Item Cost year 1	Item Cost years 2 - 3	Item Cost years 4 - 30	Item Cost every 5 years	Notes
Five Year Site Review				$23,000	
Subtotal	$0	$0	$0	$23,000	
Contingency @ 10%	$0	$0	$0	$2,300	
TOTAL	**$0**	**$0**	**$0**	**$25,300**	

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-1: No Action
Present Worth Analysis

12/31/2012 7:39 AM

Year	Capital Cost	Operation & Maintenance Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$11,340			$11,340	1.000	$11,340
1			$0	$0	0.980	$0
2			$0	$0	0.961	$0
3			$0	$0	0.942	$0
4			$0	$0	0.924	$0
5		$0	$25,300	$25,300	0.906	$22,915
6			$0	$0	0.888	$0
7			$0	$0	0.871	$0
8			$0	$0	0.853	$0
9			$0	$0	0.837	$0
10		$0	$25,300	$25,300	0.820	$20,755
11			$0	$0	0.804	$0
12			$0	$0	0.788	$0
13			$0	$0	0.773	$0
14			$0	$0	0.758	$0
15		$0	$25,300	$25,300	0.743	$18,798
16			$0	$0	0.728	$0
17			$0	$0	0.714	$0
18			$0	$0	0.700	$0
19			$0	$0	0.686	$0
20		$0	$25,300	$25,300	0.673	$17,026
21			$0	$0	0.660	$0
22			$0	$0	0.647	$0
23			$0	$0	0.634	$0
24			$0	$0	0.622	$0
25		$0	$25,300	$25,300	0.610	$15,421
26			$0	$0	0.598	$0
27			$0	$0	0.586	$0
28			$0	$0	0.574	$0
29			$0	$0	0.563	$0
30		$0	$25,300	$25,300	0.552	$13,967
					TOTAL PRESENT WORTH	**$120,223**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-2: Bio-Barriers, MNA, 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
1	**PROJECT PLANNING & DOCUMENTS**											
1.1	Prepare Documents & Plans	500	hr			$60.00		$0	$0	$30,000	$0	$30,000
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
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	4	ea			$188.00	$566.00	$0	$0	$752	$2,264	$3,016
3	**FIELD SUPPORT AND SITE ACCESS**											
3.1	Office Trailer	3	mo				$365.00	$0	$0	$0	$1,095	$1,095
3.2	Field Office Equipment, Utilities, & Support	3	mo		$508.00			$0	$1,524	$0	$0	$1,524
3.3	Storage Trailer	3	mo				$94.00	$0	$0	$0	$282	$282
3.4	Survey Support	4	day	$1,150.00				$4,600	$0	$0	$0	$4,600
3.5	Site Superintendent	45	day		$166.00	$420.00		$0	$7,470	$18,900	$0	$26,370
3.6	Site Health & Safety and QA/QC	45	day		$166.00	$370.00		$0	$7,470	$16,650	$0	$24,120
3.7	Underground Utility Clearance	1	ls	$10,000.00				$10,000	$0	$0	$0	$10,000
4	**DECONTAMINATION**											
4.1	Decontamination Services	2	mo		$1,220.00	$2,245.00	$1,550.00	$0	$2,440	$4,490	$3,100	$10,030
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	2,000	gal		$0.20			$0	$400	$0	$0	$400
4.4	Decon Water Storage Tank, 6,000 gallon	2	mo				$813.00	$0	$0	$0	$1,626	$1,626
4.5	Clean Water Storage Tank, 4,000 gallon	2	mo				$731.00	$0	$0	$0	$1,462	$1,462
4.6	Disposal of Decon Waste (liquid & solid)	2	mo	$985.00				$1,970	$0	$0	$0	$1,970
5	**SITE PREPARATION**											
5.1	Material Handling Pad, 100' by 100'	5,000	sf		$5.84	$0.89	$1.34	$0	$29,200	$4,450	$6,700	$40,350
5.2	Signs on Fence	4	ea		$123.50	$23.35	$12.89	$0	$494	$93	$52	$639
6	**BIO-BARRIER**											
6.1	Injection Wells, 49 wells	1,512	lf	$50.00				$75,600	$0	$0	$0	$75,600
6.2	Injection Wells Heads	49	ea	$500.00				$24,500	$0	$0	$0	$24,500
6.3	Inject Pumps	20	day				$525.00	$0	$0	$0	$10,500	$10,500
6.4	Site Labor (2 laborers)	40	day			$280.80		$0	$0	$11,232	$0	$11,232
6.5	AquaBupH	56	drum		$1,608.00			$0	$90,048	$0	$0	$90,048
6.6	Water Tank Truck	20	day				$485.00	$0	$0	$0	$9,700	$9,700
6.8	Injection Water	42,500	gal		$0.20			$0	$8,500	$0	$0	$8,500
7	**SITE RESTORATION**											
7.1	Area Seeding	15	msf	$96.50				$1,448	$0	$0	$0	$1,448
8	**POST CONSTRUCTION COST**											
8.1	Contractor Completion Report	300	hr			$60.00		$0	$0	$18,000	$0	$18,000
8.2	Remedial Action Closeout Report	250	hr			$60.00		$0	$0	$15,000	$0	$15,000
	Subtotal							$118,118	$150,046	$148,567	$40,581	$457,311
	Overhead on Labor Cost @ 30%									$44,570		$44,570
	G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$11,812	$15,005	$14,857	$4,058	$45,731
	Tax on Materials and Equipment Cost @ 6.25%								$9,378		$2,536	$11,914
	Total Direct Cost							$129,929	$174,428	$207,994	$47,175	$559,527
	Indirects on Total Direct Cost @ 25%											$139,882
	Profit on Total Direct Cost @ 10%											$55,953
	Subtotal											$755,361

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-2: Bio-Barriers, MNA, 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
Health & Safety Monitoring @ 2%											$15,107
Total Field Cost											$770,469
Engineering on Total Field Cost @ 10%											$77,047
Contingency on Total Field Cost @ 20%											$154,094
TOTAL CAPITAL COST											**$1,001,609**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-2: Bio-Barriers, MNA, and LUCs
O & M Cost: Years 5, 10, 15, 20, 25 Injection

