Nosedocks/Apron 2 Chlorinated Plume
Former Griffiss Air Force Base
Rome, New York

FINAL

REMEDIAL INVESTIGATION REPORT

DEPARTMENT OF THE AIR FORCE
UNITED STATES OF AMERICA
MCMXLVII

Contract No. GS10F0006L
Delivery Order No. DASW01-01-F-1175
Project No. JREZ 2001-7008

Revision 1.0
April 2004

FPM group

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REMEDIAL INVESTIGATION REPORT

Prepared for:

Nosedocks/Apron 2 Chlorinated Plume
Former Griffiss Air Force Base
Rome, New York

through

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PREFACE

FPM Group, Ltd. (FPM), under contract with the Air Force Center for Environmental Excellence (AFCEE), has conducted a Remedial Investigation (RI) for the previously identified chlorinated hydrocarbon plumes associated with the Nosedocks/Apron 2 vicinity at the former Griffiss Air Force Base (AFB), Rome, New York. The main objectives of the RI were to identify the source area for the chlorinated hydrocarbon compounds, investigate the upgradient, crossgradient, and downgradient extents of the plumes, and to assess the vertical extent of contamination by means of Hydropunch® sampling down to the top of the bedrock. The RI was conducted in accordance with provisions of the Basic Contract # GS10F0006L and Delivery Order (DO) #DASW01-01-F-1175.

The RI included the installation of vertical profile wells at 39 locations in the vicinity of the Nosedocks and Apron 2 for the collection and analysis of samples for chlorinated volatile organic compounds in particular which were present in groundwater, surface water, and/or soil. Permanent monitoring wells were also installed at 28 downgradient, crossgradient, and upgradient locations to allow for characterization of the plume(s) over time. Additionally, two permanent wells were installed to evaluate the bedrock aquifer beneath the subsurface plumes.

This report summarizes the tasks accomplished and the data collected during the RI, and includes a history of the results of previous investigations, including the groundwater monitoring conducted in 1999 and 2000 by FPM, as documented in the Informal Technical Information Report for the Building 782 Chlorinated Plume (FPM, 2001). The field work was conducted from November 2001 through February 2002, with additional sampling events conducted in May and August 2002, for surface water and metals in groundwater, respectively, and in February 2003, for groundwater and surface water. The two additional bedrock wells (782MW-181 and -184) were installed in April and May of 2003. The data was thereafter evaluated for the purposes of presenting plume depictions and developing a site conceptual model.

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LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
ARAR	applicable or relevant and appropriate requirement
AOC	Area of Concern
BFSA	Bulk Fuel Storage Area
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Program
COC	contaminant of concern
CoC	chain of custody
COPC	Chemical of Potential Concern
DCE	dichloroethylene/dichloroethene
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DO	Delivery Order
DO	dissolved oxygen
DOD	Department of Defense
DNAPL	dense non-aqueous phase liquid
E&E	Ecology and Environment, Inc.
EPA	Environmental Protection Agency
EPC	exposure point concentration
FPM	FPM Group, Ltd.
FS	Feasibility Study
FSP	Field Sampling Plan
ft	feet
GC/MS	gas chromatography/mass spectrometry
HI	hazard index
HQ	hazard quotient
HAS	hollow stem auger
IRP	Installation Restoration Program
K	hydraulic conductivity
Kp	permeability constant
LAW	Law Engineering and Environmental Sciences, Inc.
LCP	Lateral Control Pit
LCS	laboratory control sample

LIST OF ACRONYMS AND ABBREVIATIONS (cont'd.)

LNAPL	light nonaqueous phase liquids
LPD	Low Point Drain
LTM	long-term monitoring
MDL	method detection limit
mg/L	milligrams per liter
MS/MSD	matrix spike/matrix spike duplicate
MSL	mean sea level
MTBE	methyl *tert*-butyl ether
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NYS	New York State
NYSBC	New York State Barge Canal
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORP	oxidation/reduction potential
OU	Operable Unit
OWS	oil/water separator
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene/perchloroethylene/tetrachloroethene/perchloroethene
PEER	Peer Consultants, P.C.
PID	photoionization detector
ppb	parts per billion
ppm	parts per million
PRG	preliminary remediation goal
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act of 1976
RfD	reference dose
RI	Remedial Investigation
RL	reporting limit
RPD	relative percent difference
SAC	Strategic Air Command
SARA	Superfund Amendments and Reauthorization Act
SI	Supplemental Investigation
STARS	Spill Technology and Remediation Series
SVOC	semivolatile organic compound
TAGM	Technical and Administrative Guidance Memorandum

LIST OF ACRONYMS AND ABBREVIATIONS (cont'd.)

TBC	to-be-considered
TCE	trichloroethylene/trichloroethene
TCL	Target Compound List
TOC	total organic carbon
TOIC	top of inner casing
TRPH	total recoverable petroleum hydrocarbons
UCL	upper confidence limit
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound
µg/L	micrograms per liter
%R	percent recovery

1.0 INTRODUCTION

This report was prepared by FPM Group, Ltd. (FPM) and presents the results of a remedial investigation (RI) conducted to characterize the extent of groundwater and soil contamination associated with chlorinated hydrocarbons in the vicinity of Apron 2 and the Nosedocks at the former Griffiss Air Force Base (AFB) in Rome, New York (see Figure 1-1). The Nosedocks/Apron 2 Chlorinated plume is an operable unit (OU) of the On-Base Groundwater Area of Concern (AOC), also known as Installation Restoration Program (IRP) Site SD-52. Previous groundwater investigations conducted in the vicinity of Nosedocks 1 and 2 had identified a portion of the contaminant plume as indicated by concentrations of cis-1,2-dichloroethene (cis-DCE) and vinyl chloride (VC) at levels in excess of the New York State Class GA Groundwater Standards. The purpose of the RI was to investigate the extent of the contamination and identify the potential source area(s).

The Nosedocks are located along the northwestern edge of Apron 2, in the southeastern section of former Griffiss AFB. The Nosedocks (otherwise known as Buildings 782 through 786) were used as fuel systems maintenance docks prior to being decommissioned, and Apron 2 was used as an aircraft parking and refueling area when the base was operational. The site is surrounded by Apron 1 to the north and west, Taxiway 2 to the south, and Taxiway 3 to the east. The main site features are shown in Figure 1-2.

cis-DCE and VC are not compounds used by the Air Force, but are normally found in groundwater as the daughter products of the anaerobic bioremediation of both perchloroethene (PCE) and trichloroethene (TCE). PCE, to some extent, and TCE, to a large extent, were used by the Air Force at Griffiss Air Force Base most commonly for metal degreasing purposes (*Basewide Environmental Baseline Survey*, Tetra Tech, 1994). The previous investigations were limited to the areas between Nosedocks 1, 2, and 3 (Buildings 782, 783, and 784, respectively), leaving the source area or western boundary (upgradient) of the contamination unidentified. Because TCE is considered a dense nonaqueous phase liquid (DNAPL), and previous studies were limited to groundwater sample collection within the top 10 feet (ft) of the groundwater table, another objective of the RI was to define the vertical extent of the contamination.

1.1 PROJECT PURPOSE AND SCOPE

FPM, under contract with the Air Force Center for Environmental Excellence (AFCEE), conducted an RI for soil and groundwater associated with the Nosedocks/Apron 2 Chlorinated Plume at the former Griffiss AFB, Rome, New York. The RI tasks included site characterization to delineate the lateral and vertical extents of groundwater contamination associated with the chlorinated hydrocarbon plume previously identified in association with Nosedocks 1 and 2 (Buildings 782 and 783, respectively), and to identify the possible source(s). The RI was conducted in accordance with provisions of the Basic Contract # GS10F0006L and Delivery Order (DO) #DASW01-01-F-1175.

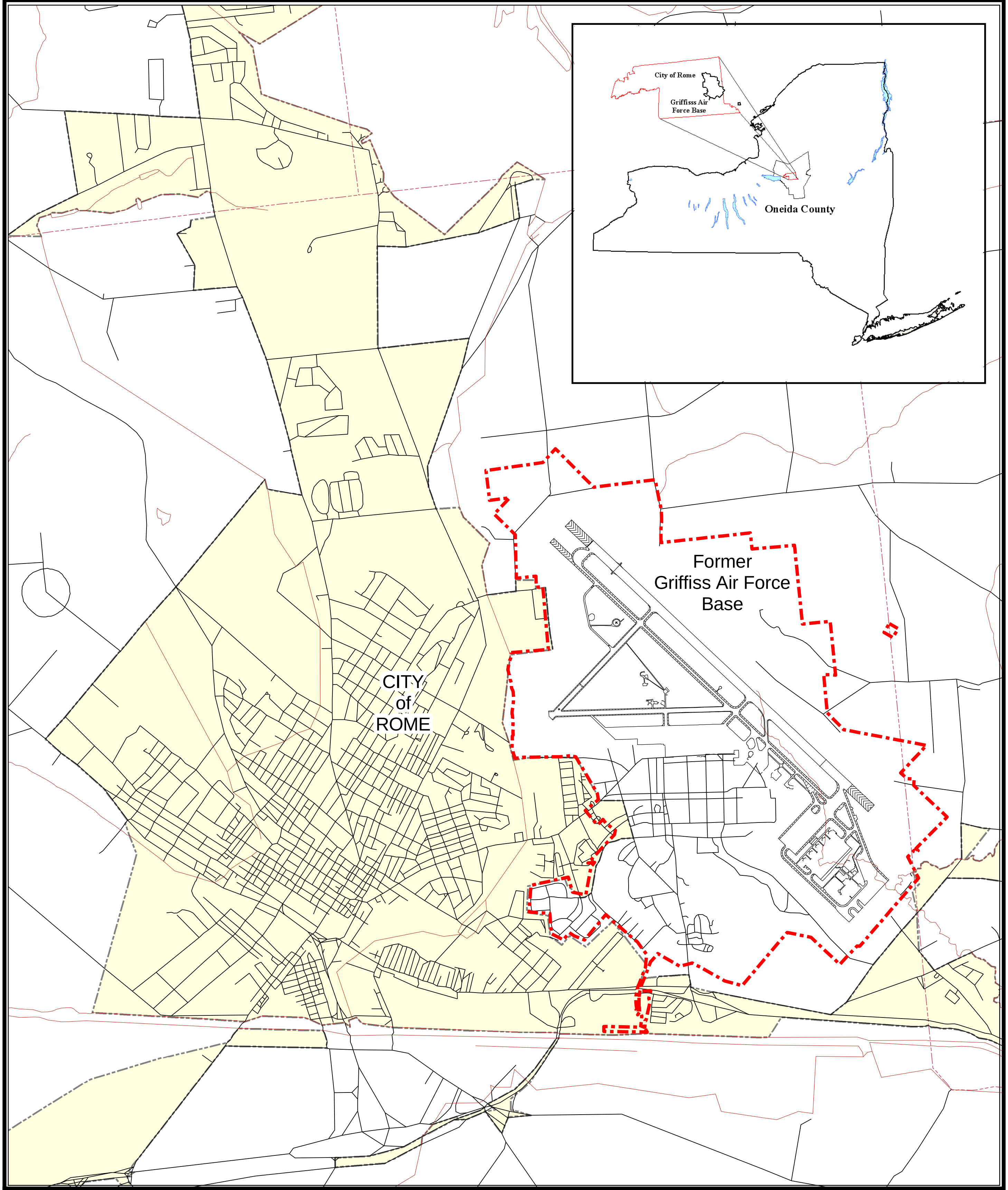

FIGURE 1-1
Base Location Map

UNITED STATES AIR FORCE
GRIFFISS AIR FORCE BASE
ROME,NEW YORK

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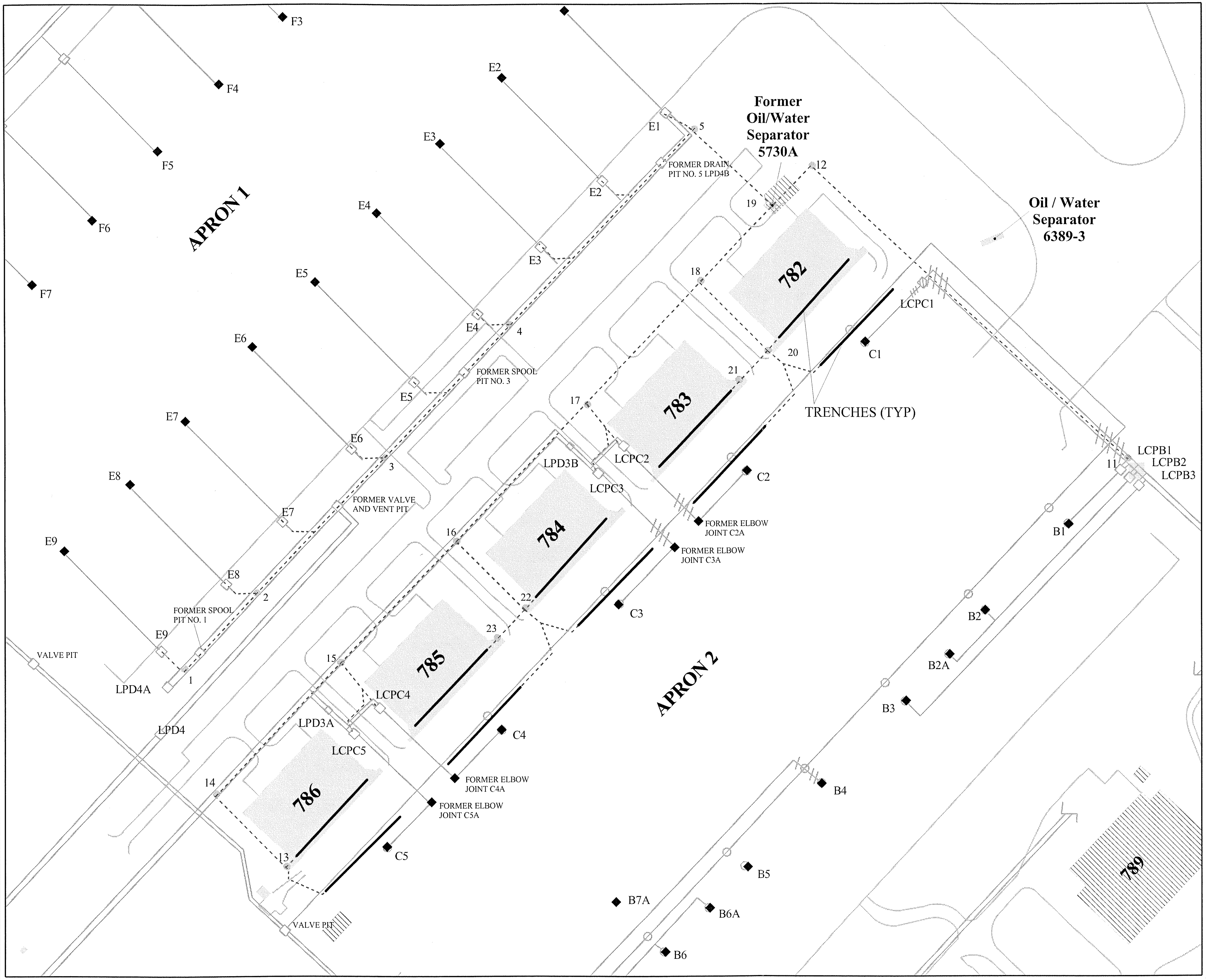

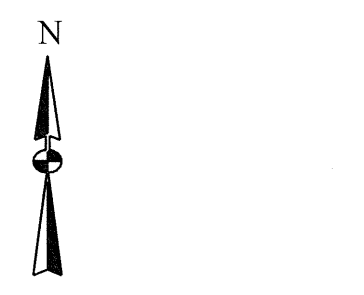

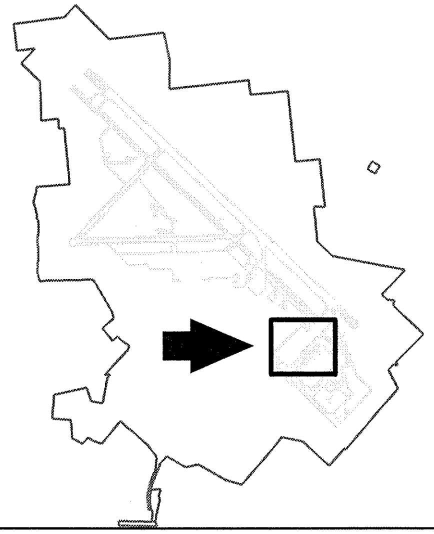

Approximate Location of Nose Docks Wash Waste System

Former Fuel Pipeline

Road

18 ● Wash Waste Manhole (and No.)

○ Former Hydrant Lateral Control Pit (LCP)/
☐ Low Point Drain (LPD)

B2■ Former Hydrant (and Identifier)

Facility

Existing

▨ Demolished

NOTE: Nose Docks Wash Waste System Location approximated from PEER, Decision Document/Closure Report for Project 96-0020, Volume II, Wash Waste System, Figure 2.2.1, Washwaste Collection System, Nosedock System.

UNITED STATES AIR FORCE
GRIFFISS AIR FORCE BASE
ROME, NEW YORK

SCALE

150 0 150 300 Feet

Figure 1-2
Nosedocks / Apron 2
Site Features

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Groundwater and soil samples were collected using Hydropunch® sampling at locations upgradient, downgradient, and within the previously identified extent of the plume, for further characterization. The groundwater samples were collected at multiple depths, down to the top of the bedrock, where possible, at each location to assess the vertical extent of the contamination. Permanent wells were installed at contaminated locations within the zone of highest concentration of total chlorinated solvents to enable monitoring of the plume over the long term. In addition, static groundwater level measurements were collected to develop groundwater elevation data and assess local groundwater flow directions. A land survey established accurate horizontal coordinates and vertical elevations of all sampling points.

All samples were submitted for volatile organic compound (VOC) analysis; in addition, samples from permanent wells were submitted for geochemical parameters (nitrate, dissolved iron, sulfate, sulfide, alkalinity, chloride, and total organic carbon). Samples from selected permanent wells were also submitted for methane/ethane/ethene analysis. These parameters were selected based on the results of previous investigations identifying chlorinated hydrocarbons as potential contaminants of concern (COCs), and the intent of this RI to delineate the chlorinated hydrocarbon plume(s) and to determine whether reductive dechlorination processes are actively working to decrease COC concentrations. Finally, a select group of permanent wells was also sampled for metals analysis, the results of which were applied to the baseline risk assessment (i.e., arsenic and manganese had been identified as potential contributors to overall site risk during the RIs conducted at the Building 786 Contaminated Soil AOC and the Nosedocks 1 and 2 AOC [Law, 1996]). A second permanent monitoring well sampling round was conducted one year after the initial sampling event to preliminarily evaluate long-term trends. Finally, two bedrock wells were installed to evaluate the potential for deeper contamination of the bedrock aquifer.

The objectives of the RI were to:

- Develop a summary description of environmental factors affecting the sites;
- Collect data to assess the extent and magnitude of contamination;
- Collect data to conduct a quantitative human health risk assessment;
- Identify possible contaminant migration pathways; and
- Collect data to perform a Feasibility Study, Remedial Design, and Remedial Action, if needed, for the site.

Project tasks included:

- Identification and quantification of the vertical and horizontal extent of potential soil and/or groundwater contamination;
- Comparison of the on-site contaminant concentrations with the New York State Class GA Groundwater Standards;
- Development of water-level contour maps and groundwater hydrology characterization (i.e., groundwater velocity, hydraulic conductivity, etc.);

- Fate and transport evaluation modeling including predictions of plume movement rate and direction;
- Development of a site conceptual model;
- Baseline Risk Assessment in accordance with established guidelines for previous RI risk assessments at Griffiss;
- A detailed discussion of remedial action possibilities and recommendations for additional work.

A total of up to 20 vertical profile wells were initially proposed for installation in conjunction with the work plan for this RI (FPM, 2001). At each of these locations, a permanent monitoring well was proposed for installation for potential monitoring purposes, with the exception that only one upgradient well be installed; the wells were to be screened across the interval indicating the highest total chlorinated solvent concentration. In addition, once the source area was located, up to six soil borings were proposed for installation in the nearby vicinity to investigate potential soil contamination.

Because the extent of the contaminant plume was greater than anticipated, a total of 39 temporary wells were installed to characterize the plume, nine from which soil samples were also collected. Permanent wells were installed within the same boreholes of 28 temporary wells for long-term monitoring purposes, and included two upgradient wells.

1.2 FACILITY BACKGROUND

1.2.1 The U.S. Air Force Installation Restoration Program

The objective of the U.S. Air Force (USAF) Installation Restoration Project (IRP) is to assess past hazardous waste disposal and spill sites at USAF installations and to develop remedial actions consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) for sites that pose a threat to human health and welfare or the environment. This section presents information on the program origins, objectives, and organization.

The 1976 Resource Conservation Recovery Act (RCRA) is one of the primary federal laws governing the disposal of hazardous wastes. Sections 6001 and 6003 of RCRA require federal agencies to comply with local and state environmental regulations and provide information to the EPA concerning past disposal practices at federal sites. RCRA Section 3012 requires state agencies to inventory past hazardous waste disposal sites and provide information to the EPA concerning those sites.

In 1980, Congress enacted CERCLA (Superfund). CERCLA outlines the responsibility for identifying and remediating contaminated sites in the United States and its possessions. The CERCLA legislation identifies the EPA as the primary policy and enforcement agency regarding contaminated sites.

The 1986 Superfund Amendments and Reauthorization Act (SARA) extends the requirements of CERCLA and modifies CERCLA with respect to goals for remediation and the steps that lead to the selection of a remedial process. Under SARA, technologies that provide permanent removal or destruction of a contaminant are preferable to action that only contains or isolates the contaminant. SARA also provides for greater interaction with public and state agencies and extends the EPA's role in evaluating health risks associated with contamination. Under SARA, early determination of Applicable or Relevant and Appropriate Requirements (ARARs) is required, and the consideration of potential remediation alternatives is recommended at the initiation of an RI/FS. SARA is the primary legislation governing remedial action at past hazardous waste disposal sites.

Executive Order 12580, adopted in 1987, gave various federal agencies, including the Department of Defense (DOD), the responsibility to act as lead agencies for conducting investigations and implementing remediation efforts when they are the sole or co-contributor to contamination on or off their properties.

To ensure compliance with CERCLA, its regulations, and Executive Order 12580, the DOD developed the IRP, under the Defense Environmental Restoration Program, to identify potentially contaminated sites, investigate these sites, and evaluate and select remedial actions for potentially contaminated facilities. The DOD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP program in June 1980, and implemented the policies outlined in this memorandum in December 1980. The NCP was issued by the EPA in 1980 to provide guidance on a process by which: (1) contaminant release could be reported; (2) contamination could be identified and quantified; and (3) remedial actions could be selected. The NCP describes the responsibility of federal and state governments and those responsible for contaminant releases.

The DOD formally revised and expanded the existing IRP directives and amplified all previous directives and memoranda concerning the IRP through DEQPPM 81-5, dated 11 December 1981. The memorandum was implemented by a USAF message dated 21 January 1982.

The IRP is the DOD's primary mechanism for response actions on USAF installations affected by the provisions of SARA. In November 1986, in response to SARA and other EPA interim guidance, the USAF modified the IRP to provide for a Remedial Investigation/Feasibility Study (RI/FS) program. The IRP was modified so that RI/FS studies could be conducted as parallel activities rather than serial activities. The program now includes ARAR determinations, identification and screening of technologies, and development of alternatives. The IRP may include multiple field activities and pilot studies prior to a detailed final analysis of alternatives. Over the years, requirements of the IRP have been developed and modified to ensure that DOD compliance with federal laws, such as RCRA, NCP, CERCLA, and SARA, can be met.

1.2.2 Site Description

Apron 2, a former aircraft parking apron and refueling area, and the Nosedocks, each used as aircraft maintenance facilities, are located in the southeast portion of Griffiss AFB. Apron 2 is approximately 1600 ft by 900 ft in size. The Apron is a relatively flat, 18-in. thick, steel-reinforced concrete pad. The concrete paving is flanked by 50-ft wide areas of asphalt paving on the northwest and southeast sides. The surrounding surface is unpaved lawn. The Apron is sloped toward the center, where stormwater collection drains channel runoff into trenches that discharge through an oil/water separator (OWS) and into the Six Mile Creek drainage. The site covers an area of approximately 420,000 square feet.