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	150	hr			$60.00		$0	$0	$9,000	$0	$9,000
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	3	ea			$188.00	$566.00	$0	$0	$564	$1,698	$2,262
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	2	mo				$94.00	$0	$0	$0	$188	$188
3.2 Site Superintendent and QA/QC	24	day		$166.00	$420.00		$0	$3,984	$10,080	$0	$14,064
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Temporary Equipment Decon Pad	0	ls		$1,500.00	$2,000.00	$300.00	$0	$0	$0	$0	$0
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$813.00	$0	$0	$0	$813	$813
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$731.00	$0	$0	$0	$731	$731
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 BIO-BARRIER											
5.1 Inject Pumps	20	day				$525.00	$0	$0	$0	$10,500	$10,500
5.2 Site Labor (2 laborers)	40	day			$280.80		$0	$0	$11,232	$0	$11,232
5.3 AquaBupH	56	drum		$1,608.00			$0	$90,048	$0	$0	$90,048
5.4 Water Tank Truck	20	day				$485.00	$0	$0	$0	$9,700	$9,700
5.5 Injection Water	42,500	gal		$0.20			$0	$8,500	$0	$0	$8,500
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	100	hr			$60.00		$0	$0	$6,000	$0	$6,000
Subtotal							$985	$103,952	$39,121	$25,180	$169,238
Overhead on Labor Cost @ 30%									$11,736		$11,736
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$99	$10,395	$3,912	$2,518	$16,924
Tax on Materials and Equipment Cost @ 6.25%								$6,497		$1,574	$8,071
Total Direct Cost							$1,084	$120,844	$54,769	$29,272	$205,969
Indirects on Total Direct Cost @ 25%											$51,492
Profit on Total Direct Cost @ 10%											$20,597
Subtotal											$278,058
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$278,058
Engineering on Total Field Cost @ 25%											$69,514
Contingency on Total Field Cost @ 25%											$69,514
TOTAL CAPITAL COST											**$417,087**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-2: Bio-Barriers, MNA, 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 RD
Surface Water & Groundwater Sampling	$22,100	$11,050	$5,525		Labor and supplies to collect samples from 12 wells, quarterly year 1, semi-annually years 2 & 3, annually years 4-30.
Analysis: Groundwater	$38,268	$19,134	$9,567		Analyze groundwater samples for VOCs, PAHs, arsenic, cadmium, manganese, & MNA
Sampling Report	$48,000	$24,000	$12,000		
Five Year Site Review				$23,000	
Subtotal	$110,718	$56,534	$29,442	$23,000	
Contingency @ 10%	$11,072	$5,653	$2,944	$2,300	
TOTAL	**$121,790**	**$62,187**	**$32,386**	**$25,300**	

NAVAL AIR STATION SOUTH WEYMOUTH
Building 81 FS
Weymouth, MA
Alternative G-2: Bio-Barriers, MNA, and LUCs
Present Worth Analysis

Year	Capital Cost	Operation & Maintenance Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$1,001,609			$1,001,609	1.000	$1,001,609
1			$121,790	$121,790	0.980	$119,402
2			$62,187	$62,187	0.961	$59,773
3			$62,187	$62,187	0.942	$58,601
4			$32,386	$32,386	0.924	$29,920
5		$417,087	$57,686	$474,773	0.906	$430,017
6			$32,386	$32,386	0.888	$28,758
7			$32,386	$32,386	0.871	$28,194
8			$32,386	$32,386	0.853	$27,641
9			$32,386	$32,386	0.837	$27,099
10		$417,087	$57,686	$474,773	0.820	$389,479
11			$32,386	$32,386	0.804	$26,047
12			$32,386	$32,386	0.788	$25,536
13			$32,386	$32,386	0.773	$25,036
14			$32,386	$32,386	0.758	$24,545
15		$417,087	$57,686	$474,773	0.743	$352,763
16			$32,386	$32,386	0.728	$23,592
17			$32,386	$32,386	0.714	$23,129
18			$32,386	$32,386	0.700	$22,676
19			$32,386	$32,386	0.686	$22,231
20		$417,087	$57,686	$474,773	0.673	$319,509
21			$32,386	$32,386	0.660	$21,368
22			$32,386	$32,386	0.647	$20,949
23			$32,386	$32,386	0.634	$20,538
24			$32,386	$32,386	0.622	$20,135
25		$417,087	$57,686	$474,773	0.610	$289,389
26			$32,386	$32,386	0.598	$19,353
27			$32,386	$32,386	0.586	$18,974
28			$32,386	$32,386	0.574	$18,602
29			$32,386	$32,386	0.563	$18,237
30			$57,686	$57,686	0.552	$31,847
					TOTAL PRESENT WORTH	**$3,544,947**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, 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
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	500	hr			$60.00		$0	$0	$30,000	$0	$30,000
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
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	4	ea			$188.00	$566.00	$0	$0	$752	$2,264	$3,016
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Office Trailer	3	mo				$365.00	$0	$0	$0	$1,095	$1,095
3.2 Field Office Equipment, Utilities, & Support	3	mo		$508.00			$0	$1,524	$0	$0	$1,524
3.3 Storage Trailer	3	mo				$94.00	$0	$0	$0	$282	$282
3.4 Survey Support	4	day	$1,150.00				$4,600	$0	$0	$0	$4,600
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	2	mo		$1,220.00	$2,245.00	$1,550.00	$0	$2,440	$4,490	$3,100	$10,030
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	2,000	gal		$0.20			$0	$400	$0	$0	$400
4.4 Decon Water Storage Tank, 6,000 gallon	2	mo				$813.00	$0	$0	$0	$1,626	$1,626
4.5 Clean Water Storage Tank, 4,000 gallon	2	mo				$731.00	$0	$0	$0	$1,462	$1,462
4.6 Disposal of Decon Waste (liquid & solid)	2	mo	$985.00				$1,970	$0	$0	$0	$1,970
5 SITE PREPARATION											
5.1 Material Handling Pad, 100' by 100'	5,000	sf		$5.84	$0.89	$1.34	$0	$29,200	$4,450	$6,700	$40,350
5.2 Signs on Fence	4	ea		$123.50	$23.35	$12.89	$0	$494	$93	$52	$639
6 IN-SITU BIOREMEDIATION											
6.1 Injection Wells, 24 wells	1,032	lf	$50.00				$51,600	$0	$0	$0	$51,600
6.2 Injection Wells Heads	24	ea	$500.00				$12,000	$0	$0	$0	$12,000
6.3 Inject Pumps	5	day				$525.00	$0	$0	$0	$2,625	$2,625
6.4 Site Labor (2 laborers)	10	day			$280.80		$0	$0	$2,808	$0	$2,808
6.5 AquaBupH	8	drum		$1,608.00			$0	$12,864	$0	$0	$12,864
6.6 Water Tank Truck	5	day				$485.00	$0	$0	$0	$2,425	$2,425
6.8 Injection Water	4,200	gal		$0.20			$0	$840	$0	$0	$840
7 BIO-BARRIER											
7.1 Injection Wells, 49 wells	1,512	lf	$50.00				$75,600	$0	$0	$0	$75,600
7.2 Injection Wells Heads	49	ea	$500.00				$24,500	$0	$0	$0	$24,500
7.3 Inject Pumps	20	day				$525.00	$0	$0	$0	$10,500	$10,500
7.4 Site Labor (2 laborers)	40	day			$280.80		$0	$0	$11,232	$0	$11,232
7.5 AquaBupH	56	drum		$1,608.00			$0	$90,048	$0	$0	$90,048
7.6 Water Tank Truck	20	day				$485.00	$0	$0	$0	$9,700	$9,700
7.7 Injection Water	42,500	gal		$0.20			$0	$8,500	$0	$0	$8,500
8 SITE RESTORATION											
8.1 Area Seeding	17	msf	$96.50				$1,641	$0	$0	$0	$1,641
9 POST CONSTRUCTION COST											
9.1 Contractor Completion Report	300	hr			$60.00		$0	$0	$18,000	$0	$18,000
9.2 Remedial Action Closeout Report	250	hr			$60.00		$0	$0	$15,000	$0	$15,000
Subtotal							$181,911	$167,070	$159,275	$45,631	$553,886
Overhead on Labor Cost @ 30%									$47,783		$47,783
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$18,191	$16,707	$15,928	$4,563	$55,389
Tax on Materials and Equipment Cost @ 6.25%								$10,442		$2,852	$13,294
Total Direct Cost							$200,102	$194,219	$222,986	$53,046	$670,352