The vicinity of the Nosedocks encompasses the buildings themselves, two oil/water separators (OWS 5730 [removed in 2001] and 6389-3), and several underground utilities (storm drains and sanitary sewers). The buildings are surrounded by grassy areas with several asphalt parking areas and driveways. The topography across the site is relatively flat. Surface runoff in the vicinity of Nosedocks 1 and 2 flows into storm drains by way of a large unpaved drainage swale that extends several hundred feet from the southwest to the northeast. The storm drains of the Nosedocks flow through to OWS 6389-3 before discharging into Six Mile Creek.

1.2.3 Site History

Before 1950, the land in the Nosedocks area was part of a family farm. Two houses, a large barn, a hayfield, and a chicken coop were located at the site, and Six Mile Creek flowed through the site in an open channel. High-voltage power lines, including several 45-foot towers, cut through the southern portion of the site. The property encompassing the Nosedocks and Apron 2 was procured by the government in the 1950s. After acquisition, the land was significantly altered to accommodate the large aircraft aprons (including Apron 1) and the Nosedocks. Six Mile Creek was diverted into an underground culvert, and the old channel was filled in. The high-voltage power lines in the area were rerouted (Law, 1996).

The main JP-4 fuel line for the refueling system at Apron 2 originated from the Bulk Fuel Storage Area (BFSA) located at the southern boundary of the base. The fuel line extended from the BFSA in generally a northwest direction onto the base, turned east along Brookley Road, passed above Three Mile Creek, turned north to the Strategic Air Command (SAC) Hill, and branched off to Pumphouses 1 through 5.

When in operation, Apron 2 consisted of two independent refueling systems. Pumphouses 1, 2 and 3 serviced the refueling systems by way of refuel lines and smaller diameter defuel lines to Lateral Control Pits (LCPs) located in the grassy areas along the perimeter of Aprons 1 and 2. Pumphouse 1 serviced LCPs on the north side of Apron 2, Pumphouse 2 serviced LCPs on the south side of Apron 2, and Pumphouse 3 serviced LCPs on the west side of Apron 2. The LCPs in turn serviced the hydrants used to fuel aircraft. Each LCP consisted of a concrete structure with a sump pit that housed fuel piping, valves, and appurtenances. Low Point Drains (LPDs) were located on both ends of the refuel and defuel lines servicing the LCPs and fuel lines from the pumphouses. The LPDs contained blowoff pipes that were able to substantially drain a portion of the fuel system when any portion of the pipeline needed repair. In 1992, the Type III fuel system was installed to service Apron 2. The system consisted of Building 772 and Building 8002 (Generator Room) located adjacent to Apron 1 and a system of distribution pipelines used to feed jet fuel (JP-8) to fuel hydrants located on Apron 2.

The five Nosedocks (Buildings 782 through 786) were also used as aircraft maintenance buildings. Each Nosedock has two types of trench drains consisting of interior floor drains and exterior apron drains. The interior drains received a variety of liquid wastes generated by maintenance activities, while the exterior drains received drainage from the apron. The Nosedock Wash Waste system was installed in 1959 to receive wash wastes from the Apron 2 interior and exterior trench drains. Wash waste lines originated from the LCP sump pits. The system collected drainage from the five Nosedocks and a washrack that was set up in the corner of Building 786, and drained to Manhole 19, where the effluent was pumped to former OWS 5730. OWS 5730 was formerly located adjacent to the northwest corner of Nosedock 1 (Building 782), a former aircraft fuel cell repair facility. Currently, the Nosedocks buildings house either private businesses or are vacant. All Nosedocks' interior floor drains/trenches have been plugged by the Air Force (PEER, 1999).

1.2.4 Previous Investigations

1.2.4.1 Remedial Investigation - 1994

Groundwater and soil samples were collected from the north and northwest sides of Buildings 782 and 783 (Nose Docks 1 and 2) during the RI (Law, 1996). Twenty VOCs were detected in the groundwater samples, 13 of which were detected at concentrations exceeding potential ARARs. The only chlorinated hydrocarbon detected above reporting limits was cis-1,2-DCE, reported at 782MW-4R (12 µg/L) and 782MW-1R (0.4 J µg/L) (shown on Figure 1-3). No samples were collected on the east or south side of Nosedocks/Apron 2 during the RI.

1.2.4.2 Supplemental Investigation - 1997

The Supplemental Investigation (SI) also identified locations with chlorinated hydrocarbon contamination north of Building 782 (E&E, 1998). New monitoring wells were installed, including 782MW-5, located approximately 600 ft west of Building 782, and 782MW-6R1 and 782MW-6R2, located approximately 150 feet east of Building 782 (Figure 1-3). Existing wells 782MW-1R, -2, and -3R were also sampled during the SI. Monitoring well 782MW-6R1 proved to be unsuitable for sampling, as it was assumed to be screened across a perched zone. A groundwater sample collected at 782MW-6R2 indicated the presence of cis-1,2-DCE (37 µg/L) and VC (26 µg/L) above ARARs; no chlorinated hydrocarbons were reported above the

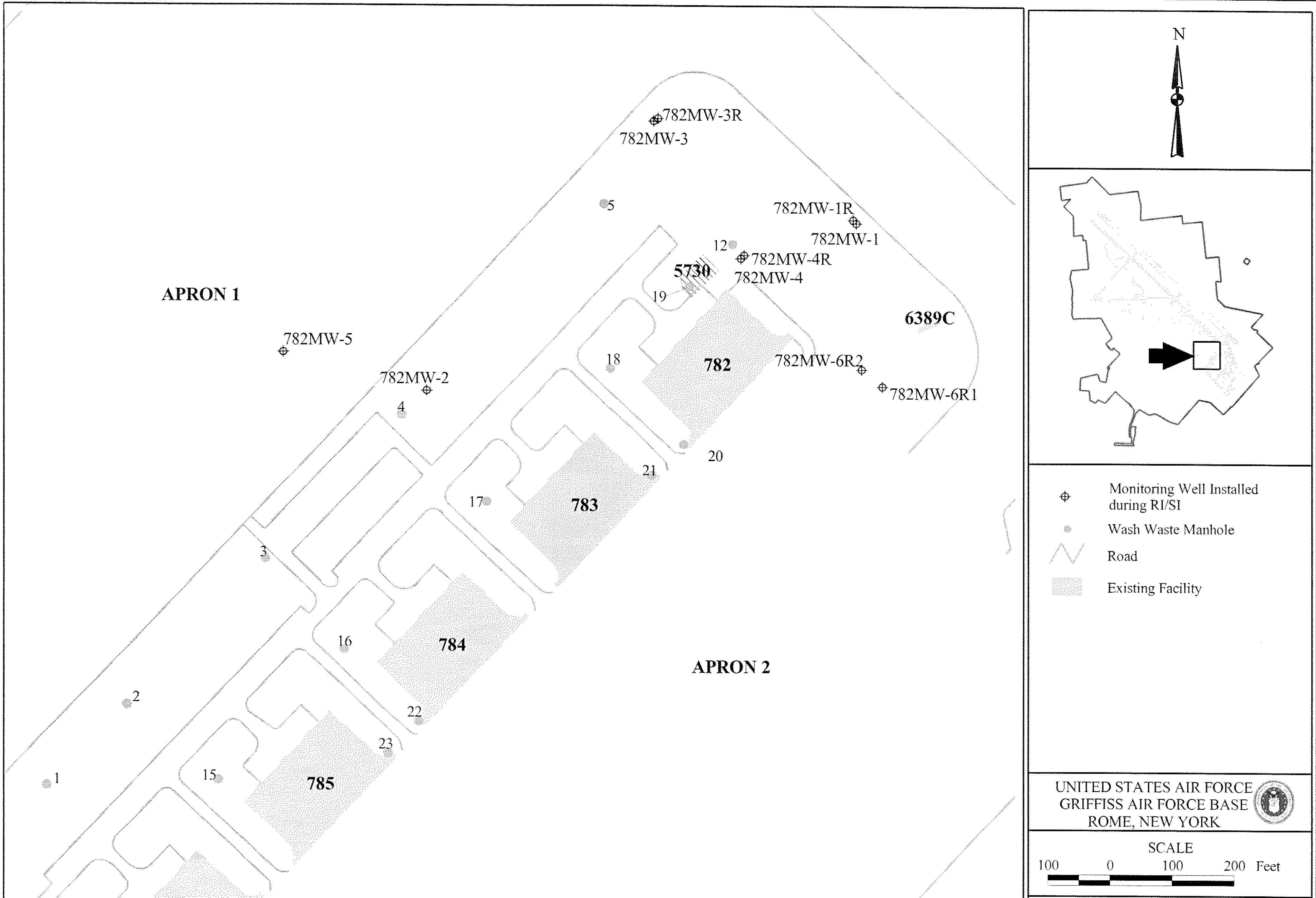

Figure 1-3
Building 782
RI/SI Well Locations

FPM group

detection limits in 782MW-2, 782MW-3R, or 782MW-5. A trace concentration (1.0 µg/L) of cis-1,2-DCE was detected at 782MW-1R, located downgradient (northeast) of 782MW-4R. The SI recommended that additional wells be installed to the east of Building 782 to characterize the extent of groundwater contamination.

1.2.4.3 Post RI/SI Investigations – 1996-2000

In 1996, during the Jet Fuel Hydrant System Assessment and Closure conducted by PEER Consultants, P.C. (PEER), several components of the jet fuel hydrant system at Apron 2 were excavated or demolished and removed, including Low Point Drain (LPD)-3B and Lateral Control Pits (LCP)s-C2 and -C3 (shown on Figure 1-1). Endpoint soil samples collected at LPD-3B indicated the presence of residual VOC and semivolatile organic compound (SVOC) contamination and those at LCP-C3 indicated residual VOC contamination. VOCs were analyzed using Environmental Protection Agency (EPA) method SW8021, which does not include chlorinated hydrocarbon analysis (PEER, 1997).

PEER also conducted closure activities on the Wash Waste System in 1996. In association with the Nose Dock Wash Waste System, Manholes 13 through 18 and 21 through 23 were excavated, and the Wash Waste System pipeline was cleaned, capped with hydraulic cement, and either removed or closed in place (PEER, 1999). Endpoint soil samples were collected following excavation procedures. The analytical results from bottom samples collected at Manholes 13, 21, 22, and 23 and from an area approximately 24 feet downstream of Manhole 15 along a removed pipeline section indicated VOC concentrations above Spill Technology and Remediation Series (STARS) Guidance Values. VOCs were analyzed at these locations using EPA Method SW8021 (no chlorinated hydrocarbon results are available). The Nose Dock Wash Waste System is also depicted in Figure 1-2. A water main also extends between Buildings 782 through 786 (not shown).

The initial purpose of the additional groundwater monitoring conducted by FPM at Nosedocks/Apron 2 from August to October 1999 was to characterize the downgradient extent of the chlorinated solvent contamination, as recommended by the SI. Groundwater samples were collected from temporary wells installed using Geoprobe® technology. After continuous soil screening was conducted to the groundwater table, groundwater samples were collected using a Geoprobe® Mill-Slotted Sampler and pumping through dedicated tubing with a peristaltic pump.

In August 1999, 12 borings were installed in the vicinity of Building 782 (782TW-54 through -65). No evidence of soil contamination was detected in the unsaturated zone during soil screening procedures. Groundwater samples were collected at each of the 12 locations from screened depths of 22 to 26 ft bgs. Groundwater samples were also collected from existing wells 782MW-1R, -4R, -6R1, and -6R2 in August 1999. The locations of all sampling points and monitoring wells are shown in Figure 1-4.

Groundwater samples were analyzed for VOCs by EPA Method SW8260B, which includes full chlorinated hydrocarbon analysis. The laboratory analytical results for groundwater indicated

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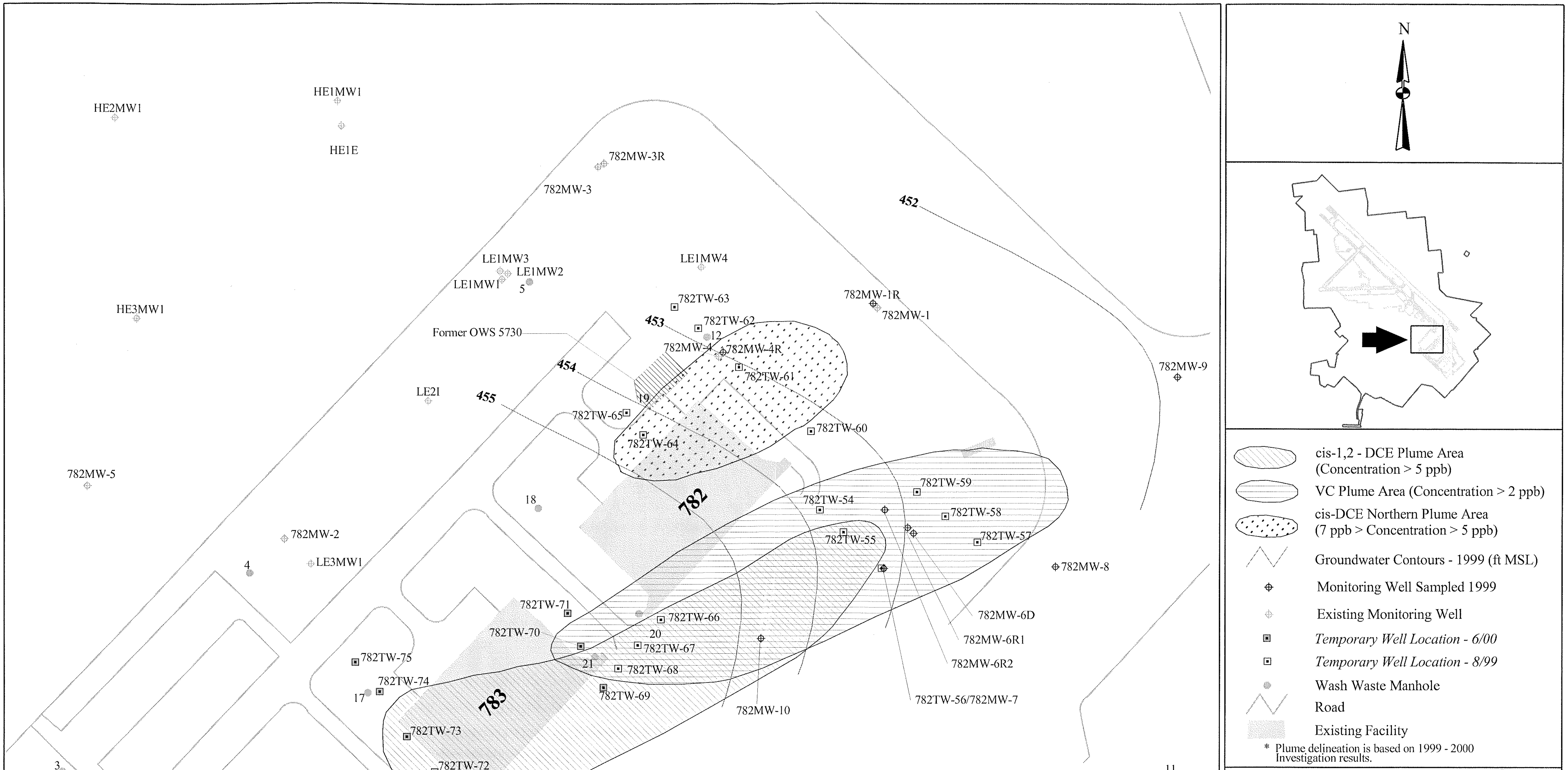

UNITED STATES AIR FORCE
GRIFFISS AIR FORCE BASE
ROME, NEW YORK

SCALE
90 0 90 180 Feet

Figure 1-4
Building 782
Previous Investigations

FPM group

that samples collected from 13 locations (782TW-54 through -59, 782TW-61, and 782TW-64) contained concentrations of chlorinated hydrocarbons exceeding the New York State (NYS) Groundwater Standards. (These analytical results are shown in Table 1-1.) The majority of elevated concentrations of total chlorinated hydrocarbons were detected at locations southeast of Building 782, and were reported highest at location 782TW-55 (46 μg/L). In addition, slight exceedances for cis-1,2-DCE (5.55 μg/L) and VC (3.67 μg/L) were reported in existing monitoring wells 782MW-4R and 782MW-6R2, respectively (these results are shown in Table 1-2). Only in temporary wells 782TW-60 through -65, located north-northeast of Building 782, were benzene levels reported at levels more than one order of magnitude above the NYS Groundwater Standard (1 μg/L), ranging from 16 to 241 μg/L. These locations are likely associated with a separate petroleum hydrocarbon plume identified in association with Apron 1 and Nose Docks 1 and 2.

FPM also collected groundwater samples at locations 782TW-66, -67, and -68 in August 1999 during a separate petroleum spills investigation that did not target chlorinated hydrocarbons. The samples were analyzed for STARS Volatiles List 8021 (results are shown in Table 1-3). Soil samples collected from the top of the capillary zone were also submitted for analysis, but no soil contamination was reported. FPM contacted the laboratory regarding the presence of chlorinated hydrocarbons in samples 782TW-66, -67, and -68, and the laboratory confirmed the presence of chlorinated hydrocarbons in those three samples (the magnitude of contamination of these compounds was not available).

In October 1999, five new permanent wells were installed and sampled, including 782MW-6D, -7, -8, -9, and -10 (see Figure 1-3). Most of these wells are screened across the top of the groundwater table, except for 782MW-6D, screened from 38 to 48 ft bgs: 782MW-7 is screened from 20 to 35 ft bgs; 782MW-8 from 17 to 27 ft bgs; 782MW-9 from 15 to 30 ft bgs; and 782MW-10 from 19 to 34 ft bgs. Monitoring wells 782MW-6D, -7, and -10 each reported exceedances of the NYS Groundwater Standard for VC. 782MW-10, originally intended as an upgradient monitoring well, contained the highest concentration of total chlorinated ethenes (49 μg/L). These analytical results are included in Table 1-2.

Groundwater elevations at each of the new and existing wells that were sampled in 1999 were also recorded, and confirmed the presumed northeast groundwater flow direction at Building 782 (SI, 1997); the groundwater contours are illustrated in Figure 1-4.

In June 2000, FPM installed seven temporary wells (using a Geoprobe® / Geoprobe® Mill-Slotted Sampler) west of Building 782 to characterize the upgradient (or western) extent of the chlorinated hydrocarbon plume and to possibly identify the source area. The wells were installed along transects perpendicular to the presumed groundwater flow direction. One transect consisted of three temporary wells, 782TW-69 through -71, located just east of Building 783, and the second transect of four temporary wells, 782TW-72 through -75, was situated just west of Building 783. Samples were collected from two depth intervals at each location (with the

Table 1-1
1999 Building 782 Groundwater Analytical Results, Temporary Wells
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample Location	NYS Class GA GW Standard	782 TW-54	782 TW-55	782 TW-56	782 TW-57	782 TW-58	782 TW-59	782 TW-60	782 TW-61	782 TW-62	782 TW-63	782 TW-64	782 TW-65
Sample ID		**782T5422B**	**782T5522B**	**782T5622B**	**782T5722B**	**782T5822B**	**782T5922B**	**782T6022B**	**782T6122B**	**782T6222B**	**782T6322B**	**782T6422B**	**782T6522B**
Date of Collection		8/9/1999	8/9/1999	8/9/1999	8/9/1999	8/9/1999	8/9/1999	8/9/1999	8/9/1999	8/9/1999	8/9/1999	8/9/1999	8/9/1999
Sample Interval (ft below TOIC)		22-26	22-26	22-26	22-26	22-26	22-26	22-26	22-26	22-26	22-26	22-26	22-26
VOCs (µg/L)													
1,1-Dichloroethane	5*	0.38 F***	0.29 F	0.33 F	U	0.36 F	0.25 F***	0.20 F	0.29 F	1.19	2.34	0.36 F	U
1,2,4-Trimethylbenzene	5*	U	U	U	U	U	U	3.15	***6.15***	***5.53***	U	0.31 F	U
1,3,5-Trimethylbenzene	5*	U	U	U	U	U	U	0.97	1.67	1.06	U	U	U
Acetone	50**	U	U	U	U	U	U	U	U	***239 J***	U	U	***125 J***
Benzene	1	***1.76***	***0.70***	***0.93***	U	U	***1.47 ******	***25.90***	***66.90 DL***	***241.00 DL***	***48.10***	***15.80***	***69.20 DL***
Chloroform	7	U	U	U	U	U	U	U	U	1.23	U	U	0.63
cis-1,2-Dichloroethene	5*	1.87	***23.40***	0.38 F	1.57	1.36	0.94 F***	3.30	***5.21***	3.67	2.56	***5.20***	1.02 F
Ethylbenzene	5*	U	U	U	U	U	U	U	1.90	U	U	U	U
Isopropylbenzene	5*	U	U	U	U	U	U	0.37 F	3.52	0.45 F	U	U	U
m,p-Xylene	5*	U	U	U	U	U	U	U	1.57	0.98 F	U	U	1.02 F
n-Butylbenzene	5	U	U	U	U	U	U	U	2.96	U	U	U	U
n-Propylbenzene	5*	U	U	U	U	U	U	U	4.83	0.25 F	U	U	U
Napthalene	10**	0.45 J***	0.18 F	0.20 F	U	U	U	0.85	***21.20***	1.44	0.23 F	U	0.55
o-Xylene	5*	U	U	U	U	U	U	U	U	U	U	0.37 F	U
sec-Butylbenzene	5*	U	U	U	U	U	U	0.36 F	3.00	0.37 F	U	U	U
Tetrachloroethene	5*	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	0.45 F***	U	U	U	U	U	U	U	0.30 F	U	U	U
trans-1,2-Dichloroethene	5*	0.58 F	0.88	0.68	U	0.32 F	0.36 F	U	U	U	U	U	U
Vinyl chloride	2	***5.74***	***22.40***	***31.40***	***25.40***	***14.00***	***3.17 ******	U	U	U	U	U	U

Notes:
F= Analyte detected above the MDL, however the concentration is below the RL.
J= The analyte was positively identified, the quantitation is an approximate value of the concentration of the analyte in the sample.
U = The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
* The principal organic contaminant standard for groundwater of 5 µg/L applies to this substance.
** The DEC Guidance value applies to this substance.
*** Concentration from duplicate sample is reported since it is greater than the parent sample concentration.
DL- The numerical value was taken from sample dilution analyses
Shading indicates the value exceeds the NYSDEC Class GA Groundwater Standard.

Table 1-2
1999 Building 782 Groundwater Analytical Results, Permanent Monitoring Wells Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample Location	NYS Class GA GW Standard	782MW-1R	782MW-4R	782MW-6R1	782MW-6R2	782MW-6D	782MW-7	782MW-8	782MW-9	782MW-10
Sample ID		**782M01R 20A**	**782M04 22A**	**782M06R1 24A**	**782M06R2 25A**	**782MW6D 25AA**	**782MW7 26AA**	**782MW8 18AA**	**782MW9 24AA**	**782MW10 22AA**
Date of Collection		8/10/1999	8/10/1999	8/10/1999	8/10/1999	10/14/1999	10/15/1999	10/15/1999	10/15/1999	10/15/1999
Depth to Water (ft below TOIC)		20.82	22.12	24.29	25.2	25.54	26.55	18.03	24.60	22.75
VOCs (µg/L)										
1,1-Dichloroethane	5*	0.95	0.40 F	U	0.21 F	U	U	U	U	U
1,1-Dichloroethene	5*	U	U	U	U	U	U	U	U	1.76 J***
1,2,4-Trimethylbenzene	5*	1.59	U	0.33 F	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	0.30 F	***52.60 DL***	U	U	U	U	U	U	U
Acetone	50**	U	U	U	U	--	--	--	--	--
Benzene	1	***174.00 DL***	***121.00 DL***	0.22 F	0.52	U	0.291 F	U	U	0.331 F
Bromodichloromethane	50**	U	U	U	U	0.309 F	U	U	U	U
Chloroform	7	0.24 F	0.42 F	U	U	***9.11***	1.37	0.502	U	***18.3***
cis-1,2-Dichloroethene	5*	0.53 F	***5.55***	U	0.67 F	1.50	1.65	U	U	***41.5***
Ethylbenzene	5*	U	***9.02***	0.22 F	U	U	U	U	U	U
Isopropylbenzene	5*	U	***9.06***	0.43 F	U	U	U	U	U	U
m,p-Xylene	5*	U	***10.20***	U	U	U	U	U	U	U
n-Propylbenzene	5*	U	***17.80***	U	U	U	U	U	U	U
Napthalene	10**	3.29	U	U	U	U	U	U	U	U
4-Isopropyltoluene	5*	0.28 F	U	0.69 F	U	U	U	U	U	U
sec-Butylbenzene	5*	U	U	0.59 F	U	U	U	U	U	U
tert-Butylbenzene	5*	U	U	0.25 F	U	U	U	U	U	U
Toluene	5*	U	U	U	U	4.01	U	2.57	0.918 F	U
trans-1,2-Dichloroethene	5*	U	U	U	U	U	U	U	U	1.48***
Trichlorofluoromethane	5*	U	U	U	U	UJ	UJ	UJ	UJ	UJ
Vinyl chloride	2	U	U	U	***3.67***	***5.32***	***2.12***	U	U	***7.80***

Notes:
F= Analyte detected above the MDL, however the concentration is below the RL.
UJ= The analyte was not detected above the reporting limit. However, the quantitation is an approximatation.
U = The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
* The principal organic contaminant standard for groundwater of 5 µg/L applies to this substance.
** The DEC Guidance value applies to this substance.
*** Concentration from duplicate sample is reported since it is greater than the parent sample concentration.
DL- The numerical value was taken from sample dilution analyses
Shading indicates the value exceeds the NYSDEC Class GA Groundwater Standard.
-- Analyte was not included in the laboratory analysis report.