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, 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
Indirects on Total Direct Cost @ 25%											$167,588
Profit on Total Direct Cost @ 10%											$67,035
Subtotal											$904,975
Health & Safety Monitoring @ 2%											$18,099
Total Field Cost											$923,074
Engineering on Total Field Cost @ 10%											$92,307
Contingency on Total Field Cost @ 20%											$184,615
TOTAL CAPITAL COST											**$1,199,996**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, and LUCs
O & M Cost: Years 5, 10, 15, 20, 25 Reinjection Bio-Barriers

			Unit Cost				Extended Cost				
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
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			$188.00	$566.00	$0	$0	$564	$1,698	$2,262
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	2	mo				$94.00	$0	$0	$0	$188	$188
3.2 Site Superintendent and QA/QC	24	day		$166.00	$420.00		$0	$3,984	$10,080	$0	$14,064
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Temporary Equipment Decon Pad	0	ls		$1,500.00	$2,000.00	$300.00	$0	$0	$0	$0	$0
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$813.00	$0	$0	$0	$813	$813
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$731.00	$0	$0	$0	$731	$731
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 BIO-BARRIER											
5.1 Inject Pumps	20	day				$525.00	$0	$0	$0	$10,500	$10,500
5.2 Site Labor (2 laborers)	40	day			$280.80		$0	$0	$11,232	$0	$11,232
5.3 AquaBupH	56	drum		$1,608.00			$0	$90,048	$0	$0	$90,048
5.4 Water Tank Truck	20	day				$485.00	$0	$0	$0	$9,700	$9,700
5.5 Injection Water	42,500	gal		$0.20			$0	$8,500	$0	$0	$8,500
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	100	hr			$60.00		$0	$0	$6,000	$0	$6,000
Subtotal							$985	$103,952	$39,121	$25,180	$169,238
Overhead on Labor Cost @ 30%									$11,736		$11,736
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$99	$10,395	$3,912	$2,518	$16,924
Tax on Materials and Equipment Cost @ 6.25%								$6,497		$1,574	$8,071
Total Direct Cost							$1,084	$120,844	$54,769	$29,272	$205,969
Indirects on Total Direct Cost @ 25%											$51,492
Profit on Total Direct Cost @ 10%											$20,597
Subtotal											$278,058
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$278,058
Engineering on Total Field Cost @ 25%											$69,514
Contingency on Total Field Cost @ 25%											$69,514
TOTAL CAPITAL COST											**$417,087**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, and LUCs
O & M Cost: Year 5 only, Reinjection In-Situ Bioremediation

				Unit Cost				Extended Cost			
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	0	hr			$60.00		$0	$0	$0	$0	$0
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Equipment Mobilization/Demobilization	0	ea			$188.00	$566.00	$0	$0	$0	$0	$0
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	0	mo				$94.00	$0	$0	$0	$0	$0
3.2 Site Superintendent and QA/QC	5	day		$166.00	$420.00		$0	$830	$2,100	$0	$2,930
4 DECONTAMINATION											
4.1 Decontamination Services	0	mo		$1,220.00	$2,245.00	$1,550.00	$0	$0	$0	$0	$0
4.2 Temporary Equipment Decon Pad	0	ls		$1,500.00	$2,000.00	$300.00	$0	$0	$0	$0	$0
4.3 Decon Water	0	gal		$0.20			$0	$0	$0	$0	$0
4.4 Decon Water Storage Tank, 6,000 gallon	0	mo				$813.00	$0	$0	$0	$0	$0
4.5 Clean Water Storage Tank, 4,000 gallon	0	mo				$731.00	$0	$0	$0	$0	$0
4.6 Disposal of Decon Waste (liquid & solid)	0	mo	$985.00				$0	$0	$0	$0	$0
5 IN-SITU BIOREMEDIATION											
5.1 Inject Pumps	3	day				$525.00	$0	$0	$0	$1,575	$1,575
5.2 Site Labor (2 laborers)	6	day			$280.80		$0	$0	$1,685	$0	$1,685
5.3 AquaBupH	4	drum		$1,608.00			$0	$6,432	$0	$0	$6,432
5.4 Water Tank Truck	3	day				$485.00	$0	$0	$0	$1,455	$1,455
5.5 Injection Water	2,100	gal		$0.20			$0	$420	$0	$0	$420
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	100	hr			$60.00		$0	$0	$6,000	$0	$6,000
Subtotal							$0	$7,682	$9,785	$3,030	$20,497
Overhead on Labor Cost @ 30%									$2,935		$2,935
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$0	$768	$978	$303	$2,050
Tax on Materials and Equipment Cost @ 6.25%								$480		$189	$670
Total Direct Cost							$0	$8,930	$13,699	$3,522	$26,151
Indirects on Total Direct Cost @ 25%											$6,538
Profit on Total Direct Cost @ 10%											$2,615
Subtotal											$35,304
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$35,304
Engineering on Total Field Cost @ 25%											$8,826
Contingency on Total Field Cost @ 25%											$8,826
TOTAL CAPITAL COST											**$52,957**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS

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Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, 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 RD
Surface Water & Groundwater Sampling	$22,100	$11,050	$5,525		Labor and supplies to collect samples from 12 wells, quarterly year 1, semi-annually years 2 & 3, annually years 4-30.
Analysis: Groundwater	$38,268	$19,134	$9,567		Analyze groundwater samples for VOCs, PAHs, arsenic, cadmium, manganese, & MNA
Sampling Report	$48,000	$24,000	$12,000		
Five Year Site Review				$23,000	
Subtotal	$110,718	$56,534	$29,442	$23,000	
Contingency @ 10%	$11,072	$5,653	$2,944	$2,300	
TOTAL	**$121,790**	**$62,187**	**$32,386**	**$25,300**	

NAVAL AIR STATION SOUTH WEYMOUTH
Building 81 FS
Weymouth, MA

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Alternative G-3: Enhanced In-Situ Bioremediation, Bio-Barriers, MNA, and LUCs
Present Worth Analysis

Year	Capital Cost	Operation & Maintenance Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$1,199,996			$1,199,996	1.000	$1,199,996
1			$121,790	$121,790	0.980	$119,402
2			$62,187	$62,187	0.961	$59,773
3			$62,187	$62,187	0.942	$58,601
4			$32,386	$32,386	0.924	$29,920
5		$470,044	$57,686	$527,730	0.906	$477,981
6			$32,386	$32,386	0.888	$28,758
7			$32,386	$32,386	0.871	$28,194
8			$32,386	$32,386	0.853	$27,641
9			$32,386	$32,386	0.837	$27,099
10		$417,087	$57,686	$474,773	0.820	$389,479
11			$32,386	$32,386	0.804	$26,047
12			$32,386	$32,386	0.788	$25,536
13			$32,386	$32,386	0.773	$25,036
14			$32,386	$32,386	0.758	$24,545
15		$417,087	$57,686	$474,773	0.743	$352,763
16			$32,386	$32,386	0.728	$23,592
17			$32,386	$32,386	0.714	$23,129
18			$32,386	$32,386	0.700	$22,676
19			$32,386	$32,386	0.686	$22,231
20		$417,087	$57,686	$474,773	0.673	$319,509
21			$32,386	$32,386	0.660	$21,368
22			$32,386	$32,386	0.647	$20,949
23			$32,386	$32,386	0.634	$20,538
24			$32,386	$32,386	0.622	$20,135
25		$417,087	$57,686	$474,773	0.610	$289,389
26			$32,386	$32,386	0.598	$19,353
27			$32,386	$32,386	0.586	$18,974
28			$32,386	$32,386	0.574	$18,602
29			$32,386	$32,386	0.563	$18,237
30			$57,686	$57,686	0.552	$31,847
					TOTAL PRESENT WORTH	**$3,791,298**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-4: In-Situ Chemical Oxidation, Bio-Barriers, MNA, and LUCs
Capital Cost

				Unit Cost			Extended Cost				
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans	500	hr			$60.00		$0	$0	$30,000	$0	$30,000
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
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	4	ea			$188.00	$566.00	$0	$0	$752	$2,264	$3,016
2.3 Subcontractor Equipment Mobilization/Demobilization	1	ls	$25,551.00				$25,551	$0	$0	$0	$25,551
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Office Trailer	4	mo				$365.00	$0	$0	$0	$1,460	$1,460
3.2 Field Office Equipment, Utilities, & Support	4	mo		$508.00			$0	$2,032	$0	$0	$2,032
3.3 Storage Trailer	4	mo				$94.00	$0	$0	$0	$376	$376
3.4 Survey Support	4	day	$1,150.00				$4,600	$0	$0	$0	$4,600
3.5 Site Superintendent	65	day		$166.00	$420.00		$0	$10,790	$27,300	$0	$38,090
3.6 Site Health & Safety and QA/QC	65	day		$166.00	$370.00		$0	$10,790	$24,050	$0	$34,840
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				$813.00	$0	$0	$0	$2,439	$2,439
4.5 Clean Water Storage Tank, 4,000 gallon	3	mo				$731.00	$0	$0	$0	$2,193	$2,193
4.6 Disposal of Decon Waste (liquid & solid)	3	mo	$985.00				$2,955	$0	$0	$0	$2,955
5 SITE PREPARATION											
5.1 Material Handling Pad, 100' by 100'	5,000	sf		$5.84	$0.89	$1.34	$0	$29,200	$4,450	$6,700	$40,350
5.2 Signs on Fence	4	ea		$123.50	$23.35	$12.89	$0	$494	$93	$52	$639
6 IN-SITU CHEMICAL OXIDATION											
6.1 Pilot Study	1	ls	$50,000.00				$50,000	$0	$0	$0	$50,000
6.2 Injection Wells, 4 wells	72	lf	$50.00				$3,600	$0	$0	$0	$3,600
6.3 Injection Wells Heads	4	ea	$500.00				$2,000	$0	$0	$0	$2,000
6.4 Subcontractor Design and Documentation	1	ls	$11,850.00				$11,850	$0	$0	$0	$11,850
6.5 Injection: equipment, labor, etc.	1	ls	$142,960.00				$142,960	$0	$0	$0	$142,960
6.6 Reagents; sodium permanganate	778	lb		$3.16			$0	$2,458	$0	$0	$2,458
6.7 Reagents; potassium permanganate & sand blend	15,000	lb		$2.33			$0	$34,950	$0	$0	$34,950
6.8 Injection Monitoring -5 times	5	ea	$1,000.00	$500.00	$3,600.00		$5,000	$2,500	$18,000	$0	$25,500
7 BIO-BARRIER											
7.1 Injection Wells, 49 wells	1,512	lf	$50.00				$75,600	$0	$0	$0	$75,600
7.2 Injection Wells Heads	49	ea	$500.00				$24,500	$0	$0	$0	$24,500
7.3 Inject Pumps	20	day				$525.00	$0	$0	$0	$10,500	$10,500
7.4 Site Labor (2 laborers)	40	day			$280.80		$0	$0	$11,232	$0	$11,232
7.5 AquaBupH	56	drum		$1,608.00			$0	$90,048	$0	$0	$90,048
7.6 Water Tank Truck	20	day				$485.00	$0	$0	$0	$9,700	$9,700
7.7 Injection Water	42,500	gal		$0.20			$0	$8,500	$0	$0	$8,500
8 SITE RESTORATION											
8.1 Area Seeding	17	msf	$96.50				$1,641	$0	$0	$0	$1,641
9 POST CONSTRUCTION COST											
9.1 Contractor Completion Report	300	hr			$60.00		$0	$0	$18,000	$0	$18,000
9.2 Remedial Action Closeout Report	250	hr			$60.00		$0	$0	$15,000	$0	$15,000
Subtotal							$360,257	$198,522	$184,612	$44,134	$787,525

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-4: In-Situ Chemical Oxidation, Bio-Barriers, MNA, 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
Overhead on Labor Cost @	30%								$55,384		$55,384
G & A on Labor, Material, Equipment, & Subs Cost @	10%						$36,026	$19,852	$18,461	$4,413	$78,752
Tax on Materials and Equipment Cost @	6.25%							$12,408		$2,758	$15,166
Total Direct Cost							$396,282	$230,782	$258,457	$51,305	$936,827
Indirects on Total Direct Cost @	25%										$234,207
Profit on Total Direct Cost @	10%										$93,683
Subtotal											$1,264,717
Health & Safety Monitoring @	2%										$25,294
Total Field Cost											$1,290,011
Engineering on Total Field Cost @	10%										$129,001
Contingency on Total Field Cost @	20%										$258,002
TOTAL CAPITAL COST											**$1,677,014**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
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Alternative G-4: In-Situ Chemical Oxidation, Bio-Barriers, MNA, and LUCs
O & M Cost: Years 5, 10, 15, 20, 25 Reinjection Bio-Barriers

			Unit Cost				Extended Cost				
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
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			$188.00	$566.00	$0	$0	$564	$1,698	$2,262
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	2	mo				$94.00	$0	$0	$0	$188	$188
3.2 Site Superintendent and QA/QC	24	day		$166.00	$420.00		$0	$3,984	$10,080	$0	$14,064
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Temporary Equipment Decon Pad	0	ls		$1,500.00	$2,000.00	$300.00	$0	$0	$0	$0	$0
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$813.00	$0	$0	$0	$813	$813
4.5 Clean Water Storage Tank, 4,000 gallon	1	mo				$731.00	$0	$0	$0	$731	$731
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 BIO-BARRIER											
5.1 Inject Pumps	20	day				$525.00	$0	$0	$0	$10,500	$10,500
5.2 Site Labor (2 laborers)	40	day			$280.80		$0	$0	$11,232	$0	$11,232
5.3 AquaBupH	56	drum		$1,608.00			$0	$90,048	$0	$0	$90,048
5.4 Water Tank Truck	20	day				$485.00	$0	$0	$0	$9,700	$9,700
5.5 Injection Water	42,500	gal		$0.20			$0	$8,500	$0	$0	$8,500
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	100	hr			$60.00		$0	$0	$6,000	$0	$6,000
Subtotal							$985	$103,952	$39,121	$25,180	$169,238
Overhead on Labor Cost @ 30%									$11,736		$11,736
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$99	$10,395	$3,912	$2,518	$16,924
Tax on Materials and Equipment Cost @ 6.25%								$6,497		$1,574	$8,071
Total Direct Cost							$1,084	$120,844	$54,769	$29,272	$205,969
Indirects on Total Direct Cost @ 25%											$51,492
Profit on Total Direct Cost @ 10%											$20,597
Subtotal											$278,058
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$278,058
Engineering on Total Field Cost @ 25%											$69,514
Contingency on Total Field Cost @ 25%											$69,514
TOTAL CAPITAL COST											**$417,087**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS
Alternative G-4: In-Situ Chemical Oxidation, Bio-Barriers, MNA, and LUCs
O & M Cost: Year 1 only, Reinjection In-Situ Chemical Oxidation

			Unit Cost				Extended Cost				
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
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 Subcontractor Equipment Mobilization/Demobilization	1	ls	$5,860.00				$5,860	$0	$0	$0	$5,860
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Storage Trailer	0	mo				$94.00	$0	$0	$0	$0	$0
3.2 Site Superintendent and QA/QC	5	day		$166.00	$420.00		$0	$830	$2,100	$0	$2,930
4 DECONTAMINATION											
4.1 Decontamination Services	0	mo		$1,220.00	$2,245.00	$1,550.00	$0	$0	$0	$0	$0
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	0	gal		$0.20			$0	$0	$0	$0	$0
4.4 Decon Water Storage Tank, 6,000 gallon	0	mo				$813.00	$0	$0	$0	$0	$0
4.5 Clean Water Storage Tank, 4,000 gallon	0	mo				$731.00	$0	$0	$0	$0	$0
4.6 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 CHEMICAL OXIDATION											
5.1 Subcontractor Design and Documentation	1	ls	$2,650.00				$2,650	$0	$0	$0	$2,650
5.2 Injection: equipment, labor, etc.	1	ls	$21,280.00				$21,280	$0	$0	$0	$21,280
5.3 Reagents; sodium permanganate	389	lb		$3.16			$0	$1,229	$0	$0	$1,229
6 POST CONSTRUCTION COST											
6.1 Contractor Completion Report	0	hr			$60.00		$0	$0	$0	$0	$0
Subtotal							$30,775	$3,559	$13,100	$300	$47,734
Overhead on Labor Cost @ 30%									$3,930		$3,930
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$3,078	$356	$1,310	$30	$4,773
Tax on Materials and Equipment Cost @ 6.25%								$222		$19	$241
Total Direct Cost							$33,853	$4,138	$18,340	$349	$56,679
Indirects on Total Direct Cost @ 25%											$14,170
Profit on Total Direct Cost @ 10%											$5,668
Subtotal											$76,516
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$76,516
Engineering on Total Field Cost @ 25%											$19,129
Contingency on Total Field Cost @ 25%											$19,129
TOTAL CAPITAL COST											**$114,775**