Table 1-3
1999 Building 782 Soil and Groundwater Analytical Results
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample Location	NYS Class GA GW Standard	782SB-66	782TW-66	782SB-67	782TW-67	782SB-68	782TW-68
Sample ID		**782S6617A (Soil)**	**782T6622B (GW)**	**782S6718A (Soil)**	**782T6722B (GW)**	**782S6817A (Soil)**	**782T6822B (GW)**
Date of Collection		8/9/1999	8/10/1999	8/9/1999	8/9/1999	8/9/1999	8/10/1999
Sample Interval (ft below TOIC)		17-19	22-26	18-20	22-26	17-19	22-26
VOCs (μg/L)							
1,2,4-Trimethylbenzene	5*	U	U	U	U	2.3	U
1,3,5-Trimethylbenzene	5*	U	U	U	U	1.09 F	U
Benzene	1	U	0.37F	U	U	U	0.38 F
Ethylbenzene	5*	U	U	U	U	0.28 F	U
Isopropylbenzene	5*	U	U	U	U	0.23 F	U
n-Propylbenzene	5*	U	U	U	U	0.46 F	U
MTBE	5*	U	U	U	0.56 F	U	0.58F
sec-Butylbenzene	5*	UJ	U	UJ	U	UJ	U
SVOCs (μg/L)							
Benzo(a)pyrene	0.002**	154.39 F	UJ	U	UJ	U	UJ
Benzo(a)anthracene	0.002**	U	UJ	U	UJ	U	UJ
Benzo(b)fluoranthene	0.002**	U	UJ	U	UJ	U	UJ
Benzo(ghi)perylene	0.002**	U	UJ	U	UJ	U	UJ
Benzo(k)fluoranthene	0.002**	U	UJ	U	UJ	U	UJ
Chrysene	0.002**	U	UJ	U	UJ	U	UJ
Dibenzo(a,h)anthracene	0.002**	U	UJ	U	UJ	U	UJ
Indeno(1,2,3-cd)pyrene	0.002**	U	UJ	U	UJ	U	UJ
Pyrene	0.002**	U	UJ	U	UJ	U	UJ

Notes:
F= Analyte detected above the MDL, however the concentration is below the RL.
UJ= The analyte was not detected above the reporting limit. However, the quantitation is an approximatation.
U = The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
* The principal organic contaminant standard for groundwater of 5 μg/L applies to this substance.
** The DEC Guidance value applies to this substance.
Shading indicates the value exceeds the NYSDEC Class GA Groundwater Standard.

exception of 782TW-75): from the top of the water table, ranging from 19 to 25 ft bgs, and from approximately 4 ft below the water table, ranging from 23 to 30 ft bgs. Of the 13 samples submitted (only one groundwater sample was able to be retrieved from 782TW-75, from 21 to 25 ft bgs [the interval from 24 to 28 ft bgs did not recharge]), five were reported with cis-1,2-DCE or VC levels above NYS Groundwater Standards. The highest concentrations were reported at 782TW-72 from 24 to 28 ft bgs, with cis-1,2-DCE at 79 µg/L and VC at 15 µg/L. Of particular interest were concentrations of cis-1,2-DCE, the parent compound to VC during anaerobic biodegradation, at higher levels in upgradient locations relative to downgradient locations. (TCE, the parent compound to cis-1,2-DCE, had not been reported above reporting limits in any of the locations sampled thus far, but was detected at 782TW-74 at 0.22 F µg/L.) Results are shown in Table 1-4. (Table 1-4 also includes the results for a soil sample collected at 782SB-69 from 2 to 4 ft bgs that was submitted for VOC analysis due to high PID reading; however, no VOCs were detected above the reporting limit in the total analysis performed on the sample).

From these investigations, two cis-1,2-DCE plumes and one VC plume, continuous with the south cis-1,2-DCE plume, were identified by assessing the extent of chlorinated hydrocarbon results above NYS Groundwater Standards (see Figure 1-2). The axis of the south cis-1,2-DCE plume appears to be along a line connecting sampling locations 782TW-73, 782TW-69, 782MW-10, and 782MW-6D. The upgradient extent of this plume was thus undefined. Suspected source areas were associated with the former Wash Waste System between Buildings 783 and 784, or between Buildings 784 and 785, or even further upgradient between Buildings 785 and 786. Several manholes associated with the former Wash Waste system are located between Buildings 783 and 786, including 15, 16, 17, 22, and 23. The manholes are upgradient of those locations where elevated concentrations of chlorinated hydrocarbons were detected.

The north cis-1,2-DCE plume was believed to be potentially commingling with a petroleum hydrocarbon plume (mainly benzene) that is located north of Building 782 in association with Apron 1 and Nose Docks 1 and 2 (FPM, *Draft Informal Technical Information Report, Oil/Water Separator 5730 and Adjacent Trench Fire/Drainage Swale,* November 2002). The benzene plume likely originated from the former Oil/Water Separator 5730, just north of Building 782, and/or numerous possible leaks associated with the jet fuel hydrant system at Apron 1. Samples from new wells to be installed in association with the Petroleum Long-Term Monitoring Plan at Apron 1/Nose Docks 1 and 2 will be submitted to the laboratory for VOC analysis using EPA Method 8260 (including chlorinated hydrocarbons), as appropriate.

Based on the results from the 1999 and June 2000 investigations (FPM, 2000), the following were recommended:

- Because samples collected at deeper intervals indicated higher concentrations of contaminants, vertical profiling to the top of bedrock should be conducted;
- The source area should be identified by installing transects of wells that are perpendicular to the groundwater flow and situated upgradient of potential source areas (i.e., manholes);

Table 1-4
June 2000 Building 782 Soil and Groundwater Analytical Results
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample Location	NYS Class GA GW Standards	782SB-69	782 TW-69		782 TW-70		782 TW-71		782 TW-72		782 TW-73		782TW-74		782TW-75
Sample ID		**782S69 02AA**	**782T69 25AA**	**782T69 30AA**	**782T70 25AA**	**782T70 29AA**	**782T71 25AA**	**782T71 29AA**	**782T72 24AA**	**782T72 29AA**	**782T73 20AA**	**782T73 27AA**	**782T74 19AA**	**782T74 28AA**	**782T75 21AA**
Date of Collection		6/23/2000	6/23/2000	6/23/2000	6/23/2000	6/23/2000	6/23/2000	6/23/2000	6/26/2000	6/26/2000	6/26/2000	6/26/2000	6/26/2000	6/26/2000	6/27/2000
Sample Interval		2-4	21-25	26-30	20-25	25-29	19-25	25-29	23-25	24-28	20-24	23-27	19-25	24-28	21-25
VOCs (µg/L)															
1,1-Dichloroethane	5*	U	U	U	U	0.36 F	U	U	U	0.50 F	U	U	0.26 F	U	U
1,2,3-Trichlorobenzene	5*	UJ	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2,4-Trichlorobenzene	5*	UJ	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	U	0.85 F**	U	U	U	U	U	U	U	U	U	U	U	U
1,2-Dibromo-3-chloropropane	0.04	U	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
Benzene	1	U	***1.6 *****	0.70 F	U	***1.1***	U	U	0.33 F	0.67 F	U	0.24 F	0.92 F	U	U
cis-1,2-Dichloroethene	5*	U	0.40 F	***16***	0.25 F	U	U	U	U	***79 DL***	0.42 F	***60***	2.2	0.31 F	3.5
Dichlorodifluoromethane	5*	U	U	U	U	U	U	0.19 M	U	U	U	U	U	U	U
Ethylbenzene	5*	U	0.97 F**	U	U	U	U	U	U	U	U	U	U	U	U
m,p-Xylene	5*	U	1.4 F**	U	U	U	U	U	U	U	U	U	0.36 F	U	U
Methylene chloride	5*	*5.6* [f]	0.28 F	UJ	UJ	UJ	UJ	UJ	U	U	U	U	U	U	U
n-Butylbenzene	5	UJ	U	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	UJ	U	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	U	U	5.0	U	U	U	1.4	U	U	U	U	U	U	U
trans-1,2-Dichloroethene	5*	U	U	0.26 F	U	U	U	U	0.29 F	***7.4***	U	3.9	U	U	U
Trichloroethene	5*	U	U	U	U	U	U	U	U	U	U	U	0.22 F	U	U
Vinyl chloride	2	U	1.1	1.7	0.40 F	***2.1***	U	0.25 F	***6.0***	***15***	0.25 F	***2.3***	U	U	U

Notes:
F= Analyte detected above the MDL, however the concentration is below the RL.
U = The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
UJ= The analyte was not detected above the reporting limit. However, the quantitation is an approximatation.
M= A matrix effect was present.
* The principal organic contaminant standard for groundwater of 5 µg/L applies to this substance.
** Concentration from duplicate sample is reported since it is greater than the parent sample concentration.
DL- The numerical value was taken from sample dilution analyses
[f] A suspected laboratory-introduced contaminant.
Shading indicates the value exceeds the NYSDEC Class GA Groundwater Standard.

- Once the source area is identified, soil samples should be collected in the vicinity to delineate potential soil contamination in the source area;
- The two plumes should be better characterized with upgradient, crossgradient, and downgradient wells for further plume delineation.

The results of this additional sampling would be used to assess whether reductive dechlorination processes are actively working to decrease chlorinated hydrocarbon concentrations across the lengths of the plumes. These recommendations were used as a foundation for the work conducted for this RI.

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2.0 SITE INVESTIGATION ACTIVITIES

Based on the results of previous groundwater sampling activities near the Nosedocks/Apron 2, additional sampling was recommended to delineate groundwater contamination upgradient (northwest) of Buildings 783 and 784 and isolate the source of contamination. The scope of work for the RI at Nosedocks/Apron 2 included a variety of tasks as discussed below. A summary of field activities conducted during the RI is presented in Table 2-1.

2.1 GROUNDWATER INVESTIGATIONS

2.1.1 Groundwater Screening Using Vertical Profile Wells

A total of 39 vertical profile wells were installed, using a combination of both hollow-stem auger (HSA) and Hydropunch® techniques, as described in the Final Work Plan (FPM, 2001). The general procedure for collecting groundwater samples was as follows:

- Soil samples were screened for well logging purposes at 2-ft intervals using standard split-spoon techniques from ground surface to the top of groundwater, and then at 5-ft intervals to the depth of completion, for all sampling locations. A photoionization detector (PID) capable of measuring in parts per billion (ppb) was used to locate possible zones of high contamination of VOCs in the unsaturated and vadose zones;
- The first groundwater sample was collected at the top of the water table by driving the split-spoon 12 to 24 inches past the bottom of the augers. A temporary well screen was inserted, and the first sample was collected using a disposable bailer;
- A split-spoon soil sample was then retrieved and screened, after which the auger was advanced 5 feet to the next split-spoon sampling interval. After the next split-spoon sample was screened, the auger was advanced to the second Hydropunch® interval;
- A Hydropunch® sample was collected at the second interval (approximately 10 feet below the top of the groundwater table), by driving the sampler 6 to 24 inches past the bottom of the augers, and allowing the sampler to fill no less than 30 minutes before retrieving the samples.

The split-spoon, auger, and Hydropunch® sampler were alternatively advanced as described above, until the top of the bedrock was reached, or auger refusal was identified. The last groundwater screening sample was collected from the zone immediately above the top of the bedrock. When soil lithology did not allow for adequate sample recovery in the Hydropunch® sampler within 30 minutes, a temporary well with a 1-inch diameter, 2-to 3-ft long screen was installed, which was packed with sand up to 1 to 2 ft, respectively, above the top of the screen, and 3 ft of bentonite above the top of the sand. The well was purged at least three well volumes before collection of the sample, by using a disposable 1-inch bailer. Temporary wells were also installed, in some cases, when Hydropunch® samplers were retrieved empty, or did not yield sufficient volume for adequate sample collection.

Table 2-1
Summary of Groundwater Sampling Field Activities
Remedial Investigation, Nosedocks/Apron 2 Chlorinated Plume

Well No.	No. of Vertical Profile Samples	Permanent Monitoring Well Installed/Sampled	Existing Well Sampled	No. of Soil Sample(s) Collected	Methane/ Ethane/ Ethene(1)
782VMW-76	5	X			
782VMW-77	5	X			
782VMW-78	5	X			
782VMW-79	5				
782VMW-80	8[a]	X			
782VMW-81	5[b]	X			X
782VMW-82	4	X			
782VMW-83	6	X			
782VMW-84	5	X			X
782VMW-85	5	X			
782VMW-86	4	X			
782VMW-87	5	X			
782VMW-88	4	X			
782VMW-89	4	X			
782VMW-90	4	X			
782SB-90RE2				2	
782VMW-91	5	X			
782VMW-92	5	X			
782VMW-93	5	X			
782VMW-94	5	X			
782VMW-95	5	X			
782VMW-96	5	X			X
782VMW-97	4[b]	X			
782VMW-98	5	X			X
782VMW-99	5	X			
782VMW-100	2	X			
782VMW-101	2	X			X
782VMW-102	2	X			X
782VMW-103	2				
782VMW-104	4	X		2	
782VMW-105	4			3	
782VMW-105b	3	X		3	X
782VMW-106	4				
782VMW-107	2			1	
782VMW-108	2			1	
782VMW-109	2			1	
782VMW-110	2			1	
782VMW-111	2			2	
782VMW-112	2				
782VMW-113	2				
782MW-6D			X		
782MW-6R2			X		
782MW-10			X		
AP2MW-3			X		
LD4MW1 (2002 only)			X[c]		
LD4MW2 (2002 only)			X[c]		
786MW-30 (2003 only)			X[c]		
782MW-181 (2003 only)		X[c]			
782MW-184 [illegible]3 only)		X[c]			

(1)All vertical pr[illegible] groundwater samples collected were analyzed for VOCs only. All permanent monitoring well samples collected in 2002 were analyzed for VOCs and geochemical parameters, except for methane/ethane/ethene, which was performed for only those sample locations shown.

[a] Includes three samples which were re-collected due to laboratory analysis problems.

[b] Includes one sample which was re-collected due to laboratory analysis problems.

[c] These samples were analyzed for VOCs only.

Exact locations of sampling locations deviated in some cases from the original work plan (FPM, 2001), when field observations and screening results at already-drilled locations helped to refine the plume extent (these results are discussed and presented in Section 4.0). Figure 2-1 shows all the vertical profile sample locations. Vertical profiling of the groundwater using Hydropunch® techniques was conducted from the top of the groundwater table down to the top of the bedrock or auger refusal (whichever occurred first). (Depth to bedrock in the vicinity of Nosedocks/Apron 2 ranged from 24 ft bgs [near Six Mile Creek] to 66 ft bgs [near Building 786/Nosedock 5]). Groundwater samples were collected at approximately 10-ft intervals, (initially using a bailer and thereafter using a Hydropunch® sampler), based on the recommendations put forth in the Final Work Plan (FPM, 2001).

During drilling operations, there was an occasional need to use clean, potable water during drilling, to control flowing sands in the deeper aquifer. The use of drill water for specific borings is summarized in Table 2-2. Although in most cases the Hydropunch® samplers were steam-cleaned between vertical profile samples, if Hydropunch® recovery was insufficient, a second attempt was made to collect a Hydropunch® sample within 2 to 3 ft of the first attempt. Between these attempts, the Hydropunch® sampler was decontaminated using an Alconox/drilling water rinse, and then rinsed with drilling water. Residual water from this decontamination procedure could also have introduced trace levels of drilling water to the samples.

The analytes in the drilling water (City of Rome drinking water) which were reported detected using EPA Method 8260B (VOC analysis) are summarized in Table 2-3. Three VOCs were detected in all drilling water samples: bromodichloromethane, chloroform, and dibromochloromethane. Please note that only chloroform was detected in Hydropunch® samples, but at levels below the New York State Groundwater Standard in all cases. (Hydropunch® sample results are summarized in Section 4.1.)

All groundwater samples collected from the vertical profile wells were analyzed for VOCs using EPA Method SW8260B, which includes the chlorinated hydrocarbon COCs, or Target Compound List (TCL) VOCs. The analyses were performed on a rapid turnaround basis (typically within 24 hours) by an off-site laboratory. The results were used to guide the decisions for the permanent monitoring well installations as to the appropriate interval to best screen for chlorinated hydrocarbon contamination.

2.1.2 Groundwater Sampling Using Permanent Wells

The results of the vertical profiling were used to assess the appropriate well screening interval that would allow for plume characterization and plume monitoring (e.g., the interval indicating the highest total chlorinated hydrocarbon concentrations). In those wells where little to no contamination was detected, or where little vertical difference was noted, the screen was placed at the most likely contaminated depth interval (based on surrounding wells). A permanent well

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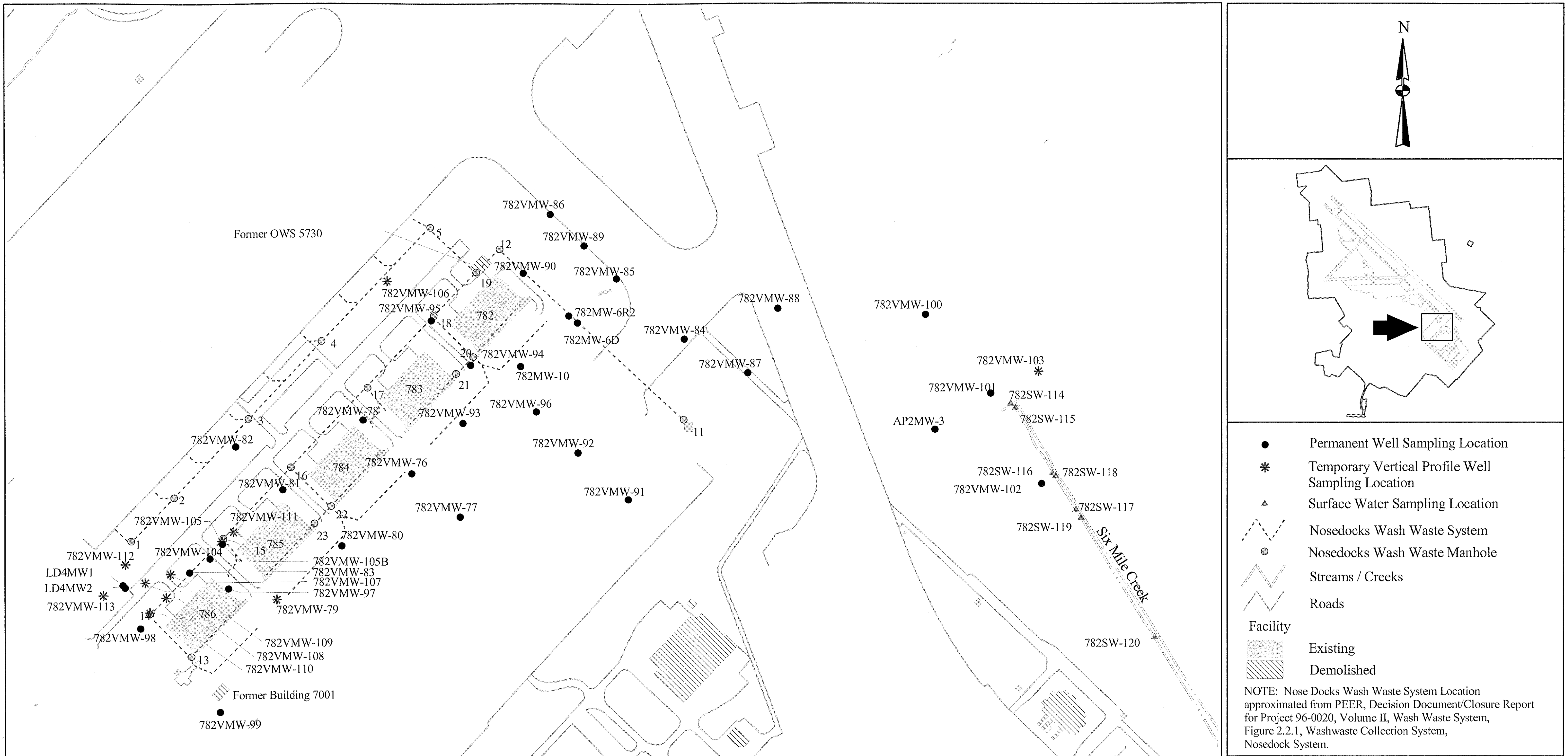

NOTE: Nose Docks Wash Waste System Location approximated from PEER, Decision Document/Closure Report for Project 96-0020, Volume II, Wash Waste System, Figure 2.2.1, Washwaste Collection System, Nosedock System.

UNITED STATES AIR FORCE
GRIFFISS AIR FORCE BASE
ROME, NEW YORK

SCALE
200 0 200 400 Feet

Figure 2-1
Nosedocks / Apron 2 Chlorinated Plume
Sampling Locations

FPM group

Table 2-2
Summary of Water Added to Borings during Drilling and Monitoring Well Installations
Remedial Investigation, Nosedocks/Apron 2 Chlorinated Plume
Former Griffiss AFB, Rome, NY

Sampling Location	Date Water Added	Approximate Volume Added (gallons)	Comments	Source of Drilling Water[(1)]
782VMW-94	11/16/01	25	Wash out flowing sand in augers	CME 550 Drill Rig Tank
782VMW-93	11/20/01	30	Wash out flowing sand in augers	CME 550 Drill Rig Tank
782VMW-76	11/28/01	25	Wash down bridged sand during well construction	CME 750 Drill Rig Tank
782VMW-85	12/4/01	5	Water used to apply sand to set temporary well at 32'	CME 750 Drill Rig Tank
782VMW-80	12/7/01	40	Wash down bridged sand during well construction	CME 550 Drill Rig Tank
782VMW-83	12/11/01	30	Wash out flowing sand in augers	CME 550 Drill Rig Tank
782VMW-77	12/11/01	20	Wash out flowing sand in augers	CME 750 Drill Rig Tank
782VMW-83	12/13/01	25	Wash down bridged sand during well construction	CME 550 Drill Rig Tank
782VMW-87	12/20/01	20	Wash down bridged sand during well construction	CME 550 Drill Rig Tank
782VMW-88	12/21/01	30	Wash down bridged sand during well construction	CME 550 Drill Rig Tank
782VMW-97	1/8/02	40	Wash out flowing sand in augers	CME 750 Drill Rig Tank
782VMW-95	1/10/02	10+	Water used to apply sand to set temporary well at 50'; wash out flowing sand in augers	CME 750 Drill Rig Tank
782VMW-105	1/17/02	55	Wash out flowing sand in augers	CME 550 Drill Rig Tank
782VMW-104	1/21/02	10	Water used to apply sand to set temporary well at 45.5'	CME 750 Drill Rig Tank

(1) Ultimate water source is from a hydrant at the southwest corner of Apron 1.