NAVAL AIR STATION SOUTH WEYMOUTH
Weymouth, MA
Building 81 FS

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Alternative G-4: In-Situ Chemical Oxidation, Bio-Barriers, MNA, 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 RD
Surface Water & Groundwater Sampling	$22,100	$11,050	$5,525		Labor and supplies to collect samples from 12 wells, quarterly year 1, semi-annually years 2 & 3, annually years 4-30.
Analysis: Groundwater	$38,268	$19,134	$9,567		Analyze groundwater samples for VOCs, PAHs, arsenic, cadmium, manganese, & MNA
Sampling Report	$48,000	$24,000	$12,000		
Five Year Site Review				$23,000	
Subtotal	$110,718	$56,534	$29,442	$23,000	
Contingency @ 10%	$11,072	$5,653	$2,944	$2,300	
TOTAL	**$121,790**	**$62,187**	**$32,386**	**$25,300**	

NAVAL AIR STATION SOUTH WEYMOUTH
Building 81 FS
Weymouth, MA

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Alternative G-4: In-Situ Chemical Oxidation, Bio-Barriers, MNA, and LUCs
Present Worth Analysis

Year	Capital Cost	Operation & Maintenance Cost	Annual Cost	Total Year Cost	Annual Discount Rate 2.0%	Present Worth
0	$1,677,014			$1,677,014	1.000	$1,677,014
1		$114,775	$121,790	$236,565	0.980	$231,926
2			$62,187	$62,187	0.961	$59,773
3			$62,187	$62,187	0.942	$58,601
4			$32,386	$32,386	0.924	$29,920
5		$417,087	$57,686	$474,773	0.906	$430,017
6			$32,386	$32,386	0.888	$28,758
7			$32,386	$32,386	0.871	$28,194
8			$32,386	$32,386	0.853	$27,641
9			$32,386	$32,386	0.837	$27,099
10		$417,087	$57,686	$474,773	0.820	$389,479
11			$32,386	$32,386	0.804	$26,047
12			$32,386	$32,386	0.788	$25,536
13			$32,386	$32,386	0.773	$25,036
14			$32,386	$32,386	0.758	$24,545
15		$417,087	$57,686	$474,773	0.743	$352,763
16			$32,386	$32,386	0.728	$23,592
17			$32,386	$32,386	0.714	$23,129
18			$32,386	$32,386	0.700	$22,676
19			$32,386	$32,386	0.686	$22,231
20		$417,087	$57,686	$474,773	0.673	$319,509
21			$32,386	$32,386	0.660	$21,368
22			$32,386	$32,386	0.647	$20,949
23			$32,386	$32,386	0.634	$20,538
24			$32,386	$32,386	0.622	$20,135
25		$417,087	$57,686	$474,773	0.610	$289,389
26			$32,386	$32,386	0.598	$19,353
27			$32,386	$32,386	0.586	$18,974
28			$32,386	$32,386	0.574	$18,602
29			$32,386	$32,386	0.563	$18,237
30			$57,686	$57,686	0.552	$31,847
					TOTAL PRESENT WORTH	**$4,332,876**

APPENDIX H

EVALUATION OF SOIL EXCAVATION IN THE SOURCE AREA

EVALUATION OF SOIL EXCAVATION IN THE SOURCE AREA

Introduction

Potential technologies and process options that may be applicable to the remedial alternatives for the Site were identified, screened, and evaluated in Section 3 of this FS. The results of the preliminary screening summarized in Table 3-1 indicate that limited excavation of saturated soil in the source area would not be cost effective in removing a significant mass of contaminants. This appendix provides assumptions used in the evaluation of soil excavation and information to support the elimination of this process option from further consideration in the FS. A cost estimate is included in this appendix to further support the elimination of soil excavation as a process option for the FS.

Background

Excavation is typically applied to unsaturated soils. If an excavation of significant depth is required in saturated soil, the soil generally must first be dewatered. At the Building 81 Site, the overburden thickness is 15 to 20 feet and depth to the groundwater table ranges from 5 to 8 feet below ground surface (bgs). Thus, the majority of the overburden is saturated soil. A variety of equipment such as front-end loaders, backhoes, and clam shell excavators could be used to perform the excavation. The type of equipment selected must take into account several factors such as the type of material to be removed, the load-bearing capacity of the ground surrounding the removal area, the depth and areal extent of removal, the required rate of removal, and the elevation of the groundwater table. Excavation is the technology of choice for the removal of well-consolidated material such as soil from well-defined areas with significant load-bearing capacity.

Dewatering can be performed using a series of wells or well points. Treatment of the groundwater is required prior to discharge, and the type of treatment will depend on the groundwater quality. For example, uncontaminated groundwater may only need filtration to remove suspended solids, while contaminated groundwater would require treatment, such as granular activated carbon (GAC) to remove organic compounds. Treated groundwater may need to be stored and tested prior to discharge.

The excavation walls may need to be stabilized with sheet piling prior to excavation. The sheet piles would also limit the amount of groundwater that seeps into the excavation after the excavation is completed. Alternatively, the excavation walls can be sloped back if sheet piling is not used. Both excavation techniques are discussed in greater detail below.

The logistics of excavation must take into account the available space for operating the equipment, stockpiling, loading, and unloading of the excavated material, treatment of groundwater, location of the

site, etc. After the excavation is completed, the location would be backfilled and graded with clean fill material.

Description

This evaluation of excavation at the Building 81 Site assumed that the area to be excavated is at the upgradient end of the 200 µg/L PCE contour. Because of the relatively low PCE concentrations within this contour (200 to 360 µg/L), a small source area was assumed to be present at the most upgradient end of the contour. The maximum PCE concentration at this location is 280 µg/L. The assumed footprint would be 20 feet by 20 feet; the excavation depth would be to the top of bedrock which is 18 feet bgs. The depth to groundwater is assumed to be 5 feet bgs. The soil is classified as sand, silt, and gravel.