Table 2-3
Detected Analytes in Drilling Water[a] Samples
Remedial Investigation, Nosedocks/Apron 2 Chlorinated Plume
Former Griffiss AFB, Rome, NY

Parameter Sample ID: Sample Location: Sample Date:	782VM9400AW 782VMW-94 11/16/01	782VM9300AW 782VMW-93 11/20/01	782VM7600AW 782VMW-76 11/28/01	782VM8000AW 782VMW-80 12/7/01	782VM8300AW 782VMW-83 12/11/01	782VM8300AW 782VMW-83 12/13/01	782VM9700AW 782VMW-97 1/8/02
Bromodichloromethane	1.55	1.61	5.87	4.96	2.41	2.28	1.11
Chloroform	33.7	35.2	22.6	10.5	27.4	25.7	22.8
Dibromochloromethane	U	U	2.43	2.56	0.604	0.573	U
1,2,4-Trimethylbenzene	U	U	U	U	U	U	9.36
1,3,5-Trimethylbenzene	U	U	U	U	U	U	2.43
Benzene	U	U	U	U	U	U	0.437
Naphthalene	U	U	U	U	U	U	9.92

[a] City of Rome drinking water.

was installed at each vertical profile well location, except for those wells that indicated no chlorinated hydrocarbon contamination and whose locations were deemed non-critical for plume characterization, and for the temporary wells installed in the vicinity of Manhole 15/the Nosedocks Wash Waste System. In addition, two monitoring wells were installed – one adjacent to location 782VMW-81, and one adjacent to location 782VMW-84 to evaluate potential bedrock aquifer contamintion. In all, a total of 30 new permanent wells were installed during the RI. Well construction details are summarized for each location in Table 2-4.

All permanent monitoring wells were installed according to the protocol as described in the Field Sampling Plan (FSP) for the Areas of Concern (AOC) Long-Term Monitoring Baseline Study (FPM, 1998), with the exception that the well screens were constructed of 2-inch, factory slotted (0.010-inch) Schedule 40 PVC (not stainless steel). Each new well was developed no sooner than 48 hours after grout placement. A ground survey was performed by LaFave, White, and McGivern, L.S., P.C. to determine the northings/eastings and elevations of all sampling locations and/or permanent monitoring wells. Well development forms, field sampling forms, and survey data are included in Appendices A, B, and C, respectively.

During drilling operations and/or monitoring well installation, there was an occasional need to use clean, potable water during drilling, to control flowing sands in the deeper aquifer. If water was added to a particular boring, at least two times the amount used was removed during well development. The use of drill water for specific borings is summarized in Table 2-2.

The analytes in the drilling water (City of Rome drinking water) reported detected using EPA Method 8260B (VOC analysis) are summarized in Table 2-3. Three VOCs were detected in all drilling water samples: bromodichloromethane, chloroform, and dibromochloromethane. Please note that chloroform only was detected at trace levels (up to 0.6 ppb) in monitoring well samples (at locations 782VMW-95, -97, -98, -99, and -105B). (Sample results from permanent monitoring well samples are summarized in Section 4.2.)

All groundwater samples collected from the permanent monitoring wells were analyzed for VOCs using EPA Method SW8260B. In February 2002, groundwater samples were also collected from six preexisting monitoring wells in the vicinity of the Nosedocks/Apron 2 that were deemed appropriately screened to aid in source area identification and/or plume extent delineation, including 782MW-6D, 782MW-10, AP2MW-3, 782MW-6R2, LD4MW-1, and LD4MW-2. The 2003 sampling round was conducted as a resampling event of the 2002 sampling round, with the following exceptions: LD4MW-1 and -2 were not sampled (the 2002 results were non-detect for all VOCs), and a new well installed in conjunction with the Petroleum Spill Site 8910168 at Building 786, 786MW-30, was sampled (this well was installed in May 2002).

Table 2-4
Vertical Profile Well Construction Summary

Monitoring Well No.	Well Tyoe Permanent/ Temporary	Date Started	Date Completed	Date Development Started	Date Development Completed	Date Sampled	Depth Drilled (ft BGS)	Total Casing Depth (ft TOIC)	TOIC Casing Elevation (fr AMSL)	Ground Elevation (ft AMSL)	Screened (0.10 Slot) Interval (ft BGS)	Sand Inverval (ft BGS)	Bentotnite Seal Interval (ft BGS)	Grout Interval (ft BGS)	Static Water Level (ft BTOIC)	Stickup or Flush
782VMW-76	P	11/20/01	11/30/01	12/5/01	12/5/01	2/26/02	54.5	43.5	477.59	477.86	33-43	29-43	27-29	0.5-27	21.52	F
782VMW-77	P	12/11/01	12/14/01	12/19/01	12/19/01	2/25/02	60	40.5	476.54	476.93	20-40	18-40	14.8-18	0.5-14.8	18.79	F
782VMW-78	P	11/15/01	11/21/01	11/30/01	11/30/01	2/26/02	59.3	42.5	481.22	478.26	32-42	29-42	27-29	1-27	25.02	S
782VMW-79	T	1/23/02	1/25/02	N/A	N/A	N/A	55.8	N/A	N/A	477.74	N/A	N/A	N/A	N/A	N/A	N/A
782VMW-80	P	11/27/01	12/10/01	12/13/01	12/13/01	2/22/02	57	38.5	477.41	477.87	28-38	26-38	16-26	1-16	20.43	F
782VMW-81	P	11/27/01	12/6/01	12/12/01	12/13/01	2/21/02	52.4	50.5	479.57	477.71	40-50	34.5-50	31.5-34.5	1-31.5	22.12	S
782VMW-82	P	12/6/01	12/13/01	12/18/01	12/18/01	2/22/02	50.5	48.5	478.06	475.49	38-48	36-48	33-36	1-33	20.98	S
782VMW-83	P	12/6/01	12/13/01	12/18/01	12/18/01	2/28/02	67	35.5	480.13	477.72	25-35	23-35	20-23	1-20	20.41	S
782VMW-84	P	11/30/01	12/5/01	12/12/01	12/12/01	2/21/02	55.3	45.5	476.08	476.40	35-45	31.9-55	28.7-31.9	0.5-28.7	24.88	F
782VMW-85	P	12/3/01	12/10/01	12/17/01	12/17/01	2/25/02	51.5	39.5	478.02	475.70	29-39	26-40	23.1-26	1-23.1	24.64	S
782VMW-86	P	12/4/01	12/10/01	12/14/01	12/17/01	2/25/02	51	37.5	477.68	475.65	27-37	25-37	22.5-25	1-22.5	23.49	S
782VMW-87	P	12/13/01	12/20/01	12/28/01	12/28/01	2/27/02	53	40.5	476.27	476.86	30-40	28-45	25-28	1-25	24.42	F
782VMW-88	P	12/18/01	12/21/01	12/28/01	1/2/02	2/27/02	52	40.5	477.75	478.15	30-40	27-40	24-27	1-27	27.49	F
782VMW-89	P	1/9/02	1/14/02	1/21/02	1/21/02	2/25/02	51.2	40.5	478.85	475.94	25-40	23-41	19.2-23	1-19.2	25.15	S
782VMW-90	P	1/3/02	1/9/02	1/16/02	1/16/02	2/25/02	52	30.5	479.79	477.12	20-30	18-30	15-18	1-15	23.75	S
782VMW-91	P	12/18/01	12/21/01	12/27/01	1/14/02	2/28/02	57.5	30.5	477.70	478.05	20-30	18-30	15-18	0.5-15	22.31	F
782VMW-92	P	12/12/01	12/14/01	12/20/01	12/20/01	2/26/02	59.1	40.5	476.65	476.99	30-40	28-40	24.7-28	0.5-24.7	22.75	F
782VMW-93	P	11/19/01	11/21/01	11/27/01	11/28/01	2/26/02	56.9	40.5	477.57	477.87	30-40	28-40	26-28	0.5-26	22.09	F
782VMW-94	P	11/13/01	11/16/01	11/26/01	11/27/01	2/26/02	64	47.5	478.03	478.30	37-47	34-47	32-34	0.5-32	22.73	F
782VMW-95	P	1/9/02	1/14/02	1/21/02	1/21/02	2/25/02	57	35.5	479.26	477.19	20-35	18-35	15-18	1-15	23.79	S
782VMW-96	P	11/21/01	11/30/01	12/5/01	12/5/01	2/21/02	54.2	43.5	476.73	477.13	33-43	31-43	29-31	0.5-29	22.43	F
782VMW-97	P	1/2/02	1/8/02	1/15/02	1/15/02	2/22/02	44.4	35.5	480.76	478.52	25-35	23-35	20-23	1-20	21.11	S
782VMW-98	P	1/4/02	1/11/02	1/20/02	1/20/02	2/20/02	59	35.5	479.47	477.06	25-35	23-35	20-23	1-20	19.51	S
782VMW-99	P	1/2/02	1/8/02	1/15/02	1/16/02	2/22/02	59	35.5	480.89	477.83	20-35	18-35	15-18	1-15	20.81	S
782VMW-100	P	1/10/02	1/17/02	1/22/02	1/22/02	2/28/02	25.5	25.5	459.94	457.10	10-25	8-25.5	5-8	1-5	16.30	S
782VMW-101	P	1/14/02	1/17/02	1/22/02	1/22/02	2/20/02	25	22.5	453.95	451.11	7-22	5-23	2-5	1-2	9.90	S
782VMW-102	P	1/15/02	1/17/02	1/23/02	1/23/02	2/20/02	25.2	23.5	451.84	448.82	8-23	6-24	3-6	1-3	8.81	S
782VMW-103	T	1/18/02	1/18/02	N/A	N/A	N/A	24.4	N/A	N/A	455.23	N/A	N/A	N/A	N/A	N/A	N/A

Table 2-4 (cont'd)
Vertical Profile Well Construction Summary

Monitoring Well No.	Well Tyoe Permanent/ Temporary	Date Started	Date Completed	Date Development Started	Date Development Completed	Date Sampled	Depth Drilled (ft BGS)	Total Casing Depth (ft TOIC)	TOIC Casing Elevation (fr AMSL)	Ground Elevation (ft AMSL)	Screened (0.10 Slot) Interval (ft BGS)	Sand Inverval (ft BGS)	Bentotnite Seal Interval (ft BGS)	Grout Interval (ft BGS)	Static Water Level (ft BTOIC)	Stickup or Flush
782VMW-104	P	1/18/02	1/22/02	1/29/02	1/30/02	2/22/02	47.5	33.5	479.63	477.04	18-33	16-33	12.8-16	1-12.8	20.00	S
782VMW-105	T	1/15/02	1/17/02	N/A	N/A	N/A	49.8	N/A	N/A	477.24	N/A	N/A	N/A	N/A	N/A	N/A
782VMW-105B	P	1/22/02	1/25/02	1/29/02	1/29/02	2/21/02	42.5	42.5	480.25	477.37	27-42	25-42	23-25	1-23	21.26	S
782VMW-106	T	1/18/02	1/22/02	N/A	N/A	N/A	49.8	N/A	N/A	475.07	N/A	N/A	N/A	N/A	N/A	N/A
782VMW-107	T	1/24/02	1/24/02	N/A	N/A	N/A	31	N/A	476.71	N/A	N/A	N/A	N/A	N/A	N/A	N/A
782VMW-108	T	1/28/02	1/28/02	N/A	N/A	N/A	31	N/A	476.97	N/A	N/A	N/A	N/A	N/A	N/A	N/A
782VMW-109	T	1/29/02	1/29/02	N/A	N/A	N/A	31	N/A	476.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A
782VMW-110	T	1/29/02	1/30/02	N/A	N/A	N/A	31	N/A	476.82	N/A	N/A	N/A	N/A	N/A	N/A	N/A
782VMW-111	T	1/30/02	1/30/02	N/A	N/A	N/A	31	N/A	477.39	N/A	N/A	N/A	N/A	N/A	N/A	N/A
782VMW-112	T	1/31/02	1/31/02	N/A	N/A	N/A	31	N/A	475.60	N/A	N/A	N/A	N/A	N/A	N/A	N/A
782VMW-113	T	2/4/02	2/4/02	N/A	N/A	N/A	31	N/A	478.05	N/A	N/A	N/A	N/A	N/A	N/A	N/A
782MW-181	P	4/28/03	5/1/03	N/A	N/A	6/12/03	88	88	480.48	478.36	78-88	76-88	72-76	2-72	87.96	S
782MW-184	P	5/5/03	5/8/03	N/A	N/A	6/12/03	74.5	74.3	475.86	476.20	64.3-74.3	62.3-74.3	58.3-62.3	1-58.3	23.74	F

Note: All permanent wells were constructed with 2-inch Schedule 40 PVC.

To assess how degradation processes may be working to decrease chlorinated hydrocarbon concentrations, samples were also submitted for the analysis of geochemical parameters, including nitrate, total iron, sulfate, sulfide, methane/ethane/ethene, alkalinity, and chloride for each location (except for LD4MW-1 and -2). Field parameters were also collected at each well sampled, including pH, temperature, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. A Hach® kit was also used to test for dissolved iron in the field. These data were used to assess if reductive dechlorination processes are operating to reduce chlorinated solvent concentrations across the length of the plume (i.e., as indicated by ferrous iron and sulfide), or if direct oxidation is possible (i.e., as indicated by dissolved oxygen, alkalinity, and chloride levels). At selected locations, groundwater samples were also submitted for methane/ethene/ethane analysis (using EPA Method RSK-175) to confirm anaerobic/redox conditions in the subsurface. These selected locations are noted in Table 2-1. Geochemical results are discussed in Section 4.6.

For risk assessment evaluation purposes, five permanent wells (786MW-2, 786MW-3, 782MW-4R, 782VMW-81, and 782VMW-96) were sampled in August 2002 and submitted for metals analysis (EPA Method SW6010B). These results are discussed in Section 6.2.1.2. As discussed above, each permanent monitoring well sampled during the initial permanent well sampling event (with the exception of LD4MW-1 and LD4MW-2, where no VOCs were detected) was resampled in February 2003, and new monitoring well 786MW-30 was also sampled (installed as part of the Building 786 Petroleum Spill Site investigation, FPM, 2001). In 2003, the samples were submitted for VOCs, metals, and geochemical parameters (nitrate, total iron, sulfate, sulfide, alkalinity, and chloride only) analysis.

2.1.3 Slug Testing

Hydraulic conductivities were calculated from slug tests performed at the following wells: 782VMW-81, -85, -87, -88, -95, -96, -97, -101, -105b, and 782MW-4R. Two rising and two falling head tests were performed at each of these wells, using a Hermit® Datalogger, a 2-inch, 5-ft. long slug, and a pressure transducer. The results were converted from pressure units to depth units, and the results then subjected to the Bouwer-Rice method for determining the hydraulic conductivity.

Three of the wells chosen for slug testing were screened across the top of the groundwater table – 782VMW-95, -101, and 782MW-4R – while the remaining wells were screened well below the top of the groundwater table. The recovery rate from 782VMW-4R was deemed too quick to derive hydraulic conductivity information, but each of the remaining wells yielded usable data. Results are discussed in Section 3.4.1.

2.2 SOIL AND VADOSE ZONE INVESTIGATIONS

Soil sampling for the purposes of geological characterization and well logging was conducted at 2-foot intervals from ground surface to the top of groundwater, and at 5-foot intervals thereafter to the top of bedrock, using standard split-spoon techniques until the depth of completion (i.e., the top of bedrock or the depth of refusal). Soil sample collection for laboratory analysis was conducted at locations in the vicinity of the source area (782VMW-104, -105, and -107 through -111), and at 782VMW-90, where significant soil contamination was detected via field screening methods (PID, olfactory, staining, etc.). The soil samples were submitted for laboratory analysis from the depth interval where the highest concentration of contamination was detected using a low-range (parts per billion) PID. Results are discussed in Section 4.3.

2.3 SURFACE WATER INVESTIGATION

When the results from vertical profile wells installed at the downgradientmost edge of the plume (782VMW-100 through -102) indicated that the plume could be discharging to Six Mile Creek, surface water samples were collected from seepage flowing into the creek from the west creek bank, and from Six Mile Creek itself, to assess the impact of groundwater seeps along the bank on the surface water quality. Samples were collected by placing a clean sampling device (i.e., a laboratory-certified clean glass bottle) at the seepage discharge point or in the creek with the opening facing up and allowing the water to slowly fill the bottle, and then carefully pouring the water into the laboratory-certified clean sample jars. The samples were collected at four points along the creek: one seepage (782SW-114) and creek (782SW-115) sample downgradient from 782VMW-101 at the Six Mile Creek culvert; one seepage (782SW-116) and creek (782SW-118) sample in the downgradient vicinity of 782VMW-102; one seepage (782SW-117) and creek (782SW-119) sample from approximately 100 ft south of 782VMW-102; and one creek sample only (782SW-120) from approximately 350 ft downstream of location 782SW-119.

In 2002, all surface water samples were submitted for laboratory analysis of VOCs (EPA Method 8260B). In addition, dissolved iron readings were collected for three of the seven samples: 782SW-114, -116, and -117, to assess the geochemistry/redox conditions of the groundwater seeps. In 2003, surface water sampling locations 782SW-115, -118, -119, and –120 were also resampled and submitted for VOC analysis only. Results are discussed in Section 4.4.

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3.0 PHYSICAL CHARACTERISTICS OF STUDY AREA

3.1 GEOGRAPHY

The former Griffiss AFB is located in the city of Rome in Oneida County, New York (refer to Figure 1-1). The former Base lies within the Mohawk Valley between the Appalachian plateau and the Adirondack Mountains. A rolling plateau northeast of the former Base reaches an elevation of 1300 ft above mean sea level (MSL). The New York State Barge Canal (NYSBC) and the Mohawk River valley south of the former Base lie below 430 ft above MSL. The topography across the former Base is relatively flat with elevations ranging from 435 ft above MSL in the southwest portion to 595 ft above MSL in the northwest portion of the former Base.

Apron 2 and its surrounding area, including the Nosedocks, can be characterized as an industrial setting with very little change in topography. Greater than two-thirds of the surface in the vicinity of Apron 2 is covered by structures or impermeable pavements.

3.2 CLIMATE

The former Griffiss AFB experiences a continental climate characterized by warm, humid, moderately wet summers and cold winters with moderately heavy snowfalls. The mean annual precipitation is 45.6 inches, which includes the mean annual snowfall of 107 inches. The annual evapotranspiration rate is 23 inches. The average temperature during the winter season is 20 degrees Fahrenheit; temperatures during the spring, summer, and fall vary from 31 to 81 degrees Fahrenheit. The prevailing winds are from the southwest, with an average wind speed of 5 knots.

The former Griffiss AFB is located in a region prone to acid precipitation; the annual average pH of precipitation recorded for 1992 at the three closest stations ranged from 4.25 to 4.28. Fluctuations in pH have an inverse correlation to precipitation, such that lower pH levels correlate with higher amounts of precipitation (Law, 1996).

3.3 TOPOGRAPHY, GEOLOGY, AND SOILS

Unconsolidated sediments at the former Griffiss AFB consist primarily of glacial till with minor quantities of clay and sand and significant quantities of silt and gravel. The thickness of these sediments ranges from 0 to 12 feet in the northeast portion to more than 130 feet in the southern portion of the former Base. The average thickness of the unconsolidated sediments is 25 to 50 feet in the central portion and 100 to 130 feet in the south and southwest portions of the former Base. The bedrock beneath the former AFB generally dips from the northeast to the southwest and consists of the black Utica Shale. It is a gray and black carbonaceous unit with a high/medium organic content (Law, 1996). The depth to bedrock ranges from 0 feet on the north side to as much as 150 feet on the south side of the former Base.

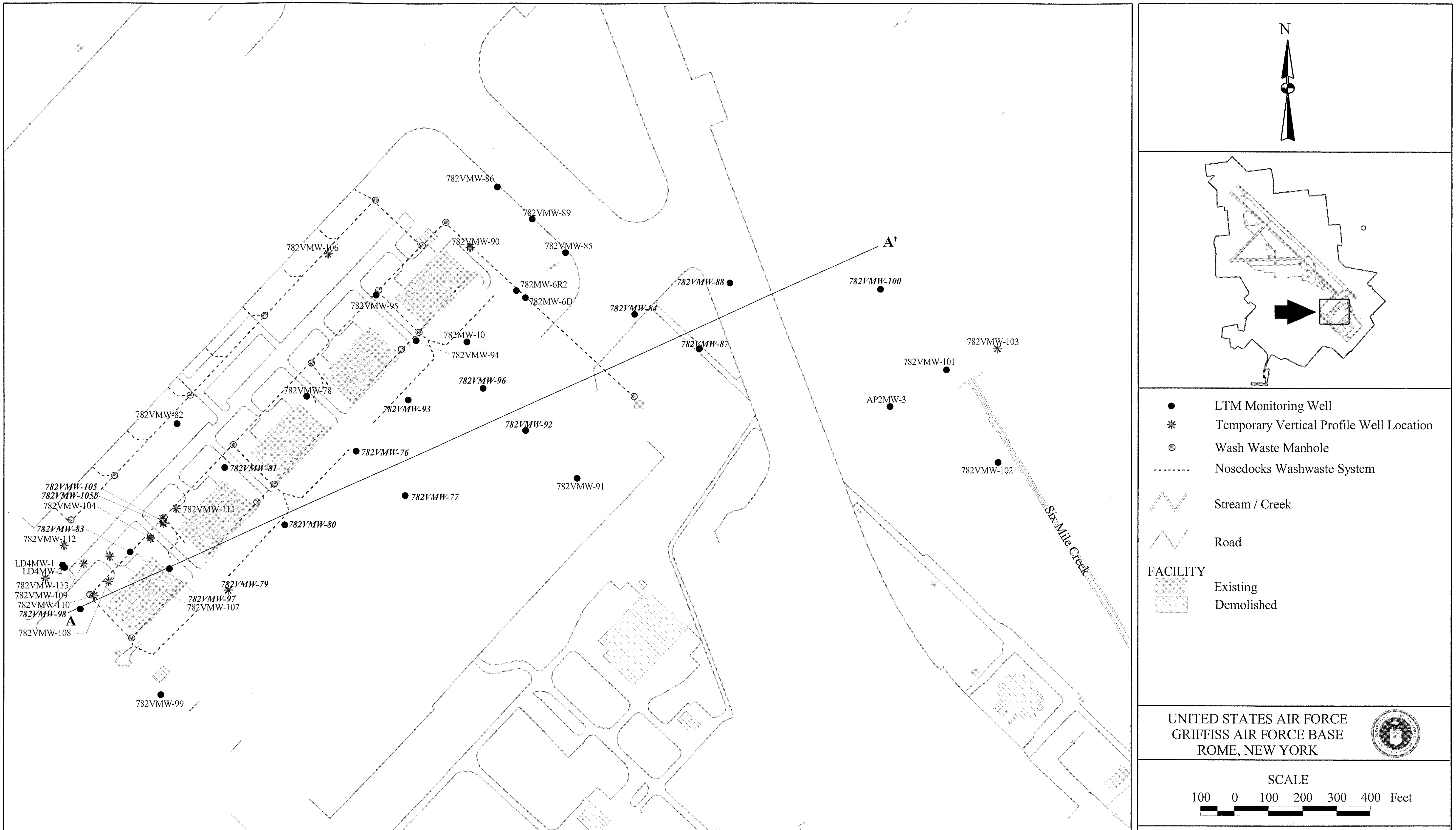
The site-specific geology in the vicinity of Apron 2 is characterized by dense soils consisting mainly of fine to medium sands with silt and occasional clay layering. During construction of Apron 2, approximately 15 feet of fill was added to the entire area. Soil screening conducted during the SI confirmed that fill material appears to exist to an approximate depth of 15 ft below ground surface (bgs) (E&E, 1998). The fill material consists mainly of fine to medium sands with varying amounts of silt and clay. Dense, unsaturated soils in the area of Apron 2 are most likely the result of thorough compaction of fill material during the construction of the area prior to the installation of the Apron 2 concrete pad. Beneath the fill is silty sand to an approximate depth of 23 ft bgs, under which occasionally, in the vicinity of the middle part of Apron 2 (from 782VMW-80 through -87), is an impenetrable clay layer, up to 3 ft thick, which appears to support perched groundwater conditions at some locations. Beneath the clay is a loose, coarse to fine gravel layer, approximately 10 ft thick, associated within the first 10 ft of the top of the groundwater table beneath the site. A fine to medium uniform sand or dense silt underlies the gravel layer, followed by till down to the top of the bedrock.

During this RI, soil characterization was performed for each sampling location at 2-ft intervals from the ground surface to the top of groundwater, and at 5-ft intervals thereafter to the top of bedrock. Soil samples were collected by using 2-ft split-spoons, continuously from ground surface to the top of groundwater, and alternatively with a hollow-stem auger thereafter (i.e., if a split-spoon was collected from 31 to 33 ft bgs, the next split spoon was collected from 36 to 38 ft bgs, and so on). This data was recorded on Boring Logs (included in Appendix D). The soil characterization data was compiled to create cross-sections of the six main lithological layers encountered: (1) unsaturated silty fine sands; (2) saturated silty fine sands; (3) confining clay layer; (4) saturated gravel; (5) fine to medium uniform sand or dense silt; and (6) till. Figure 3-1 shows a lithological cross-section across the site.

3.4 GROUNDWATER AND HYDROGEOLOGY

The shallow water table aquifer lies within the unconsolidated sediments, where depth to groundwater ranged from 0 ft bgs in the southwest portion to 63 ft bgs in the northeast portion of the former Base during the December 1998 synoptic Base-wide water-level measurement of wells (FPM, 2000). Groundwater across the former Base generally flows from the topographic high in the northeast to the Mohawk River and the New York State Barge Canal to the south. Several creeks, drainage culverts, and sewers (mostly acting as drains for shallow groundwater), intercept surface water runoff. Section 4 of the Baseline Study (FPM, 2000) includes a detailed description of the groundwater and surface water hydrogeology at the former Base.

A comprehensive description of regional and local geology, hydrogeology, lithology, and hydrology for the former Griffiss AFB was given in Section 4 of the Baseline Study (FPM, 2000), and in the RI by Law Engineering and Environmental Services, Inc. (Law, 1996), and in the SI prepared by Ecology and Environment, Inc. (E&E, 1998).



Note: Only those borings indicated ***bold and italicized*** are included in Figure 3-1a.

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ROME, NEW YORK

Figure 3-1
Nosedocks / Apron 2
Cross-Section Location A-A'

FPM group

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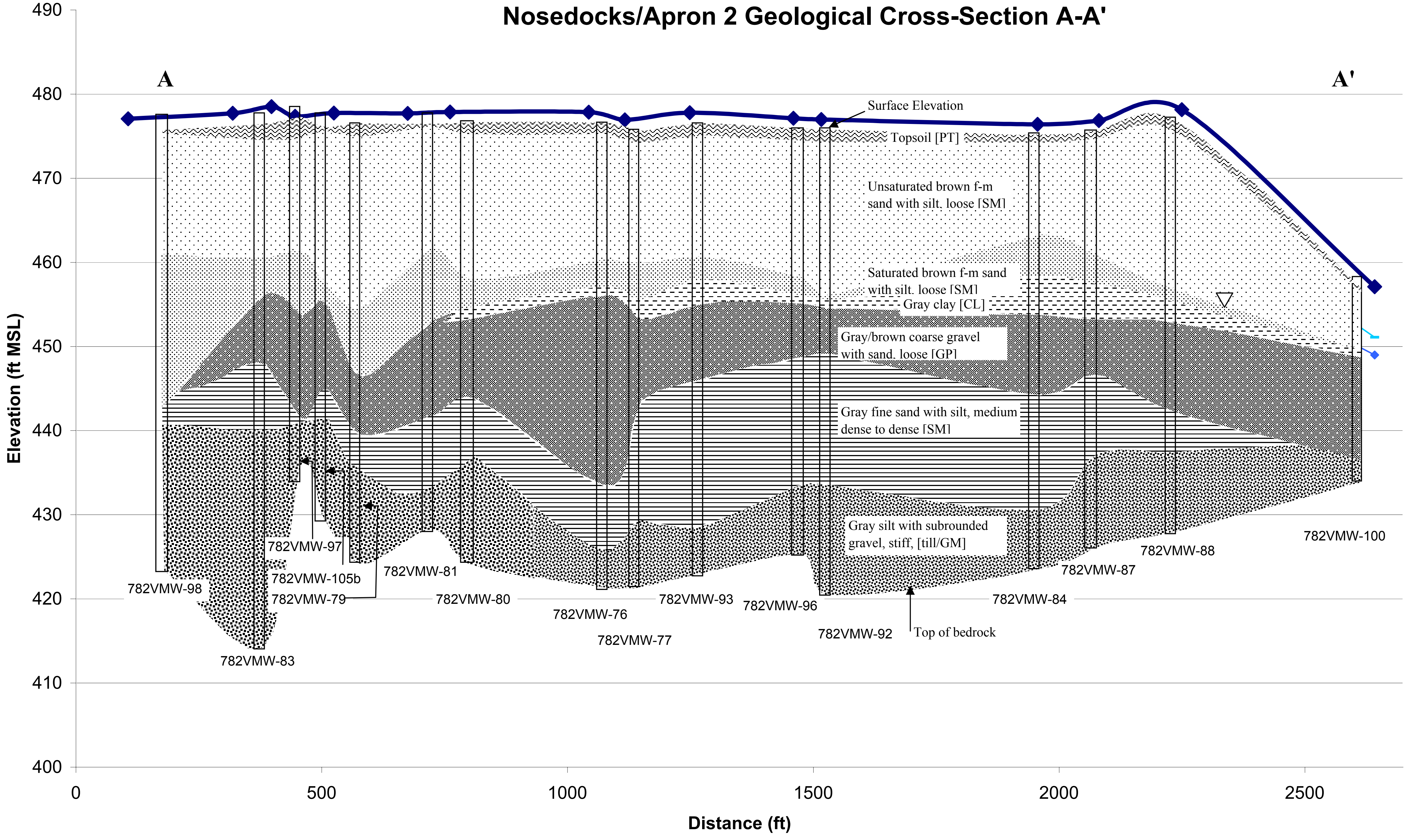
Figure 3-1a
Nosedocks/Apron 2 Geological Cross-Section A-A'



The groundwater in the vicinity of Apron 2 exists under unconfined conditions within the unconsolidated aquifer. Groundwater levels in the area range from 9 to 25 ft bgs. Water table elevation in the vicinity of Apron 2 ranges from 452 to 459 ft above MSL. Groundwater flow patterns in the area of Apron 2 are complicated due to the impermeable nature of both Apron 2 and the Alert Apron to the southeast. Massive construction has altered the natural hydrology in the area of the Aprons. Groundwater at the southwest end of Apron 2 appears to flow southwest. Groundwater flow through most of the Apron 2 site appears to flow northeast. This northeast flow of groundwater may be influenced by several drainage culverts, located on the northeast side of Apron 2, which act as conduits for groundwater, and by Six Mile Creek, where the groundwater ultimately discharges (Six Mile Creek is a gaining stream in this area). Figure 3-2 shows the Base-wide groundwater contours for the south side of the Base, including the Apron 2 vicinity, based on the results of a base-wide synoptic conducted in December 2003.

Perched water conditions appear to exist at various areas through Apron 2 due to variable soil densities and soil types resulting from the massive construction that took place at Apron 2 during its origin.

3.4.1 Slug Test Results

Based on the results of slug tests performed at selected wells, the hydraulic conductivity of the unconsolidated gravelly sand unit (where most of the highest levels of contamination were found) and the fine to medium sand unit below the gravel but above the till were measured using the Bouwer-Rice method. The wells screened across both units were predominantly between 0.723 and 24.12 ft/day (corresponding to 2.55×10^{-4} (primarily silt) and 8.00×10^{-3} (primarily gravel) centimeters/second [cm/sec]). These values are typical for silty to clean sands where 10^{-5} is at the low end of the silty sand range and 10^{-2} is near the midrange for clean sands (Freeze and Cherry, 1979). Table 3-1 summarizes the slug test results; data is included in Appendix E.

3.4.2 Groundwater Elevation/Gradient Observations

Groundwater flow beneath the Nosedocks/Apron 2 site is predominantly to the east/northeast, with a more strongly eastern component in the vicinity of Six Mile Creek. The water table exhibits a very low gradient (3.8×10^{-3} ft/ft) across the site, with a somewhat higher gradient (1.3×10^{-2} ft/ft) between the northeast edge of Apron 2 and Six Mile Creek. The estimated average groundwater velocity across the site using the following equation:

$$V = \frac{K(i)}{n} \times 365$$

where V = average groundwater flow velocity in ft/yr, K= average hydraulic conductivity in ft/day, i= hydraulic gradient in ft/ft, and n=effective porosity (expressed as a decimal, 0.25) considering an average gradient of 6.558×10^{-3} ft/ft, was thus approximated at 106 ft/yr. The hydraulic gradient across Apron 2, which is characterized by relatively flat topography, was

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N

700 0 700 1400 Feet

Roads

Airfield

Hydro

Water Table 2003 (ft MSL)

AF Boundary

Facilities

▨ Demo

▩ Existing

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Figure 3-2
Basewide Groundwater Table
Fall 2003

Table 3-1
Slug Test Results

Well No.	Hydraulic Conductivity (K) (ft/day)	Rising/Falling Head Test
782VMW-81	7.69E-01	Falling A
Geology:	7.50E-01	Falling B
Primarily till	6.98E-01	Rising A
	6.77E-01	Rising B
Average	7.23E-01	
782VMW-85	2.18	Falling A
Geology:	1.9	Rising A
Primarily f-m sand	1.98	Falling B
	2.03	Rising B
Average	2.02	
782VMW-87	17.15	Falling A
Geology:	15.33	Rising A
Primarily gravel	15.12	Falling B
	16.68	Rising B
Average	16.07	
782VMW-88	2.45	Falling A
Geology:	2.5	Rising A
Primarily f-m sand	2.16	Falling B
	2.47	Rising B
Average	2.40	
782VMW-95	1.91	Falling A
Geology:	1.98	Rising A
Primarily f-m sand	1.8	Falling B
	1.95	Rising B
Average	1.91	
782VMW-96	4.71	Falling A
Geology:	5.37	Rising A
Primarily f-m sand	4.75	Falling B
	4.93	Rising B
Average	4.94	
782 VMW-97	21.52	Falling A
Geology:	24.12	Rising A
Primarily gravel	21.63	Falling B
	23.48	Rising B
Average	22.69	
782VMW-105B	3.29	Falling A
Geology:	1.22	Rising A
Primarily f-m sand	2.29	Falling B
	1.51	Rising B
Average	2.08	
Average K, f-m sand:	2.67	N/A
Average K, gravel:	19.38	N/A
Overall average K:	11.03	N/A

Note: f-m sand is fine to medium sand.

calculated at 4.6 x 10^{-3} ft/ft, compared to the hydraulic gradient for the area extending from the northeast edge of Apron 2 to Six Mile Creek, calculated at 9 x 10^{-3} ft/ft. The hydraulic conductivity was assumed to be 11.03 ft/day; this value was derived by taking the average of the average hydraulic conductivity of the fine to medium sand formation and the average hydraulic conductivity of the gravel formation, as distinguished in Table 3-1.

Table 3-2 includes a summary of the groundwater elevation/land survey measurements collected across the site. These levels were used to create groundwater elevation contours, as shown in Figure 3-3 (not including bedrock wells 782MW-181 and -184). These results confirmed the presumed northeast-east groundwater flow direction (i.e., the groundwater appears to flow more easterly as it nears Six Mile Creek).

3.5 SURFACE WATER HYDROLOGY

The Nosedocks are located approximately 800 to 2,500 feet southwest of the covered portion of Six Mile Creek. Apron 2 is located approximately 1,800 feet west-southwest of Six Mile Creek. Surface water run-off at the site drains into the storm water system (through OWS 6389-3), which in turn discharges into Six Mile Creek, located east of Apron 2. Six Mile Creek subsequently drains into the New York State Barge Canal to the south. A total of four surface water samples were collected as part of the RI, along with three seepage samples (groundwater was observed seeping into Six Mile Creek along the western bank).

Table 3-2
Groundwater Elevation Data, Nosedocks/Apron 2 Permanent Well Sampling

Well No.	Ground Elevation (ft MSL)	Top of Casing Elevation (ft MSL)	Depth to Groundwater (ft BTOC)	Groundwater Elevation (ft MSL)
782MW-10	477.79	477.50	22.82	454.68
782VMW-100	457.10	459.94	16.30	443.64
782VMW-101	451.11	453.95	9.90	444.05
782VMW-102	448.82	451.48	8.81	442.67
782VMW-104	477.04	479.63	20.00	459.63
782VMW-105b	477.37	480.25	21.26	458.99
782MW-6D	476.53	478.54	24.71	453.83
782MW-6R2	476.82	478.42	24.61	453.81
782VMW-76	477.86	477.59	21.52	456.07
782VMW-77	476.93	476.54	18.79	457.75
782VMW-78	478.26	481.22	25.02	456.20
782VMW-80	477.87	477.41	20.43	456.98
782VMW-81	477.71	479.57	22.12	457.45
782VMW-82	475.49	478.06	20.98	457.08
782VMW-83	477.72	480.13	20.41	459.72
782VMW-84	476.40	476.08	24.88	451.20
782VMW-85	475.70	478.02	24.64	453.38
782VMW-86	475.65	477.68	23.49	454.19
782VMW-87	476.86	476.27	24.42	451.85
782VMW-88	478.15	477.75	27.49	450.26
782VMW-89	475.94	478.85	25.15	453.70
782VMW-90	477.12	479.79	23.75	456.04
782VMW-91	478.05	477.70	22.31	455.39
782VMW-92	476.99	476.65	22.75	453.90
782VMW-93	477.79	477.55	22.09	455.46
782VMW-94	478.30	478.03	22.73	455.30
782VMW-95	477.19	479.26	23.79	455.47
782VMW-96	477.13	476.73	22.43	454.30
782VMW-97	478.52	480.76	21.11	459.65
782VMW-98	477.06	478.47	19.51	458.96
782VMW-99	477.83	480.89	20.81	460.08
AP2MW-3	465.97	465.63	20.02	445.61
LD4MW-1	475.75	478.35	18.64	459.71
LD4MW-2	475.65	478.30	18.63	459.67

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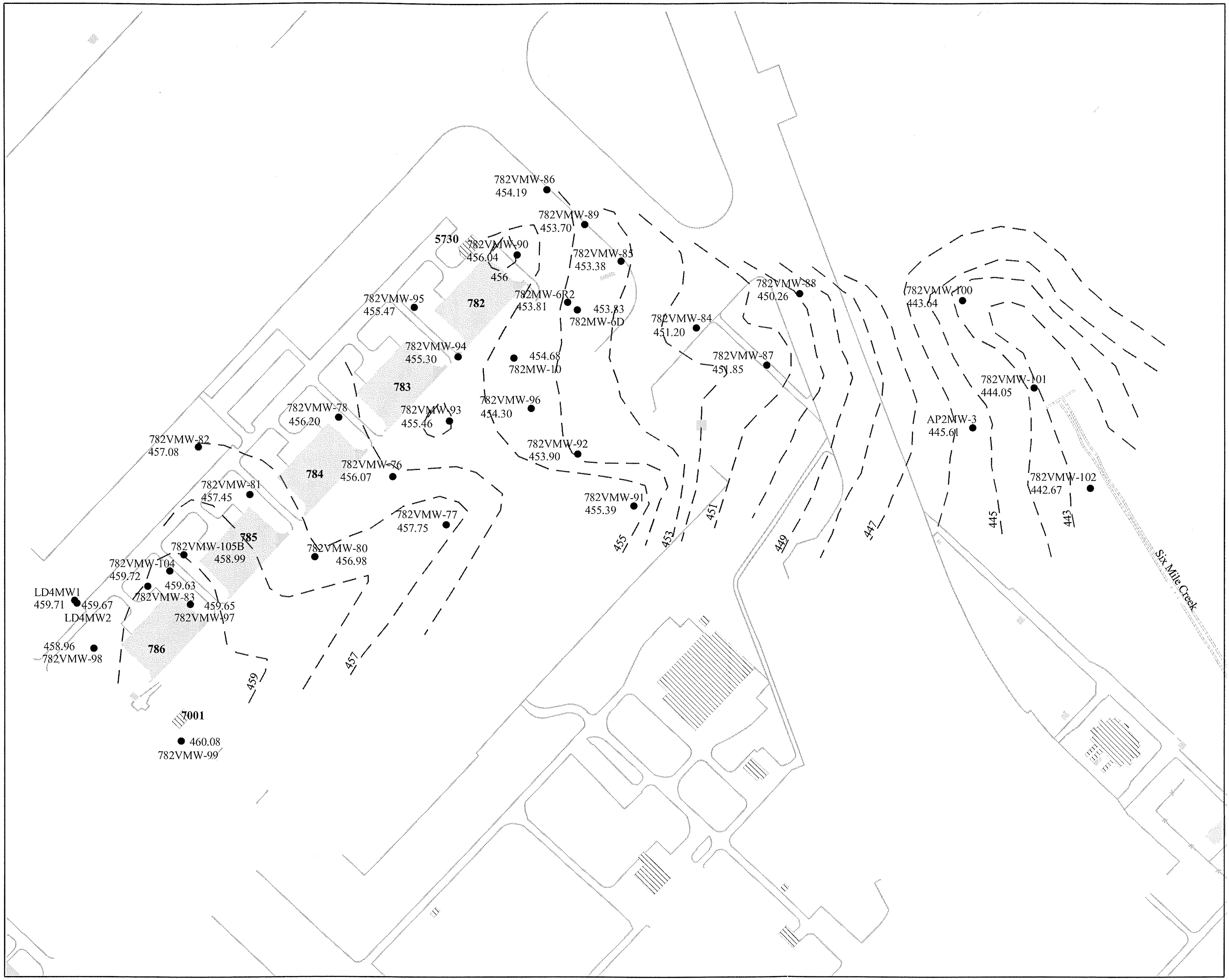

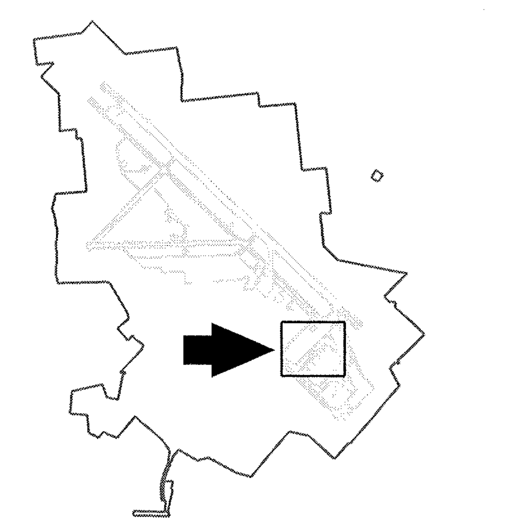

● Permanent Well Sampling Location 2/02 (ft. MSL)

╲ ╱ Groundwater Elevation Contours (ft. above MSL)

Streams / Creeks

Roads

Facility

▨ Existing

▨ Demolished

NOTE: Nose Docks Wash Waste System Location approximated from PEER, Decision Document/Closure Report for Project 96-0020, Volume II, Wash Waste System, Figure 2.2.1, Washwaste Collection System, Nosedock System.

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SCALE
200 0 200 400 Feet

Figure 3-3
Nosedocks / Apron 2
Groundwater Contours

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4.0 NATURE AND EXTENT OF CONTAMINATION

This section contains information on the nature and extent of the chlorinated hydrocarbon contamination plumes in the vicinity of the Nosedocks and Apron 2. The discussion in this section focuses on the chemicals which were detected at concentrations greater than the potential ARARs, and to-be-considered (TBC) criteria (Table 4-1 shows the specific Potential New York State and Federal ARARs and TBCs for Groundwater). The ARARs and TBCs relevant to the site are the following:

- Title 6 of the New York State Codes, Rules, and Regulations, Chapter 10, Part 703, "Water Quality Regulations," effective January 9, 1994. (Class GA Groundwater Standards and Guidance Values apply, as well as Class SA Surface Water Standards and Guidance Values.)
- NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046: Determination of Soil Cleanup Objectives and Cleanup Levels, January 24, 1994.

The RI consisted of (in 2002): drilling and vertically profiling 39 boreholes, including the collection of 110 Hydropunch® samples, the installation and sampling of 28 new wells, and the sampling of six preexisting wells in the vicinity of Building 782 and Apron 2. In 2003, a second round of permanent well and surface water sampling was conducted (see Section 2.0 for details), and two bedrock wells were installed and sampled. The raw laboratory results for the vertical profile well sampling and the permanent monitoring well sampling are provided in Appendices F and G, respectively.

4.1 VERTICAL PROFILE WELL DATA

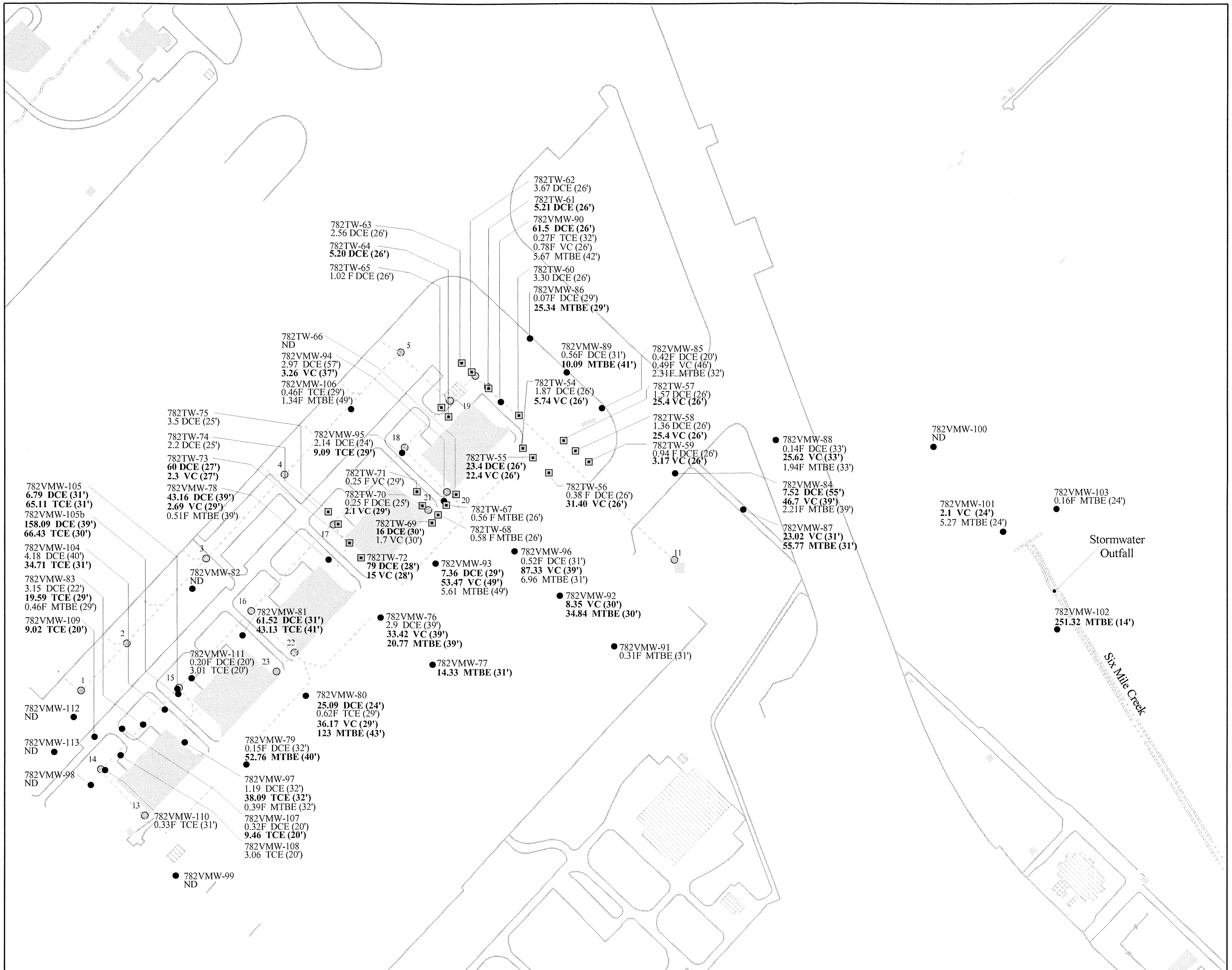
Groundwater sampling was performed to define the vertical and lateral extent of the Nosedocks/Apron 2 Chlorinated Plume(s). Vertical profile well sample locations are shown in Figure 4-1. These locations were chosen as results of ongoing sampling indicated either the presence or absence of chlorinated hydrocarbon contamination. The "plume area extent" was characterized by the results of 25 well locations, including 782VMW-76 through -82, -84 through -96, -100 through -103, and -106. The "source area extent" was characterized by the results of the remaining 14 boreholes installed during the RI, including 782VMW-83, -97, -104, -105, -105b, -107 through -113, and upgradient wells 782VMW-98 and -99.

Groundwater Hydropunch® samples were collected at 10-ft intervals starting from the top of the groundwater table at approximately 9 to 27 ft bgs down to the top of bedrock or auger refusal, ranging from 24.4 ft bgs at 782VMW-103 to 64 ft bgs at 782VMW-94. Results for VOCs reported above the detection limit are included in Table 4-2. The chlorinated hydrocarbon compound and MTBE results are also summarized in Figure 4-1. Results from previous sampling events conducted at locations 782TW-54 through -75 were added to this figure to aid in the delineation of the limits of chlorinated hydrocarbon contamination. Soil samples were also collected from 782VMW-90, -104, -105, and -107 through -111; results are discussed in Section 4.4.