The initial approach used in this evaluation was to assume that the area could be dewatered so that dry material would be removed and conventional backfilling could occur. Two excavation methods were considered, one with sheet piling to limit the amount of water that would enter the excavation and one without sheet piling. Because there is no confining layer between the bedrock and the overburden, groundwater will flow up into the excavation even if sheet piling is used. Based on estimates made for an evaluation of saturated soil excavation at the SRA Site (Appendix I of the Final Feasibility Study (2012)), the long-term groundwater pumping rate was estimated to be 5 gpm, and the total volume of groundwater from dewatering was estimated to be 80,000 to 100,000 gallons. This water would need to be treated and then discharged to a surface water stream or transported off site for disposal. Because of the relatively large volume of water to be processed and the absence of any nearby surface water bodies, the dewatering scenario was not pursued further.

The engineering and installation problems associated with the use of sheet piling were considered further. Because the depth of the excavation would extend down to bedrock and sheet piling cannot be driven into bedrock, the sheet piling cannot be supported by cantilevering. The method to support the sheet piling in this situation consists of providing internal support in the form of wales and struts or wales and tie-backs. The presence of the struts would interfere with the excavation and might require installation of the struts below the groundwater table. The installation of tie-backs would require installation below the groundwater table and also a significant amount of dewatering. Another consideration is the presence of cobbles which, if significant, would prevent driving the sheet piling. If encountered, cobbles will stop advancement of the piling and the piling must be withdrawn. The cobbles may be removed by excavation, or the piling wall can be rerouted. However, this would add time and costs to the project. An alternative using sheet piling was not fully developed due the costs and engineering issues associated with sheet piling.

A potentially feasible excavation method would be using sloped walls (1H:1V) because of the instability of the soil. Because soil in the unsaturated zone is not contaminated, it would be stockpiled and used as backfill after the excavation is completed. In the saturated zone a clamshell bucket excavator would be used to remove the soil, much like sediment dredging. The bucket full of saturated soil would be lifted up and suspended over the excavation to allow excess water to drain. After that water drains the bucket would be emptied onto a plastic-lined (i.e., geomembrane) dewatering pad where free water would be allowed to drain off and be directed back to the excavation. The excavation would progress from one end to the other, excavating to the full depth of the excavation before progressing further along the length of the excavation. Approximately 1,000 cubic yards (cy) of unsaturated and saturated soil would be excavated, of which approximately 500 cy would be from the saturated zone.

After the free water has drained from the soil, a front end loader would load the soil onto haul trucks for off-site disposal. The soil would be characterized for disposal prior to excavation. Based on the existing data, none of the soil is anticipated to require disposal as a hazardous waste.

As the water drains from the bucket and splashes into the excavation VOCs will be stripped out. Based on the PCE concentrations in groundwater, there is a potential for high PCE concentrations in the breathing zone and Level C personal protective equipment (PPE) may be required near the excavation. Air monitoring would also be required. Also note that the release of VOCs may cause nuisance odors in the area, and control of the VOCs released to the air will be problematic.

Gravel is preferred for backfill in the saturated zone because it is a free-draining material that can be placed in water. Also, traditional compaction would not be needed. However, because groundwater would be displaced by the gravel, some groundwater must be pumped out, treated through a GAC system, and discharged. Note that some of the water will seep back into the soil adjacent to the excavation. For the Building 81 Site it is assumed that approximately 8,000 to 10,000 gallons of groundwater would to be pumped out, treated, and either discharged nearby or taken off-site for disposal.

After the excavation is complete, the dewatering pad would be removed and disposed, and the site would be seeded with grass.

The estimated cost for PCE source removal by excavation of saturated soil at the Building 81 Site is $1,524,000. A cost estimate is included in this appendix.

Effectiveness

Excavation of soil from below the groundwater table would be an effective way of removing highly contaminated soil.

The effectiveness of the excavation is limited by the contaminated groundwater that flows back into the excavation. Following excavation, the area would be backfilled. The contaminated groundwater adjacent to the excavation would flow into the excavated area by way of the fractured bedrock at the base of the excavation and contaminate the fill.

As shown in Table 2-5, the estimated total mass of PCE in groundwater is approximately 6 pounds. Over 40 percent of the PCE mass (concentrations ranging from 100 µg/L to 1,000 µg/L PCE) is in bedrock and thus would not be removed by excavation of the saturated overburden material. The balance of the PCE mass is within a large plume in the overburden defined by the 5 µg/L contour. Using a conservative estimate, the area being considered for excavation would only contain approximately 10 percent of the PCE mass in the overburden or 6 percent of the total mass in the groundwater.

Implementability

Excavation would be difficult to implement due to infiltration into the excavation. Excavation of the saturated soil would require a drainage pad and management and containment of the contaminated free water. Because excess water must be allowed to drain from the excavator bucket prior to placement on the drainage pad, the excavation rate is slower than it would be for excavation of unsaturated soils.

If the soil is dewatered prior to excavation, the groundwater would need to be treated with GAC (or a similar process) to meet water quality criteria prior to discharge. The discharge would need to be to the base-wide storm drainage system which ultimately discharges into French Stream since there are no nearby water bodies. Alternatively the groundwater from dewatering the excavation could be transported off-site for disposal.

Because of the concentrations of PCE and other CVOCs in the groundwater, all soils would be characterized prior to off-site disposal. Excavated soil would need to be dewatered on-site; due to the CVOC concentrations in the groundwater, the dewatering area must be contained. Although the saturated soil is not likely to be characterized as hazardous waste, excavation, stockpiling, and transportation operations may need to be designed to meet RCRA regulations in the event that higher contaminant concentrations are encountered.

Excavation equipment is readily available from multiple vendors. This technology as applied to both unsaturated and saturated soil is well proven and established in the construction/remediation industry. During excavation, site-specific health and safety procedures such as the use of PPE and Occupational Safety and Health Act (OSHA) regulations would have to be complied with to minimize the exposure of workers to contaminants in soil, groundwater and the air.

Cost

As noted, costs for this technology would be moderate to high. A detailed cost estimate is included in this appendix.

Conclusion

As indicated in Table 3-1, excavation is eliminated as a technology for groundwater remediation via source removal on the basis of implementability and cost.

NAVAL AIR STATION SOUTH WEYMOUTH
South Weymouth, MA
Building 81
Source Excavation
Capital Cost

1/8/2013 3:50 PM

	Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1	**PROJECT PLANNING & DOCUMENTS**											
1.1	Prepare Documents & Plans	300	hr			$60.00		$0	$0	$18,000	$0	$18,000
1.2	Prepare Permits	200	hr			$60.00		$0	$0	$12,000	$0	$12,000
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	10	ea			$188.00	$566.00	$0	$0	$1,880	$5,660	$7,540
2.3	Crane Mobilization/Demobilization	1	ea			$625.00	$2,550.00	$0	$0	$625	$2,550	$3,175
3	**FIELD SUPPORT AND SITE ACCESS**											
3.1	Office Trailer	3	mo				$400.00	$0	$0	$0	$1,200	$1,200
3.2	Field Office Equipment, Utilities, & Support	3	mo		$558.50			$0	$1,676	$0	$0	$1,676
3.3	Storage Trailer (2 each)	3	mo				$103.00	$0	$0	$0	$309	$309
3.6	Survey Support	2	day	$1,150.00				$2,300	$0	$0	$0	$2,300
3.7	Site Superintendent	55	day		$166.00	$480.00		$0	$9,130	$26,400	$0	$35,530
3.8	Site Health & Safety and QA/QC	55	day		$166.00	$360.00		$0	$9,130	$19,800	$0	$28,930
3.9	Underground Utility Clearance	1	ls	$10,000.00				$10,000	$0	$0	$0	$10,000
4	**DECONTAMINATION**											
4.1	Decontamination Services	2	mo		$1,220.00	$2,245.00	$1,550.00	$0	$2,440	$4,490	$3,100	$10,030
4.2	Temporary Equipment Decon Pad	2	ls		$1,500.00	$2,000.00	$300.00	$0	$3,000	$4,000	$600	$7,600
4.3	Decon Water	2,000	gal		$0.20			$0	$400	$0	$0	$400
4.4	Decon Water Storage Tank, 6,000 gallon	2	mo				$814.00	$0	$0	$0	$1,628	$1,628
4.5	Clean Water Storage Tank, 4,000 gallon	2	mo				$731.10	$0	$0	$0	$1,462	$1,462
4.6	Disposal of Decon Waste (liquid & solid)	2	mo	$985.00				$1,970	$0	$0	$0	$1,970
5	**SITE PREPARATION**											
5.2	Material Handling Pad	5,000	sf		$5.84	$0.89	$1.34	$0	$29,200	$4,450	$6,700	$40,350
6	**EXCAVATION AND DISPOSAL**											
6.1	Clamshell Crane, 2 cy	21	day			$521.44	$1,701.40	$0	$0	$10,950	$35,729	$46,680
6.2	Excavator, 3.5 cy	21	day			$521.44	$2,211.00	$0	$0	$10,950	$46,431	$57,381
6.3	Truck, 25 cy off-road (2 each)	42	day			$518.40	$1,271.00	$0	$0	$21,773	$53,382	$75,155
6.4	Front End Loader	21	day			$521.44	$611.00	$0	$0	$10,950	$12,831	$23,781
6.6	Site Labor (3 laborers)	63	day			$377.60		$0	$0	$23,789	$0	$23,789
6.8	Transportation & Disposal, Non-Hazardous, subtitle "D"	335	ton	$93.00				$31,155	$0	$0	$0	$31,155
6.9	Waste Disposal Characterization / Analytical	8	ea	$575.00	$20.00			$4,600	$160	$0	$0	$4,760
7	**BACKFILL**											
7.2	Stone Gravel	105	cy		$16.00			$0	$1,680	$0	$0	$1,680
7.3	Topsoil	120	cy		$27.33			$0	$3,280	$0	$0	$3,280
7.4	Clamshell Crane, 2 cy	10	day			$521.44	$1,701.40	$0	$0	$5,214	$17,014	$22,228
7.5	Excavator, 3.5 cy	10	day			$521.44	$2,211.00	$0	$0	$5,214	$22,110	$27,324
7.6	Truck, 25 cy off-road (2 each)	20	day			$518.40	$1,271.00	$0	$0	$10,368	$25,420	$35,788
7.7	Front End Loader	10	day			$521.44	$611.00	$0	$0	$5,214	$6,110	$11,324
7.9	Dozer, 300 hp	10	day			$518.40	$1,718.00	$0	$0	$5,184	$17,180	$22,364
7.10	Site Labor (3 laborers)	30	day			$377.60		$0	$0	$11,328	$0	$11,328
8	**RESTORATION**											
8.1	Seeding	860	sy	$3.72				$3,199	$0	$0	$0	$3,199
9	**TREATMENT OF DISPLACED WATER (DURING BACKFILL)**											
9.1	Temporary GAC System	1	ls	$16,000.00				$16,000	$0	$0	$0	$16,000
9.2	Pump, 150 gpm (4")	10	day				$106.00	$0	$0	$0	$1,060	$1,060
9.3	Pump Hose, 500 lf	10	day				$47.00	$0	$0	$0	$470	$470
9.4	Lab Analyses, VOCs	7	ea	$100.00				$700	$0	$0	$0	$700
11	**POST CONSTRUCTION COST**											
11.1	Contractor Completion Report	150	hr			$60.00		$0	$0	$9,000	$0	$9,000
11.2	Remedial Action Closeout Report	200	hr			$60.00		$0	$0	$12,000	$0	$12,000

NAVAL AIR STATION SOUTH WEYMOUTH
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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
Subtotal							$69,924	$61,095	$233,581	$264,447	$629,046
Overhead on Labor Cost @	30%								$70,074		$70,074
G & A on Labor, Material, Equipment, & Subs Cost @	10%						$6,992	$6,110	$23,358	$26,445	$62,905
Tax on Materials and Equipment Cost @	6.25%							$3,818		$16,528	$20,346
Total Direct Cost							$76,917	$71,023	$327,013	$307,419	$782,372
Indirects on Total Direct Cost @	30%	(excluding transportation and disposal cost)									$224,774
Profit on Total Direct Cost @	10%										$78,237
Subtotal											$1,085,383
Health & Safety Monitoring @	4%										$43,415
Total Field Cost											$1,128,798
Engineering on Total Field Cost @	15%										$169,320
Contingency on Total Field Cost @	20%										$225,760
TOTAL CAPITAL COST											**$1,523,877**