Table 4-1
Potential New York State and Federal ARARs and TBCs for Groundwater Remedial Investigation

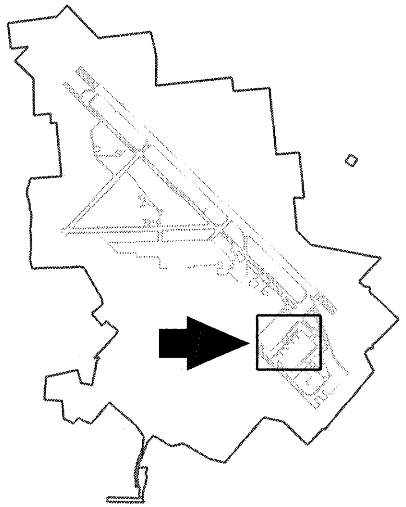
Compound	Federal Primary MCL[1] µg/L	Status	Federal Secondary MCL[1] µg/L	Status	Federal MCLG[1] µg/L	Status	New York Primary MCL[2] µg/L	New York Secondary MCL[2] µg/L	New York Groundwater-Standard[3] µg/L	New York Groundwater Guidance[3] µg/L
PCE	5	F	--		0	F	5[4]	--	5	0.7
TCE	5	F	--		0	F	5[4]	--	5	3
Cis-1,2-DCE	70	F	--		70	F	5[4]	--	5	--
VC	2	F	--		0	F	2	--	2	0.3
Benzene	5	F	--		0	F	5	--	0.7	--
MTBE										
Ethylbenzene	700	F	--		700	F	5	--	5	5
Arsenic	50	R	--		--		50	--	25	36
Manganese	--		50	F	--		--	300	300	--

Notes:
µg/L – micrograms per liter
MCL – Maximum Contaminant Level
MCLG – Maximum Contaminant Level Goal
[1] – Drinking Water Regulations and Health Advisories, Office of Water, EPA, May 1994.
[2] – New York State Sanitary Code: Drinking Water Supplies, Subpart 5-1, Public Water Systems, March, 1992
[3] – New York State Department of Environmental Conservation: Water Quality Standards and Guidance Values, October 1993.
[4] – Listed Principle Organic Contaminant



NOTE: Samples from 782TW-54 through -75 were collected in August 1999 and June 2000, and were collected at shallow (down to 30 ft bgs) intervals only.

N



- ● Vertical Profile Sampling Locations showing detections for cis-1,2-Dichloroethene, Trichloroethene, Vinyl Chloride, and MTBE (in µg/L, exceedances are shown in bold, sample depth shown in parenthesis)
- ▣ Previous Sampling Locations showing detections for cis-1,2-Dichloroethene, Trichloroethene, Vinyl Chloride, and MTBE (in µg/L, exceedances are shown in bold, sample depth shown in parenthesis)
- ○ Wash Waste Manhole(w/ID)
- Nosedocks Washwaste System
- Stream / Creek
- Road
- Existing Building
- ▨ Previously Demolished Building

UNITED STATES AIR FORCE
GRIFFISS AIR FORCE BASE
ROME, NEW YORK

SCALE
100 0 100 200 300 400 Feet

Figure 4-1
Nosedocks / Apron 2 Results
Vertical Profile Sampling Locations

***FPM** group*

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Table 4-2
Volatile Organic Compounds Results, Vertical Profile Well and Permanent Monitoring Well Sampling (2002)
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-76						782VMW-77						782VMW-78						782VMW-79				
			Vertical Profile					MW	Vertical Profile					MW	Vertical Profile					MW	Vertical Profile				
Depth BGS in ft			22	31	39	49	54	38	26	31	41	50	60	30	22	29	39	49	59	40	26	32	40	48	54
Date of Collection			11/20/2001	11/20/2001	11/26/2001	11/26/2001	11/26/2001	2/26/2002	12/11/2001	12/11/2001	12/11/2001	12/11/2001	12/12/2001	2/26/2002	11/15/2001	11/15/2001	11/15/2001	11/15/2001	11/15/2001	2/26/2002	1/24/2002	1/24/2002	1/24/2002	1/24/2002	1/28/2002
VOCs in µg/L																									
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	0.42 F	U	0.14 F	U	U	U	U	U	U	U	U	U	0.87 F	0.37 F	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.23 F	U	U
1,2-Dichloroethane	0.6	0.6	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
2-Butananone	50	10	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Acetone	50	10	6.9 F	8.8 F	3.5 F	4.9 F	11.1 J	U	U	5.0 F	1.7 F	U	U	U	14.2	6.0 F	5.9 F	U	U	U	U	U	6.3 F	6.6 F	U
Benzene	1	0.4	0.51	2.24	0.12 F	0.6	0.30 F	U	U	U	U	U	U	U	0.52	4.81	1.79	0.69	U	U	U	0.10 F	0.88	0.59	0.14 F
Chloroform	7	0.3	U	0.11 F	U	U	0.72	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
cis-1,2-Dichloroethene	5*	1	U	0.86 F	2.9	1.42	0.46 F	1.47	U	U	U	U	U	U	0.30 F	0.40 F	43.16	17.95	0.65 F	39.84	U	0.15 F	0.07 F	U	U
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	0.10 F	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Xylene (m+p)	5*	2	U	0.13 F	U	U	U	U	U	U	U	U	U	U	0.17 F	U	U	U	U	U	U	U	0.15 F	U	U
Methylene chloride	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	6.13
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	U	5.63	20.77	9.06	2.31 F	9.97	13.35	14.33	5.87	U	U	U	U	0.34 F	0.51 F	U	U	U	0.20 F	2.78 F	52.76 DL	41.79	U
o-Xylene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	0.23 F	U	U	0.29 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	0.34 F	0.12 F	U	U	0.23 F	U	U	U	U	U	0.83 F	0.12 F	0.12 F	0.11 F	0.12 F	0.05 F	U	8.26	0.07 F	U	0.18 F	0.11 F	0.15 F
trans-1,2-dichloroethene	5*	1	U	1.87	0.10 F	0.84 F	0.19 F	0.35 F	U	U	U	U	U	U	U	0.39 F	3.85	1.33	U	1.08	U	U	U	U	U
Vinyl chloride	2	1.1	0.49 F	24.57	33.42	17.34	2.69 J	16.39	U	U	U	U	U	U	U	2.69	1.36	0.33 F	U	4.91	U	U	U	U	U
Total Chlorinated Solvents:			0.49	27.3	36.42	19.6	3.34	17.86	0	0	0	0	0	0	0.3	3.48	48.51	19.61	0.65	44.75	0	0.27	0.07	0	0
								33 to 43						20 to 40						32 to 42					

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-80									782VMW-81						782VMW-82					782VMW-83						
			Vertical Profile								MW	Vertical Profile					MW	Vertical Profile				MW	Vertical Profile						MW
Depth BGS in ft			24	29	29-RE	39	43**	46	57	57-RE	33	22	31	41**	49	52**	46	24	33	43**	51	46	22	29	39	47	60	67	33
Date of Collection			11/27/2001	11/27/2001	1/30/2002	11/27/2001	12/5/2001	11/28/2001	11/28/2001	12/4/2001	2/22/2002	11/27/2001	11/27/2001	11/28/2001	11/28/2001	11/28/2001	2/21/2002	12/6/2001	12/7/2001	12/7/2001	12/10/2001	2/22/2002	12/6/2001	12/6/2001	12/7/2001	12/11/2001	12/11/2001	12/11/2001	2/28/2002
VOCs in µg/L								**Comp**		**Comp**					**Comp**														
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.32 F	U	U	U	U	0.37 F
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	0.17 F	0.08 F	U	U	U	U	U	U	U	U	U	U	U	U	0.23 F	U	U	U	U	U	U	0.25 F	U	U	U	U	0.16 F
1,2,4-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	UM	U	U	U	U	U	U	U
1,2-Dichlorobenzene	3	0.3	U	U	U	U	U	U	U	U	U	0.60 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	UM	U	U	U	U	U	U	U
2-Butananone	50	10	3.8 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Acetone	50	10	11	6.9 J	5*	1	U	U	26.3 F	U	U	4.0 F	U	U	U	13.8 F	U	6.3 F	3.4 F	U	3.1 F	U	U	U	3.6 F	5.9 F	U	2.3 F	U
Benzene	1	0.4	0.33 F	2.98	3.56	0.12 F	U	U	U	U	0.59	0.15 F	U	U	U	U	U	0.15 F	U	0.44	U	0.22 F	U	0.37 F	U	U	U	U	U
Chloroform	7	0.3	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.12 F
cis-1,2-Dichloroethene	5*	1	25.09	9.81	6.41	0.42 F	U	U	U	U	3.12	0.97 F	61.52	34.34	U	34.86	18.66	U	U	U	U	U	3.15	0.99 F	U	U	U	U	0.47 F
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Xylene (m+p)	5*	2	U	U	0.43 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.37 F	U	U	U	U	U	U
Methylene chloride	5*	1	U	U	U	U	U	U	U	0.17 F	U	U	U	U	U	U	U	U	U	U	U	U	U	0.09 F	0.59 F	U	U	U	U
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	U	13.81	16.2	84.15 DL	123 DL	1.70 F	45.2	2.99 F	36.01	U	U	U	U	U	U	U	U	U	U	U	U	0.46 F	U	U	U	U	U
o-Xylene	5*	1	U	U	0.31 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.08 F	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	5*	1	U	U	0.62 F	U	U	U	U	U	U	0.29 F	U	43.13	U	40.33	21.23	U	U	U	U	U	1.41	19.59	0.73 F	U	U	U	6.05
Tetrachloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	0.34 F	0.41 F	0.93 F	0.09 F	U	U	U	U	0.07 F	0.08 F	U	U	U	U	1.08	U	U	0.07 F	U	0.05 F	0.35 F	0.05 F	0.06 F	U	U	U	0.31 F
trans-1,2-dichloroethene	5*	1	2.5	3.9	4.7	U	U	U	U	U	0.16 F	U	U	U	U	1.13 F	1.32	U	U	U	U	U	U	0.10 F	U	U	U	U	U
Vinyl chloride	2	1.1	12.71	26.53 J	36.17	0.94 J	U	U	1.04 F	U	1.39	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Total Chlorinated Solvents:			40.3	40.24	47.9	1.36	0	0	1.04	0	4.51	1.26	61.52	77.47	0	76.32	39.89	0	0	0	0	0	4.56	20.68	0.73	0	0	0	6.52
Monitoring Well Screen Depth (ft bgs):											28 to 38						40 to 50					38 to 48							25 to 35

Notes

U -The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit. UM - The analyte was not detected, but there was a matrix effect for the analyte.

F -The analyte was detected above the MDL, but below the RL.

J -The analyte was positively identified, the quantitation is approximate.

MW -Monitoring Wells. The depth provided is the bladder pump (or peristaltic pump for 782VMW-83) intake depth during sampling (ft BGS).

*The principal organic contaminant for groundwater applies to this substance.

**A duplicate sample was collected at this location; highest results among the two samples are reported.

▨ -Shading indicates substance exceeds NYS Groundwater Standards or Guidance Values. Shading of depth indicates at least one exceedance report within the depth interval. Shading of total chlorinated solvents indicates highest interval.

Comp indicates that the sample was compromised during analysis (Hydropunch equipment was not adequately rinsed of Alconox).

DL indicates that a dilution was required to obtain the sample result.

Table 4-2 (continued)
Volatile Organic Compounds Results, Vertical Profile Well and Permanent Monitoring Well Sampling (2002)
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-84						782VMW-85						782VMW-86					782VMW-87					
			Vertical Profile					MW**	Vertical Profile					MW	Vertical Profile				MW	Vertical Profile					MW
Depth BGS in ft			19**	29	39	49	55	36	20	32**	42	46	51	37	20	29	36	49	35	22	31	40	49	53	35
Date of Collection			11/30/2001	11/30/2001	12/3/2001	12/3/2001	12/3/2001	2/21/2002	12/4/2001	12/4/2001	12/4/2001	12/5/2001	12/5/2001	2/25/2002	12/4/2001	12/5/2001	12/5/2001	12/6/2001	2/25/2002	12/14/2001	12/14/2001	12/14/2001	12/14/2001	12/14/2001	2/27/2002
VOCs in µg/L																									
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	U	U	U	U	U	U	0.23 F	U	U	U	0.27 F	U	U	U	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethane	0.6	0.6	U	U	U	U	U	U		U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
2-Butananone	50	10	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Acetone	50	10	6.7 F	17.1	U	U	3.7 F	U	2.2 F	U	5.4 F	U	U	U	13.7	14.1 F	U	U	U	2.6 F	U	7.4 F	3.1 F	13.2 J	U
Benzene	1	0.4	U	0.22 F	U	U	U	U	0.13 F	32.47	0.37 F	U	U	1.00	0.26 F	38.45 DL	0.29 F	0.61	2.83	U	U	U	U	U	U
Chloroform	7	0.3	U	U	U	U	U	U	U	2.12	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
cis-1,2-Dichloroethene	5*	1	U	0.50 F	0.50 F	U	7.52	2.67	0.42 F	0.11 F	0.17 F	0.36 F	U	U	U	0.07 F	U	U	U	U	U	U	U	U	U
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Xylene (m+p)	5*	2	U	U	U	U	U	U	U	0.13 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	U	0.83 F	2.21 F	0.24 F	0.81 F	1.89 F	U	2.31 F	1.31 F	1.40 F	U	1.70 F	U	25.34	5.55	0.87 F	3.10 F	U	55.77 DL	25.75 J	30.29	39.74 J	31.68
o-Xylene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	U	U	0.05 F	0.06 F	0.05 F	0.05 F	0.13 F	0.17 F	0.09 F	U	0.06 F	0.14 F	0.10 F	0.12 F	0.05 F	U	0.16 F	U	U	0.21 F	U	U	U
trans-1,2-dichloroethene	5*	1	U	U	U	U	U	U	U	0.21 F	U	U	U	0.08 F	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	2	1.1	U	16.34	46.7 DL	26.29	36.66	56.75 DL	U	U	U	0.49 F	U	U	U	U	U	U	U	U	23.02	9.53 J	8.52	12.20 J	24.03
Total Chlorinated Solvents:			0	17.53	47.2	26.29	44.18	59.42	0.98	0.32	0.17	0.85	0	0	0	0.07	0	0	0	0	23.02	9.53	8.52	12.2	24.03
Monitoring Well Screen Depth (ft bgs):								35 to 45						29 to 39					27 to 37						30 to 40

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-88					782VMW-89					782VMW-90					782VMW-91						782VMW-92					
			Vertical Profile				MW	Vertical Profile				MW	Vertical Profile				MW	Vertical Profile					MW	Vertical Profile					MW
Depth BGS in ft			23	33	41**	52	35	24	31	41	51	33	26	32	42	52	28	25	31	41	51	58**	28	23	30**	40	50	56**	35
Date of Collection			12/19/2001	12/19/2001	12/19/2001	12/20/2001	2/27/2002	1/9/2002	1/9/2002	1/9/2002	1/10/2002	2/25/2002	1/4/2002	1/4/2002	1/4/2002	1/4/2002	2/25/2002	12/18/2001	12/18/2001	12/18/2001	12/19/2001	12/19/2001	2/28/2002	12/12/2001	12/12/2001	12/12/2001	12/12/2001	12/13/2001	2/26/2002
VOCs in µg/L																													
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	U	U	U	U	0.39 F	0.66 F	0.21 F	U	0.64 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	U	U	U	U	U	0.77 F	0.77 F	0.23 F	U	1526.15 DL	44.19	88.08 DL	5.72	438.45 DL	10.41	1.14	0.37 F	U	U	1.96	0.29 F	U	U	U	U	U
1,2-Dichlorobenzene	3	0.3	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	323 J	U	U	U	145.03 DL	U	U	U	U	U	4.22	U	U	U	U	U	U
2-Butananone	50	10	U	U	U	U	U	U	U	4.2 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Acetone	50	10	U	U	U	7.4 F	U	U	U	17.9	6.6 F	U	U	U	U	U	U	U	U	7.5 F	U	U	U	9.9 F	3.5 F	U	2.2 F	2.1 F	U
Benzene	1	0.4	0.11 F	0.14 F	U	U	U	32.17	132.91 J	31.41	U	163.69 DL	3.24	128 J	3.9	0.69	32.76 DL	6.78	0.72	0.36 F	0.19 F	0.11 F	4.01	U	U	U	U	U	U
Chloroform	7	0.3	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
cis-1,2-Dichloroethene	5*	1	U	0.14 F	U	U	0.23 F	0.40 F	0.56 F	0.15 F	U	0.41 F	61.5 J	0.33 F	0.25 F	U	17.81 DL	U	U	U	U	U	U	U	U	U	U	U	U
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	139.55 DL	1.59	2.37	0.47 F	58.66 DL	3.52	0.28 F	U	U	U	0.78 F	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	39.86	U	2	0.29 F	20.13 DL	1.39	U	U	U	U	0.52 F	U	U	U	U	U	U
Xylene (m+p)	5*	2	U	U	U	U	U	U	0.19 F	U	0.19 F	U	505.9 DL	5.86	9.21	1.75 F	121.98 DL	11.53	0.91 F	0.29 F	U	U	2.01	U	U	U	U	U	U
Methylene chloride	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	94.5 J	U	U	U	39.03 DL	U	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	U	1.94 F	0.85 F	U	2.22 F	1.18 F	8.84	10.09	0.55 F	20.95	U	U	5.67	U	U	U	0.31 F	U	U	U	U	U	34.84	19.18	3.82 F	1.20 F	16.06
o-Xylene	5*	1	U	U	U	U	U	U	0.15 F	0.06 F	0.13 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	352.1 DL	U	32.1	2.69	U	0.41 F	U	U	U	U	0.47 F	U	U	U	U	U	U
Naphthalene	10	1	U	U	U	U	U	U	U	U	U	U	199 J	U	U	U	112.04 DL	U	U	U	U	U	1.02	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	49.57	U	4.79	0.91 F	21.4 DL	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	0.12 F	0.27 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	1.25	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	0.06 F	U	U	U	0.06 F	U	0.17 F	0.05 F	0.19 F	0.30 F	1.41	0.15 F	0.07 F	0.05 F	0.65 F	0.55 F	0.15 F	0.10 F	0.11 F	U	0.37 F	U	U	U	U	U	0.14 F
trans-1,2-dichloroethene	5*	1	U	U	U	U	0.14 F	U	U	U	U	U	5.12	U	U	U	1.16 F	U	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	2	1.1	U	25.62	22.4	6.58	42.94	U	U	U	U	U	0.78 F	U	U	U	U	U	U	U	U	U	U	U	8.35	2.27	U	U	1.53
Total Chlorinated Solvents:			0	25.76	22.4	6.58	43.17	0.4	0.56	0.15	0	0.41	67.52	0.6	0.25	0	17.81	0	0	0	0	0	0	0	8.35	2.27	0	0	1.53
Monitoring Well Screen Depth (ft bgs):							30 to 40					25 to 40					20 to 30						20 to 30						30 to 40

Notes
U -The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
F -The analyte was detected above the MDL, but below the RL.
J -The analyte was positively identified, the quantitation is approximate.
MW -Monitoring Wells. The depth provided is the bladder pump intake depth during sampling (ft BGS).
*The principal organic contaminant for groundwater applies to this substance.
**A duplicate sample was collected at this location; highest results among the two samples are reported.
▨ -Shading indicates substance exceeds NYS Groundwater Standards or Guidance Values. Shading of depth indicates at least one exceedance report within the depth interval. Shading of total chlorinated solvents indicates highest interval.
Comp indicates that the sample was compromised during analysis (Hydropunch equipment was not adequately rinsed of Alconox).
DL indicates that a dilution was required to obtain the sample result.

Table 4-2 (continued)
Volatile Organic Compounds Results, Vertical Profile Well and Permanent Monitoring Well Sampling (2002)
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-93						782VMW-94					
			Vertical Profile					MW	Vertical Profile					MW**
Depth BGS in ft			21	29	39**	49	56	35	27**	37	47	57	64	40
Date of Collection			11/19/2001	11/19/2001	11/19/2001	11/20/2001	11/20/2001	2/26/2002	11/13/2001	11/14/2001	11/14/2001	11/14/2001	11/15/2001	2/26/2002
VOCs in µg/L														
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	0.66 F	0.31 F	U	U	U	U	0.23 F	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	UM
1,2-Dichloroethane	0.6	0.6	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
2-Butananone	50	10	U	U	U	U	5.4 F	U	U	U	U	U	U	U
Acetone	50	10	4.5 F	U	3.0 F	U	4.3 F	U	4.3 F	11.5	U	8.9 F	4.2 F	U
Benzene	1	0.4	0.39 F	2.71	0.69	U	0.17 F	U	0.41	0.87	0.11 F	0.18 F	U	U
Chloroform	7	0.3	U	U	U	U	4.91	U	U	U	U	U	0.08 F	U
cis-1,2-Dichloroethene	5*	1	U	7.36	2.9	U	0.22 F	0.16 F	0.11 F	0.85 F	1.11	2.97	U	0.93 F
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
Xylene (m+p)	5*	2	U	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	5*	1	U	U	U	U	0.13 F	U	U	U	U	U	U	U
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	U	1.20 F	2.22 F	5.61	2.15 F	9.65	U	U	U	U	U	U
o-Xylene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	U	U	U	U	U	U	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	0.05 F	0.08 F	0.08 F	U	U	0.06 F	0.07 F	0.10 F	U	U	U	0.07 F
trans-1,2-dichloroethene	5*	1	U	2.24	0.51 F	U	U	U	U	U	U	U	U	U
Vinyl chloride	2	1.1	U	37.15	30.81	53.47 DL	37.97	76.02 DL	U	3.26	0.62 F	0.48 F	U	0.56 F
Total Chlorinated Solvents:			0	46.75	34.22	53.47	38.19	76.18	0.18	4.11	1.73	3.45	0	1.49
Monitoring Well Screen Depth (ft bgs):								30 to 40						37 to 47

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-95						782VMW-96					
			Vertical Profile					MW**	Vertical Profile					MW
Depth BGS in ft			24	29	39**	50	57	28	13	31	39**	49	54	39
Date of Collection			1/10/2002	1/10/2002	1/10/2002	1/11/2002	1/11/2002	2/25/2002	11/26/2001	11/26/2001	11/26/2001	11/27/2001	11/27/2001	2/21/2002
VOCs in µg/L														
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	U	U	U	U	U	U	0.09 F	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	209 J	U	U	U	1.66	U	U	U	U	U	U
1,2-Dichloroethane	0.6	0.6	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	0.31 F	59.09 J	U	U	U	0.62 F	U	U	U	U	U	U
2-Butananone	50	10	2.6 F	2.9 F	U	U	U	U	U	U	U	U	U	U
Acetone	50	10	10	13.9	U	U	5.2 F	U	2.3 F	4.5 F	U	U	4.3 F	U
Benzene	1	0.4	1.44	1.19	0.21 F	U	0.13 F	0.33 F	U	0.22 F	U	U	0.10 F	U
Chloroform	7	0.3	U	U	U	1.65 B	4.59 B	0.17 F	U	U	U	U	U	U
cis-1,2-Dichloroethene	5*	1	2.14	0.36 F	U	U	U	0.20 F	U	0.52 F	U	U	U	U
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	0.55 F	U	U	U	U	U	U
Xylene (m+p)	5*	2	U	U	U	U	U	8.78	U	U	U	U	U	U
Methylene chloride	5*	1	U	U	U	U	U	0.12 F	U	U	U	U	U	U
n-Propylbenzene	5*	1	U	20.01	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	U	U	U	U	U	1.12 F	U	6.96	2.57 F	U	0.27 F	2.60 F
o-Xylene	5*	1	0.15 F	52.98 J	0.13 F	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	23.34	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	0.18 F	76.43 J	0.26 F	U	U	U	U	0.21 F	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	5*	1	0.15 F	9.09	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	0.11 F	12.37	0.10 F	0.17 F	0.05 F	0.23 F	U	0.08 F	U	U	U	0.10 F
trans-1,2-dichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	2	1.1	U	U	U	U	U	U	U	32.9	87.33 DL	0.34 F	12.1	77.8 DL
Total Chlorinated Solvents:			2.29	9.45	0	0	0	0.20	0	33.42	87.33	0.34	12.1	77.8
Monitoring Well Screen Depth (ft bgs):								20 to 35						33 to 43

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-97					782VMW-98					
			Vertical Profile				MW	Vertical Profile					MW
Depth BGS in ft			24	32**	42	44	33	22	29	38**	48	59	32
Date of Collection			1/2/2002	1/3/2002	1/3/2002	1/8/2002	2/22/2002	1/4/2002	1/4/2002	1/4/2002	1/7/2002	1/7/2002	2/20/2002
VOCs in µg/L						**Comp**							
1,1,1-Trichloroethane	5*	0.8	0.16 F	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	0.4	U	U	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	U	U	1.28 B	U	U	U	U	U	U	U
1,2-Dichloroethane	0.6	0.6	U	0.14 F	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	0.44 F	U	U	U	U	U	U	U
2-Butananone	50	10	U	U	U	U	U	U	U	U	U	U	U
Acetone	50	10	U	U	U	4.3 F	U	U	U	4.1 F	U	U	U
Benzene	1	0.4	0.15 F	0.17 F	U	0.17 F	U	U	U	0.17 F	U	U	U
Chloroform	7	0.3	U	U	1.55 B	1.23 B	0.15 F	U	U	U	U	U	0.07 F
cis-1,2-Dichloroethene	5*	1	U	1.19	U	U	0.87 F	U	U	U	U	U	U
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U
Xylene (m+p)	5*	2	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	5*	1	U	U	U	U	U	U	U	U	U	U	U
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	U	0.39 F	U	0.28 F	U	U	U	U	U	U	U
o-Xylene	5*	1	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	U	U	U	0.49 F	U	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	5*	1	1.99	38.09	U	1.2	30.54	U	U	U	U	U	U
Tetrachloroethene	5*	1	U	0.46 F	U	U	U	U	U	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	0.23 F	0.17 F	U	0.30 F	U	0.09 F	U	0.10 F	U	U	U
trans-1,2-dichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	2	1.1	U	U	U	U	U	U	U	U	U	U	U
Total Chlorinated Solvents:			1.99	39.74	0	1.2	31.41	0	0	0	0	0	0
Monitoring Well Screen Depth (ft bgs):							25 to 35						25 to 35

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-99						782VMW-100			782VMW-101			782VMW-102		
			Vertical Profile					MW	Vertical Profile		MW	Vertical Profile		MW	Vertical Profile		MW
Depth BGS in ft			20	30	38	48	59	28	10	23	18	14	24	18	14	24	19
Date of Collection			1/2/2002	1/2/2002	1/3/2002	1/3/2002	1/4/2002	2/22/2002	1/10/2002	1/11/2002	2/28/2002	1/15/2002	1/15/2002	2/20/2002	1/15/2002	1/15/2002	2/20/2002
VOCs in µg/L																	
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	0.23 F	U	U	U	U	U	0.56 F	U	U	0.33 F	U	U	U	U
1,2-Dichloroethane	0.6	0.6	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
2-Butananone	50	10	U	U	U	U	U	9.0 F	U	U	U	U	U	U	U	U	U
Acetone	50	10	U	U	U	U	U	42.2	U	4.7 F	U	U	U	U	U	U	U
Benzene	1	0.4	0.12 F	0.15 F	U	U	U	U	U	0.19 F	U	U	U	U	U	U	U
Chloroform	7	0.3	0.19 F	0.16 F	0.21 F	U	U	0.6	U	U	U	U	U	U	U	U	U
cis-1,2-Dichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	0.14 F	U	U	U
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Xylene (m+p)	5*	2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	U	U	U	U	U	U	U	U	U	1.56 F	5.27	9.59	251.32 DL	38.92 DL	86 DL
o-Xylene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	U	U	U	U	U	U	U	0.55 F	U	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	0.06 F	0.17 F	U	U	0.10 F	0.14 F	U	0.06 F	0.10 F	U	U	U	U	U	U
trans-1,2-dichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	2	1.1	U	U	U	U	U	U	U	U	U	0.161	2.1	2.11	U	U	U
Total Chlorinated Solvents:			0	0	0	0	0	0	0	0	0	0.161	2.1	2.25	0	0	0
Monitoring Well Screen Depth (ft bgs):								20 to 35			10 to 25			7 to 22			8 to 23

Notes

U -The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit. UM - The analyte was not detected, but there was a matrix effect for the analyte.

F -The analyte was detected above the MDL, but below the RL.

J -The analyte was positively identified, the quantitation is approximate.

MW -Monitoring Wells. The depth provided is the bladder pump intake depth during sampling (ft BGS).

*The principal organic contaminant for groundwater applies to this substance.

**A duplicate sample was collected at this location; highest results among the two samples are reported.

▨ -Shading indicates substance exceeds NYS Groundwater Standards or Guidance Values. Shading of depth indicates at least one exceedance report within the depth interval. Shading of total chlorinated solvents indicates highest interval.

Comp indicates that the sample was compromised during analysis (Hydropunch equipment was not adequately rinsed of Alconox).

DL indicates that a dilution was required to obtain the sample result.

Table 4-2 (continued)
Volatile Organic Compounds Results, Vertical Profile Well and Permanent Monitoring Well Sampling (2002)
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-103		782VMW-104					782VMW-105				782VMW-105B				782VMW-106			
			Vertical Profile		Vertical Profile				MW	Vertical Profile				Vertical Profile			MW	Vertical Profile			
Depth BGS in ft			16	24	22	31	40	45	26	24	31	43**	50**	22	30	39	36	18	29	39	49
Date of Collection			1/18/2002	1/18/2002	1/18/2002	1/18/2002	1/18/2002	1/22/2002	2/22/2002	1/16/2002	1/16/2002	1/16/2002	1/22/2002	1/23/2002	1/23/2002	1/23/2002	2/21/2002	1/21/2002	1/21/2002	1/21/2002	1/22/2002
VOCs in µg/L																					
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U	U	0.28 F	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	U	U	U	U	U	U	U	0.11 F	U	U	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	U	25.13	0.24 F	0.91 F	U	0.70 F	U	0.35 F	U	U	U	U	U	U	176.24 DL	0.40 F	8.88	U
1,2-Dichloroethane	0.6	0.6	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	8.87	U	0.32 F	U	0.24 F	U	U	U	U	U	U	U	U	50.19 DL	U	2.78	U
2-Butananone	50	10	U	U	3.5 F	U	U	11.2 F	U	U	U	14.3	U	U	U	U	U	U	U	U	7.4 F
Acetone	50	10	U	4.0 F	15.9	U	6.7 F	5.7 F	U	8.1 F	3.2 F	3.0 F	U	3.7 F	U	U	U	U	U	8.2 F	3.6 F
Benzene	1	0.4	U	U	0.14 F	0.15 F	0.15 F	U	0.15 F	0.22 F	0.23 F	U	0.12 F	0.11 F	0.17 F	0.12 F	U	65.22 DL	0.18 F	10.62	0.58
Chloroform	7	0.3	U	U	U	U	0.07 F	0.22 F	U	U	0.13 F	U	0.09 F	U	0.07 F	U	0.11 F	U	0.44	U	U
cis-1,2-Dichloroethene	5*	1	U	U	U	1.26	4.18	0.46 F	0.08 F	0.36 F	6.79	5.66	0.23 F	U	4.33	158.09 DL	4.63	U	U	U	U
Ethylbenzene	5*	1	U	U	4.22	U	U	U	0.51 F	U	U	U	U	U	U	U	U	95.7	U	1.65	U
Isopropylbenzene	5*	1	U	U	1.46	U	U	U	0.30 F	U	U	U	U	U	U	U	U	10.03	0.35 F	0.75 F	U
Xylene (m+p)	5*	2	U	U	18.75	0.28 F	0.63 F	U	0.70 F	U	U	0.19 F	U	U	U	U	U	538.87 DL	0.66 F	19.63	0.40 F
Methylene chloride	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
n-Propylbenzene	5*	1	U	U	3.52	U	U	U	U	U	U	U	U	U	U	U	U	16.57	U	U	U
MTBE	10	5	U	0.16 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	1.34 F
o-Xylene	5*	1	U	U	8.63	0.11 F	0.47 F	U	0.09 F	U	U	0.08 F	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	U	U	11.44	U	0.42 F	U	U	U	2.09	U	U	U	U	U	U	62.7 DL	0.42 F	2.5	0.24 F
sec-Butylbenzene	5*	1	U	U	1.8	U	U	U	0.41 F	U	0.54 F	U	U	U	U	U	U	18.12	U	0.37 F	U
Trichloroethene	5*	1	U	U	U	34.71	4.99	0.26 F	0.85 F	0.33 F	65.11 DL	0.54 F	U	U	66.43 DL	11.57	49.95	U	0.46 F	U	U
Tetrachloroethene	5*	1	U	U	U	0.43 F	U	U	U	U	1.26	U	U	U	1.82	U	0.64 F	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	U	U	1.44	0.12 F	0.15 F	0.32 F	0.16 F	0.16 F	0.11 F	12.48	0.23 F	0.06 F	U	U	0.13 F	0.96 F	0.11 F	0.14 F	0.69 F
trans-1,2-dichloroethene	5*	1	U	U	U	U	U	U	U	U	0.18 F	U	U	U	U	3.59	U	U	U	U	U
Vinyl chloride	2	1.1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Total Chlorinated Solvents:			0	0	0	36.4	9.17	0.72	0.93	0.69	73.34	6.2	0.23	0	72.58	173.25	55.2	0	0.46	0	0
Monitoring Well Screen Depth (ft bgs):									18 to 33								27 to 42				

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-107		782VMW-108		782VMW-109		782VMW-110		782VMW-111		782VMW-112		782VMW-113	
			Vertical Profile		Vertical Profile		Vertical Profile		Vertical Profile		Vertical Profile		Vertical Profile		Vertical Profile	
Depth BGS in ft			20	31	20	31	20	31**	20	31	20	31	20	31	20	31**
Date of Collection			1/24/2002	1/24/2002	1/28/2002	1/28/2002	1/29/2002	1/29/2002	1/29/2002	1/30/2002	1/30/2002	1/30/2002	1/31/2002	1/31/2002	2/4/2002	2/4/2002
VOCs in µg/L																
1,1,1-Trichloroethane	5*	0.8	U	U	0.11 F	0.16 F	U	U	U	0.08 F	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2-Dichloroethane	0.6	0.6	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
2-Butananone	50	10	2.7 F	U	U	U	U	U	U	U	U	U	U	U	U	U
Acetone	50	10	7.8 F	U	U	U	U	2.4 F	1.8 F	U	U	9.0 F	U	U	2.7 F	5.4 F
Benzene	1	0.4	0.17 F	0.12 F	U	0.15 F	0.12 F	U	U	U	U	0.16 F	U	0.11 F	U	0.21 F
Chloroform	7	0.3	U	U	U	U	U	0.09 F	U	U	U	U	U	U	U	U
cis-1,2-Dichloroethene	5*	1	0.32 F	U	U	U	U	U	U	U	0.20 F	0.17 F	U	U	U	U
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Xylene (m+p)	5*	2	0.21 F	U	U	U	U	U	U	U	U	0.52 F	U	U	U	0.12 F
Methylene chloride	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	U	U	U	U	U	U	U	U	U	U	U	U	U	U
o-Xylene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	5*	1	9.46	9.09	3.06	2.41	9.02	1.68	0.21 F	0.33 F	3.01	1.09	U	U	U	U
Tetrachloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	0.19 F	U	U	U	0.08 F	U	0.06 F	U	U	0.10 F	U	0.11 F	U	0.18 F
trans-1,2-dichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	2	1.1	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Total Chlorinated Solvents:			9.78	9.09	3.06	2.41	9.02	1.68	0.21	0.33	3.21	1.26	0	0	0	0

Notes
U -The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
F -The analyte was detected above the MDL, but below the RL.
J -The analyte was positively identified, the quantitation is approximate.
MW -Monitoring Wells. The depth provided is the bladder pump intake depth during sampling (ft BGS).
*The principal organic contaminant for groundwater applies to this substance.
**A duplicate sample was collected at this location; highest results among the two samples are reported.
▨ -Shading indicates substance exceeds NYS Groundwater Standards or Guidance Values. Shading of depth indicates at least one exceedance report within the depth interval. Shading of total chlorinated solvents indicates highest interval.
DL indicates that a dilution was required to obtain the sample result.

4.1.1 Vertical Profile Well Location Selection

To locate the source area for the main chlorinated plume identified during previous investigations (as discussed in Section 1.2.4.3), two transects of vertical profile wells were initially installed along a line perpendicular to the estimated groundwater flow direction, and upgradient (southwest) of suspected source areas (Manholes 15, 16, and 17). Vertical profile wells 782VMW-76 through -78 were installed upgradient of Manhole 17, and wells 782VMW-80 through -82 were installed upgradient of Manhole 16. When results confirmed the presence of chlorinated hydrocarbons, additional vertical profile wells (782VMW-79, -83, -97, -104, -105, and -105b) were installed to characterize the presumed source area in the vicinity of Manhole 15/the Nosedocks Wash Waste System. Vertical profile well 782VMW-98 was installed upgradient of Building 786 and Manhole 15 of the Nosedocks Wash Waste System (but downgradient of Manhole 14) and indicated no contamination, and was thereafter considered an upgradient sampling location. 782VMW-99 was also considered an upgradient sampling location when neither chlorinated nor petroleum-related contamination was identified there. Once the source area was identified in the vicinity of Manhole 15/the Nosedocks Wash Waste System (on the north side of Building 786/Nosedock 5), seven temporary wells were installed to identify potential soil and shallow groundwater contamination in the source area (782VMW-107 through -113).

To better characterize the vertical extent of the two areas of contamination identified in previous investigations, one vertical profile well near the axis of the northern plume (782VMW-90) and a transect of five wells perpendicular to the assumed groundwater flow direction for the main plume (782VMW-91 through -95) were installed. In addition, a downgradient transect of three wells was installed (782MW-85, -86 and -89) for the northern plume, and six downgradient wells (782VMW-84, -87, -88, -100 through -103) for the main plume, until the edges of the plumes were adequately defined.

4.1.2 Plume Area Extent Vertical Profile Results

Three chlorinated hydrocarbon compounds were detected at levels exceeding New York State Groundwater Standards in the Hydropunch® samples: TCE, which was detected above standards in two of the 27 plume extent boreholes, with a maximum concentration of 43.1 µg/L in 782VMW-81 at 41 ft bgs; cis-1,2-DCE (or "cis-DCE"), which was detected above standards in six boreholes, with a maximum concentration of 61.5 µg/L in 782VMW-81 at 31 ft bgs and 782VMW-90 at 26 ft bgs; and VC, which was detected above standards in ten boreholes, with a maximum concentration of 87.3 µg/L in 782VMW-96 at 39 ft bgs. The petroleum-related compound MTBE was also reported above the NYS Groundwater Standard in nine boreholes, with a maximum concentration of 251.3 µg/L in 782VMW-102 at 14 ft bgs.

Table 4-2 also summarizes the total chlorinated solvent levels for each sample collected. These data were used to determine the appropriate screening interval for each permanent well installed, which was also determined in consideration of the well location with respect to the plume extent. The vertical profile sampling result indicating the highest concentration within one borehole is indicated with a shaded box in Table 4-2, when the concentrations of all or any one of the chlorinated solvents exceeded the NYS Groundwater Standards or Guidance Values.

4.1.3 Source Area Extent Vertical Profile Results

At each of the temporary vertical profile well locations 782VMW-107 through -113, two Hydropunch® samples were collected, from 20 ft bgs and 31 ft bgs. Only one VOC compound was detected above reporting limits at four of the seven locations: TCE, the suspected parent compound for the chlorinated hydrocarbon plume. TCE was detected in both the 20 ft and 31 ft samples at 782VMW-107, -108, -109, and -111, at levels ranging from 1.09 µg/L up to 9.46 µg/L. No MTBE was reported in the suspected source area for the chlorinated solvent VOCs.

Among the four permanent well locations (782VMW-83, -97, -104, and -105b) and temporary vertical profile well 782VMW-105, 21 Hydropunch® samples were collected at 10-ft intervals beginning from the top of the groundwater table at approximately 22 to 24 ft bgs down to the top of bedrock or auger refusal, ranging from approximately 44 ft bgs at 782VMW-97 to 67 ft bgs at 782VMW-83. Six of the 21 Hydropunch® samples indicated exceedances above the NYS Groundwater Standards for TCE, ranging from 19.6 µg/L at 782VMW-83 to 66.4 µg/L at 782VMW-105b. Each of the detections were reported at the 30 to 31 ft bgs depth interval. Three Hydropunch® samples – collected from locations 782VMW-105 and 782VMW-105b – also indicated cis-DCE levels above NYS Groundwater Standards, ranging from 5.7 µg/L to 158 µg/L; these detections were identified at both the 30 to 31 ft bgs and the 39 to 43 ft bgs depth intervals.

Only one location indicated non-chlorinated hydrocarbon contamination above NYS Groundwater Standards, at the top of groundwater depth interval (22 ft bgs) at 782VMW-104. Several petroleum-related VOCs were reported above standards, including: 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, m,p-xylene, naphthalene, and o-xylene. The source may be the JP-4 jet fuel line that runs between Buildings 785 and 786 and has been attributed to a petroleum-related contamination plume in the vicinity (NYSDEC Spill #8910168). This contamination is being investigated under the NYSDEC Petroleum Spills Program for Apron 2 (FPM, 2002).

4.2 PERMANENT MONITORING WELL DATA

4.2.1 Chlorinated Plume Characterization

Permanent monitoring wells were installed at each of the “plume area extent” vertical profile well locations, except for 782VMW-79 and -103. Permanent monitoring wells were also installed at “source area extent” vertical profile well locations 782VMW-83, -97, -104, and -105b, and at upgradient vertical profile well locations 782VMW-98 and -99. Well construction details were provided in Section 2.1.2. A total of 34 monitoring wells were included in the initial permanent well sampling event conducted in February 2002, including six existing wells: 782MW-6D, 782MW-10, AP2MW-3, 782MW-6R2, LD4MW-1, and LD4MW-2. A second permanent well sampling event was conducted in February 2003, when each well was resampled, with the following exceptions: LD4MW-1 and -2 were not sampled (these wells are not included in the plume extent, as discussed below in Section 4.5.2), and new well 786MW-30 was sampled (the well was installed in May 2002 for the Petroleum Spill Site 8910168 in association with Building 786).

During both sampling rounds, groundwater samples were submitted for VOC analysis; results are discussed in Sections 4.2.1 and 4.2.2. Groundwater samples collected from permanent monitoring wells (except for LD4MW-1 and -2) were also submitted for geochemical parameters (e.g., nitrate, total iron, sulfate, etc.); these results are discussed in Section 4.6.

Detected VOC results from the permanent monitoring well sampling only (2002 and 2003) are shown in Table 4-3. The chlorinated VOC and MTBE results (for 2002 only) are also summarized in Figure 4-2, including results from permanent wells sampled in August 1999 (as summarized in Table 1-2), and those sampled in December 2002 in conjunction with the Apron 1 Petroleum Spill site LTM program (FPM, 2002).

During the 2003 sampling round only, samples from all permanent monitoring wells were also submitted for metals analysis. Results are provided in Table 4-4.

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Table 4-3
Volatile Organic Compounds Results, Permanent Well Sampling (2002 and 2003)
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-76		782VMW-77		782VMW-78		782VMW-80		782VMW-81		782VMW-82		782VMW-83		782VMW-84		782VMW-85	
Depth BGS in ft			38	38	30	30	40	40	33	33	46	46	46	46	33	33	36	40	37	36
Date of Collection			2/26/2002	2/4/2003	2/26/2002	2/5/2003	2/26/2002	1/31/2003	2/22/2002	2/3/2003	2/21/2002	2/21/2002	2/22/2002	1/30/2003	2/28/2002	2/4/2003	2/21/2002	2/6/2003	2/25/2002	1/31/2003
VOCs in µg/L																				
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U	0.37 F	0.23 F	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	U	U	U	U	U	U	U	0.23 F	0.23 F	U	U	0.16 F	U	U	U	U	0.36 F
1,2,3-Trichlorobenzene	5*		U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
2-Butananone	50	10	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Acetone	50	10	U	U	U	1.9 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Benzene	1	0.4	U	U	U	U	U	0.23 F	0.59	U	U	U	0.22 F	U	U	U	U	U	U	1.2
Chloroform	7	0.3	U	U	U	U	U	U	U	U	U	U	U	U	0.12 F	U	U	U	U	U
cis-1,2-Dichloroethene	5*	1	1.47	1.6	U	U	39.84	64	3.12	1.6	18.66	27 M	U	U	0.47 F	0.45 F	2.67	1.7	U	U
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Xylene (m+p)	5*	2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	9.97	9.6	U	U	U	U	36.01	41	U	U	U	U	U	U	1.89 F	3.6	1.70 F	2.0
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
o-Xylene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	5*	1	U	U	U	U	U	0.21 F	U	0.30 F	21.23	11 M	U	U	6.05	7.3	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	U	0.71	0.12 F	3.3	8.26	0.34 F	0.07 F	U	1.08	0.30 F	0.05 F	U	0.31 F	U	0.05 F	U	U	U
trans-1,2-dichloroethene	5*	1	0.35 F	U	U	U	1.08	3.6	0.16 F	U	1.32	1.1	U	U	U	U	U	U	0.08 F	U
Vinyl chloride	2	1.1	16.39	13	U	U	4.91	15	1.39	1.2	U	10	U	U	U	U	51.3	55	U	U

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-86		782VMW-87		782VMW-88		782VMW-89		782VMW-90		782VMW-91		782VMW-92		782VMW-93		782VMW-94	
Depth BGS in ft			35	33	35	35	35	37	33	35	28	29	28	27	35	35	35	35	40	40
Date of Collection			2/25/2002	2/4/2003	2/27/2002	2/6/2003	2/27/2002	2/5/2003	2/25/2002	2/4/2003	2/25/2002	2/4/2003	2/28/2002	2/7/2003	2/26/2002	2/6/2003	2/26/2002	2/3/2003	2/26/2002	2/3/2003
VOCs in µg/L																				
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	U	U	U	U	U	U	0.38 F	U	U	U	U	U	U	U	U	U	U
1,2,3-Trichlorobenzene	5*		U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	438.45	670	1.96	2.6	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	145.03	180	4.22	6.5	U	U	U	U	U	U
2-Butananone	50	10	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Acetone	50	10	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Benzene	1	0.4	U	0.65	U	U	U	U	U	93 DL	32.76	36	4.01	5.1	U	0.41 F	U	U	U	U
Chloroform	7	0.3	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
cis-1,2-Dichloroethene	5*	1	U	U	U	U	0.23 F	U	0.41 F	U	17.81	15	U	U	U	U	0.16 F	U	0.93 F	0.64
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	58.66	64	0.78 F	1.6	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	20.13	24	0.52 F	0.70	U	U	U	U	U	U
Xylene (m+p)	5*	2	U	U	U	U	U	U	U	U	121.98	180	2.01	1.4	U	U	U	U	U	U
Methylene chloride	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	3.10 F	5.4	31.68	33	2.22 F	2.3	20.95	10	U	U	U	U	16.06	16	9.65	12	U	U
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	39.03	48	U	0.54	U	U	U	U	U	U
Naphthalene	10	1	U	U	U	U	U	U	U	U	112.04	170	1.02	3.0	U	U	U	U	U	U
o-Xylene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	37	0.47 F	0.85	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	21.4	28	U	0.23 F	U	U	U	U	U	U
Trichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	0.30 F	U	U	U	U	U	U
Tetrachloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	U	U	U	U	0.06 F	0.86	U	U	0.65 F	U	0.37 F	0.41 F	0.14 F	0.20 F	0.06 F	U	0.07 F	0.5
trans-1,2-dichloroethene	5*	1	U	U	U	U	0.14 F	U	U	U	1.16 F	U	U	U	U	U	U	U	U	U
Vinyl chloride	2	1.1	U	U	24.03	26	42.94	36 M	U	U	U	U	U	U	1.53	1.6	76.02	100	0.56 F	0.66

Notes
U -The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
F -The analyte was detected above the MDL, but below the RL.
J -The analyte was positively identified, the quantitation is approximate.
*The principal organic contaminant for groundwater applies to this substance.

▨ -Shading indicates substance exceeds NYS Groundwater Standards or Guidance Values.

Table 4-3 (continued)
Volatile Organic Compounds Results, Permanent Well Sampling (2002 and 2003)
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-95		782VMW-96		782VMW-97		782VMW-98		782VMW-99		782VMW-100		782VMW-101		782VMW-102		782VMW-104	
Depth BGS in ft			28	28	39	37	33	33	32	32	28	28	18	25	18	18	19	19	26	26
Date of Collection			2/25/2002	1/31/2003	2/21/2002	2/6/2003	2/22/2002	1/31/2003	2/20/2002	1/30/2003	2/22/2002	1/31/2003	2/28/2002	2/7/2003	2/20/2002	1/30/2003	2/20/2002	1/30/2003	2/22/2002	1/30/2003
VOCs in µg/L																				
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2,3-Trichlorobenzene	5*	1	U	U	U	U	U	U	U	U	U	0.26 F	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	1.66	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.70 F	9.6
1,3,5-Trimethylbenzene	5*	1	0.62 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.24 F	1.3
2-Butananone	50	10	U	U	U	U	U	U	U	U	9.0 F	U	U	U	U	U	U	U	U	U
Acetone	50	10	U	U	U	U	U	U	U	U	42.2	U	U	U	U	U	U	U	U	U
Benzene	1	0.4	0.33 F	0.25 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.15 F	0.43 F
Chloroform	7	0.3	0.17 F	U	U	U	0.15 F	U	0.07 F	U	0.6	0.28 F	U	U	U	U	U	U	U	U
cis-1,2-Dichloroethene	5*	1	0.20 F	0.49 F	U	U	0.87 F	0.71	U	U	U	U	U	U	0.14 F	U	U	U	0.08 F	U
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.51 F	5.6
Isopropylbenzene	5*	1	0.55 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.30 F	1.9
Xylene (m+p)	5*	2	8.78	0.39 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.70 F	14
Methylene chloride	5*	1	0.12 F	U	U	1.7	U	U	U	U	U	U	U	U	U	U	U	U	U	U
MTBE	10	5	1.12 F	0.57 F	2.60 F	4.0	U	0.24 F	U	0.39 F	U	U	U	U	9.59	2.2	86	110	U	U
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	1.2
Naphthalene	10	1	U	U	U	U	U	U	U	U	U	0.21 F	U	U	U	U	U	U	U	2.6
o-Xylene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.09 F	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.30 F
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.41 F	0.77
Trichloroethene	5*	1	U	U	U	U	30.54	38	U	U	U	U	U	U	U	U	U	U	0.85 F	0.39 F
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	5*	1	U	U	U	U	U	0.25 F	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	0.23 F	U	0.10 F	U	U	U	U	U	0.14 F	U	0.10 F	U	U	U	U	U	0.16 F	U
trans-1,2-dichloroethene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Vinyl chloride	2	1.1	U	U	77.78	96	U	U	U	U	U	U	U	U	2.11	0.8	U	U	U	U

Sample ID No.	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-105b		782MW-6D		782MW-10		AP2MW-3		782MW-6R2		782MW-181	782MW-184	LD4MW-1	LD4MW-2	786MW-30
Depth BGS in ft			36	36	43	43	27	27	27	27	30	30	88	24	19	19	22
Date of Collection			2/21/2002	1/30/2003	2/27/2002	1/30/2003	2/28/2002	2/6/2003	2/27/2002	2/7/2003	2/27/2002	2/4/2003	6/12/2003	6/12/2003	2/1/2002	1/28/2002	2/11/2003
VOCs in µg/L																	
1,1,1-Trichloroethane	5*	0.8	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,1- Dichloroethene	5*	1.2	U	U	U	U	0.21 F	U	U	U	U	U	U	U	U	U	U
1,1-Dichloroethane	5*	0.4	U	U	U	U	0.61 F	0.51	U	U	0.23 F	0.26 F	U	U	U	U	U
1,2,3-Trichlorobenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,2,4-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
2-Butananone	50	10	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Acetone	50	10	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Benzene	1	0.4	U	U	U	U	0.58	0.51	U	1100	U	0.77	U	U	U	U	U
Chloroform	7	0.3	0.11 F	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Chloromethane	--	1	U	U	U	U	U	U	U	U	U	U	0.54 F	U	U	U	U
cis-1,2-Dichloroethene	5*	1	4.63	2.6	0.18 F	U	66.09	56	U	U	13.75	0.48 F	U	U	U	U	U
Ethylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.73
Xylene (m+p)	5*	2	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Methylene chloride	5*	1	U	U	U	U	U	U	U	21	U	U	U	U	U	U	U
MTBE	10	5	U	U	U	U	0.36 F	U	250.8	270	U	0.31 F	U	U	U	U	U
n-Propylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	10	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
o-Xylene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
sec-Butylbenzene	5*	1	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0.26 F
Trichloroethene	5*	1	49.95	45	U	U	U	U	U	U	U	U	U	U	U	U	0.88
tert-Butylbenzene	5*	1.4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Tetrachloroethene	5*	1	0.64 F	0.70	U	U	U	U	U	U	U	U	U	U	U	U	U
Toluene	5*	1	0.13 F	0.40 F	0.05 F	U	0.06 F	U	U	U	0.10 F	U	U	U	U	U	0.38 F
trans-1,2-dichloroethene	5*	1	U	U	U	U	3.38	2.6	U	U	0.63 F	0.28 F	U	U	U	U	U
Vinyl chloride	2	1.1	U	U	2.05	2.4	25.38	19	U	U	14.34	4.3	U	U	U	U	U

Notes
U -The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
F -The analyte was detected above the MDL, but below the RL.
J -The analyte was positively identified, the quantitation is approximate.
*The principal organic contaminant for groundwater applies to this substance.
-- Groundwater standard not available.
▨ -Shading indicates substance exceeds NYS Groundwater Standards or Guidance Values.

Table 4-4
Metals Results, Permanent Well Sampling (2003)
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample Location	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-76	782VMW-77	782VMW-78	782VMW-80	782VMW-81	782VMW-82	782VMW-83	782VMW-84	782VMW-85	782VMW-86	782VMW-87	782VMW-88
Sample ID			782VMW7638BA	782VMW7730BA	782VM7840BA	782VMW8033BA	782VMW8146BA	782VM8246BA	782VM8333BA	782VMW8440BA	782VMW8536BA	782VMW8633BA	782VMW8735BA	782VMW8837BA
Date of Collection			2/4/2003	2/5/2003	1/31/2003	2/3/2003	1/30/2003	1/30/2003	2/4/2003	2/6/2003	1/31/2003	2/4/2003	2/6/2003	2/5/2003
Pump Intake Depth (ft TOIC)			38	30	40	33	46	46	33	40	36	33	35	37
Metals (µg/l)														
aluminum	2000	200	759	92 F	477	170 F	176 F	183 F	145 F	347	74.8 F	749	58 F	217 J
antimony	3	50	U	U	U	U	U	U	U	U	U	U	U	U
arsenic	25	30	U	27.8	U	U	U	U	U	U	U	U	U	U
barium	1000	50	761	109	355	479	327	726	103	282	534	1350	U	336
beryllium	3	4	U	U	U	U	U	.5 F	U	U	U	U	491	U
cadmium	5	5	U	U	U	U	U	U	U	U	U	U	U	U
calcium	--	1100	81900	146000	81800	95800 M	65000 M	58300	80400	99200	116000	119000	98300	97900
chromium	50	10	2.7 F	U	2.1 F	U	1.3 F	U	1.3 F	1.6 F	U	1.9 F	U	1.3 F
cobalt	--	60	U	U	U	U	U	U	2.2 F	U	U	U	U	U
copper	200	10	6.4	U	U	U	U	U	9	U	U	2.9 F	U	U
iron	300	200	7460	26100	5180	4610 M	1700 M	3280	234	17100	U	18400	23300	13200 M
lead	25	25	U	U	U	U	U	U	U	U	U	U	U	U
magnesium	35000	1000	21800	22700	18800	31200	17800	15000	11600	18400	18000	18500	25500	17800
manganese	300	10	1270	U	998	2150	625 M	484	919	2320	1970	2180	2930	1510
molybdenum	--	15	2.1 F	3.1 F	2.9 F	U	10.1 J	U	U	U	U	U	U	U
nickel	100	20	U	U	2.6 F	U	U	U	3.3 F	U	U	U	U	U
potassium	--	1000	3620	1350	2760	1170	4790 J	812	2230	3990	3460	3180	2690	3040
selenium	--	30	U	U	U	U	U	U	U	U	9.4 F	U	U	U
silver	50	10	U	U	U	U	U	U	U	U	U	U	U	U
sodium	20000	1000	23400	9140	30500	5300	49500	60300	75200	19100	29000	59300	15400	18400
thallium	0.5	80	U	U	U	U	U	U	U	U	U	U	U	U
vanadium	--	10	U	U	U	U	U	U	U	U	U	U	U	U
zinc	2000	20	13.5 F	6.2 F	4.5 F	2.7 F	4.4 F	2.7 F	6.1 F	6.4 F	4.8 F	7.9 F	4.3 F	6.1 F
mercury	0.7	1	0.25	U	U	U	U	U	U	U	U	U	U	U

Sample Location	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW-89	782VMW-90	782VMW-91	782VMW-92	782VMW-93	782VMW-94	782VMW-95	782VMW-96	782VMW-97	782VMW-98	782VMW-99	782VMW-100
Sample ID			782VMW8935BA	782VMW9029BA	782VMW9127BA	782VMW9235BA	782VMW9335BA	782VMW9440BA	782VMW9528BA	782VMW9637BA	782VMW9733BA	782VMW9832BA	782VM9928BA	782VMW10025BA
Date of Collection			2/4/2003	2/4/2003	2/7/2003	2/6/2003	2/3/2003	2/3/2003	1/31/2003	2/6/2003	1/31/2003	1/30/2003	1/31/2003	2/7/2003
Pump Intake Depth (ft TOIC)			35	29	27	35	35	40	28	37	33	33	28	25
Metals (µg/l)														
aluminum	2000	200	317	74	U	1170	945	27.3 F	131 F	192 F	U	128 F	392	547
antimony	3	50	U	U	U	U	U	U	U	U	U	U	U	U
arsenic	25	30	U	U	61	U	U	U	U	U	U	U	U	12.9 F
barium	1000	50	692	178	172	392	129	650	390	573	29	12.6	40.3	348
beryllium	3	4	U	U	U	.30 F	U	U	U	U	U	.4 F	U	U
cadmium	5	5	U	U	U	U	.5 F	U	U	U	.5 F	U	U	U
calcium	--	1100	102000	102000	239000	100000	93700	88200	85800	91200	79700	55300	97500	55200
chromium	50	10	1.8 F	2.4 F	1.3 F	3 F	2.1 F	U	1.5 F	1.4 F	2 F	1.4 F	2 F	2.5 F
cobalt	--	60	U	U	4.3 F	U	U	U	U	U	U	U	U	U
copper	200	10	2.1 F	U	U	3.1 F	4.7 F	U	U	2.3 F	2.4 F	U	2.2 F	U
iron	300	200	20000	34300	41600	18700	6040	1220	14500 M	3840	U	62.9 F	566	5260
lead	25	25	U	U	U	U	U	U	U	U	U	U	U	U
magnesium	35000	1000	214000	17300	32800	26300	18100	1690	13100	17800	13700	18500	19500	10100
manganese	300	10	3100	7560	1100	2150	1910	889	1870	1330	5040	33.9	66.8	2600
molybdenum	--	15	U	U	2 F	U	U	U	4.1 F	U	2.4 F	U	2.2 F	2.3 F
nickel	100	20	U	U	6 F	U	U	U	U	U	U	U	U	U
potassium	--	1000	3530	2030	1510	3120	4110	U	5010	4630	1940	9630	2560	3700
selenium	--	30	U	U	U	U	U	U	U	U	12.4 F	U	U	U
silver	50	10	U	U	U	U	U	U	U	U	U	U	U	U
sodium	20000	1000	24200	24600	14800	18600	14800	U	38600	14800	11000	11300	10500	41100
thallium	0.5	80	U	U	U	U	U	U	U	U	U	U	U	U
vanadium	--	10	U	U	U	1.6 F	U	U	U	U	U	U	U	1.4 F
zinc	2000	20	5.6 F	5.5 F	7.1 F	8.4 F	22.7 F	5.9	3.2 F	6.6	U	5.6 F	6.4 F	6.7 F
mercury	0.7	1	U	U	U	U	U	U	U	U	U	U	U	U

Notes:
B - The analyte was found in an associated blank, as well as in the sample.
F -The analyte was detected above the MDL, but below the RL.
M - A matrix effect was present.
R - The result was rejected due to an inability to meet QA/AC criteria.
U -The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
UR - The analyte was found non detected, however the result was rejected due to deficiencies in the lab's ability to meet QC criteria.
-- Groundwater Standard not available.
▨ -Shading indicates substance exceeds NYS Groundwater Standards or Guidance Values.

Table 4-4 (continued)
Metals Results, Permanent Well Sampling (2003)
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample Location	NYSDEC Class GA Groundwater Standards	Reporting Limit	782VMW101	782VMW-102	782VMW-104	782VMW-105B	782MW-6D
Sample ID			782VM10118BA	782VM10219BA	782VMW10426BA	782VMW105B36BA	782M6D43BA
Date of Collection			1/30/2003	1/30/2003	1/30/2003	1/30/2003	1/30/2003
Pump Intake Depth (ft TOIC)			18	19	26	36	43
Metals (µg/l)							
aluminum	2000	200	108 F	2130	204	11400	574
antimony	3	50	U	U	6.9 F	U	U
arsenic	25	30	U	U	20.8	11.9 F	U
barium	1000	50	170	724	26	81.2	169
beryllium	3	4	U	.60 F	U	.50 F	.70 F
cadmium	5	5	U	U	U	U	U
calcium	--	1100	74900	107000	85400	99000	124000
chromium	50	10	U	4.0 F	1.8 F	15.3	2.2 F
cobalt	--	60	U	1.9 F	2.7 F	6.2	U
copper	200	10	U	4.8 F	U	38.4	U
iron	300	200	6590	11300	21700	23500	11400
lead	25	25	U	U	U	7.2	U
magnesium	35000	1000	9900	20300	10400	20300	18500
manganese	300	10	1590	1820	1900	2470	2060
molybdenum	--	15	U	U	4.0 F	U	U
nickel	100	20	U	3.1 F	U	15.9	U
potassium	--	1000	1470	3210	1520	5520	3570
selenium	--	30	U	U	U	U	U
silver	50	10	2.4 F	1.8 F	U	U	U
sodium	20000	1000	3130	12200	15100	42500	67800
thallium	0.5	80	U	U	U	U	U
vanadium	--	10	U	4.9 F	U	19.2	U
zinc	2000	20	U	14.2 F	5.4 F	56.3	2.7 F
mercury	0.7	1	U	U	U	U	U

Sample Location	NYSDEC Class GA Groundwater Standards	Reporting Limit	782MW-6R2	782MW-10	786MW-30	AP2MW-3
Sample ID			782MW6R2BA	782MW1027BA	786MW3022BA	AP2MW0327BA
Date of Collection			2/4/2003	2/6/2003	2/10/2003	2/7/2003
Pump Intake Depth (ft TOIC)			30	27	22	27
Metals (µg/l)						
aluminum	2000	200	828	460	117 F	U
antimony	3	50	U	U	U	U
arsenic	25	30	5.8 F	15 F	7.8 F	U
barium	1000	50	124	71.8	36.1	813
beryllium	3	4	U	U	U	U
cadmium	5	5	U	.40 F	.40 F	U
calcium	--	1100	110000	90100	72400 M	102000
chromium	50	10	2.7 F	1.9 F	U	U
cobalt	--	60	1.7 F	U	U	U
copper	200	10	6.9	U	U	U
iron	300	200	21900	41800	2010 M	13800
lead	25	25	4.1 F	U	U	U
magnesium	35000	1000	15500	17500	8680	19700
manganese	300	10	2160	3930	1270 M	1570
molybdenum	--	15	U	U	U	U
nickel	100	20	U	U	U	U
potassium	--	1000	2820	1620	1800	2180
selenium	--	30	U	U	U	U
silver	50	10	U	U	U	U
sodium	20000	1000	40800	21000	2290	15800
thallium	0.5	80	U	U	U	U
vanadium	--	10	U	U	U	U
zinc	2000	20	11.5 F	8.2 F	10.2 F	2.5 F
mercury	0.7	1	U	U	U	U

Notes:
B - The analyte was found in an associated blank, as well as in the sample.
F -The analyte was detected above the MDL, but below the RL.
M - A matrix effect was present.
R - The result was rejected due to an inability to meet QA/AC criteria.
U -The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
UR - The analyte was found non detected, however the result was rejected due to deficiencies in the lab's ability to meet QC criteria.
-- Groundwater Standard not available.
▨ -Shading indicates substance exceeds NYS Groundwater Standards or Guidance Values.

4.2.1.1 Plume Area Extent Permanent Well Results

Four contaminants were detected at levels exceeding NYS Groundwater Standards from the "plume extent" permanent wells sampled in February 2002: TCE, which was reported in one of 25 plume extent wells at 21.2 µg/L in 782VMW-81; cis-DCE, which was reported in eight wells ranging from 1.47 µg/L to 66 µg/L, and at levels exceeding NYS Groundwater Standards in five wells, including 782VMW-78, -81, -90, 782MW-6R2 and -10; VC, which was detected in 13 wells ranging from 1.39 µg/L to 77.8 µg/L, and at levels exceeding NYS Groundwater Standards in 11 wells, including 782VMW-76, -78, -84, -87, -88, -93, -96, -101, 782MW-6R2, -6D and -10; and MTBE, which was reported in eight wells ranging from 9.59 µg/L to 251 µg/L, and at levels exceeding NYS Groundwater Standards in five wells, including 782VMW-80, -87, -92, -102, and AP2MW-3.

During the February 2003 sampling round, the following results are noted:

- The TCE level in 782VMW-81 decreased from 21.2 µg/L to 11 µg/L;
- cis-DCE levels increased in wells 782VMW-78 and -81, from 39.8 to 64 µg/L and 18.7 to 27 µg/L, respectively, indicating possible production from TCE degradation;
- The cis-DCE level decreased in 782MW-6R2 from 13.75 to 0.48 F µg/L (F indicates that the level is between the method detection limit and the reporting limit);
- VC levels increased in wells 782VMW-81, -93, -96, and -78, from non-detect to 10 µg/L, 76 to 100 µg/L, 77.8 to 96 µg/L, and 4.9 to 15 µg/L, respectively, indicating possible production from TCE and/or cis-DCE degradation;
- VC levels decreased in wells 782VMW-101 and 782MW-6R2, from 2.1 to 0.8 µg/L and 14.3 to 4.3 µg/L, respectively.

These data are preliminary evidence that biodegradation processes are working to decrease levels of parent compounds within the southern chlorinated solvent plume. Additional rounds of data are required, however, to confirm the decreasing trend and refute the notion that these data are not natural fluctuations inherent in normal sampling or analysis variability.

4.2.1.2 Source Area Permanent Well Results

During the permanent well monitoring event in February 2002, TCE was reported in three of the source area wells –782VMW-83, -97, and -105b – ranging from 6.05 µg/L to approximately 50.0 µg/L; and cis-DCE was found above reporting limits in 782VMW-105b only at 4.63 µg/L. Neither VC nor MTBE was reported above their respective detection limits in the source area wells, suggesting that (a) reductive dechlorination from cis-DCE to VC probably does not occur until the TCE is depleted; and (b) the MTBE detected in other wells located further downgradient is originating from another source area, probably former Building 7001.

Remarkably similar results and levels of TCE and cis-DCE were reported in all four source area permanent monitoring wells sampled during the February 2003 sampling round (see Table 4-3). In addition, TCE was reported in new well 786MW-30 at 0.88 µg/L.

4.2.2 Permanent Well Results Compared to Vertical Profile Sampling Results

Groundwater data from the permanent well sampling event (2002) were also compared to the results of the vertical profile sampling. In general, there was good correlation between the results of the vertical profile sampling at the nearest sampling depth as the permanent well screen interval with the permanent monitoring well results: the compounds detected during both Hydropunch® and permanent well sampling events were in most cases identical, with the exception of locations 782VMW-90, -95, and -104 (the latter of which is a source area extent monitoring well), which reported several petroleum-related compounds in the grab Hydropunch® samples, and from one to seven fewer compounds in the permanent well samples. Also, the magnitude of the detections was generally greater in the grab Hydropunch® samples than in the permanent monitoring well samples collected using a bladder pump. Exceptions include the vinyl chloride result at 782VMW-88 (42.94 µg/L in the monitoring well [screened from 30 to 40 ft. bgs] vs. 25.62 µg/L in the 33 ft Hydropunch® sample); the MTBE result at 782VMW-89 (20.95 µg/L in the monitoring well [screened from 25 to 40 ft. bgs] vs. 8.84 µg/L in the 31 ft Hydropunch® sample); and the vinyl chloride result at 782VMW-93 (76.02 µg/L in the monitoring well [screened from 30 to 40 ft. bgs] vs. 37.15 to 30.81 µg/L in the 29 and 39 ft Hydropunch® samples, respectively, for VC).

Among permanent well results with a much smaller detection than in the corresponding (closest in depth) Hydropunch® sample includes: vinyl chloride in 782VMW-80 (1.39 µg/L in the monitoring well [screened from 28 to 38 ft. bgs] vs. 26.53 J and 36.17 µg/L in the 29-ft Hydropunch® samples); cis-DCE in 782VMW-90 (17.81 µg/L in the monitoring well [screened from 20 to 30 ft. bgs] vs. 61.5 µg/L in the 26-ft Hydropunch® sample); TCE in 782VMW-95 (non-detect [“U”] in the monitoring well [screened from 20 to 35 ft. bgs] vs. 9.1 µg/L in the 29-ft Hydropunch® sample); and cis-DCE in 782VMW-105b (4.63 µg/L in the monitoring well [screened from 27 to 42 ft. bgs] vs. 158.1 µg/L in the 36-ft Hydropunch® sample). In most cases, monitoring well samples were collected using pumps with intakes set at midscreen depths. The variations in magnitude between the monitoring well and Hydropunch® samples may be due the slight vertical differences between the samples, or possibly more dilution/mixing with the pumped samples vs. the grab samples collected using the Hydropunch®.

4.2.3 Bedrock Aquifer Evaluation

In a separate field effort, two permanent bedrock wells were installed to evaluate potential contamination within the bedrock aquifer. Locations for these bedrock wells were based on the results of vertical profile analyses indicating relatively high (i.e., above NYS Class GA Groundwater Standards) at depths just above the estimated depth to bedrock. For example, at well 782VMW-81, the vertical profile result at 52 ft indicated total chlorinated VOCs at 76 µg/L, and at well 782VMW-84 at 55 ft, 44.18 µg/L.

Bedrock wells were installed adjacent to locations 782VMW-81 and -84 (782MW-181 and -184) in April and May of 2003 (see Figure 4-2), [illegible]d after development, the wells were sampled for VOCs only. Results indicated no detections of the chlorinated solvents associated with the main, southern plume above the bedrock/subsurface soil interface. Only chloromethane was reported at 782VMW-181 at 0.54 F [illegible]/L, below the respective reporting limit. The chlorinated solvent plume is not suspected to have migrated to the bedrock aquifer, and no further sampling of the bedrock aquifer was conducted.

4.3 SOIL DATA

4.3.1 Soil Sample Location Selection

Soil samples were collected at several locations in the vicinity of the source area near Building 786 (782VMW-104, -105, -105b, and -107 through -111), in an attempt to identify if there was remaining contamination in the soil (that could be considered a continuing source) at the approximate depth of the Nosedocks Wash Waste line. An additional soil boring was installed in the vicinity of sampling location 782VMW-90 (soil boring ID 782SB-90RE2), after elevated PID readings (i.e., greater than 50 ppm) indicated strong petroleum odor in the shallow soils (i.e., 2 to 4 ft bgs and 14 to 20 ft bgs). High petroleum-related PID readings were also recorded at 782VMW-104, from 8 to 14 ft bgs. Soil samples from one interval indicating the highest PID readings were submitted from each temporary well. Table 4-5 provides the PID readings in the soil recorded for those samples submitted for VOC analysis.

Table 4-5
Soil Sample PID Readings

Soil Boring Sample	Depth (ft bgs)	PID (ppm)
782SB-90RE2	2 – 4	>199
782SB-90RE2	16 - 18	>199
782VMW-104	10 - 12	>199
782VMW-104	26 - 27	0.98
782VMW-105	16 - 18	1.1
782VMW-105	36 - 38	0.15
782VMW-105	41 - 43	0.17
782VMW-105B	22 - 24	0.18
782VMW-105B	31 - 33	0.18
782VMW-105B	35 - 37	0.076
782VMW-107	14 - 16	0.20
782VMW-108	14 – 16	7.81
782VMW-109	14 - 16	0.19
782VMW-110	14 – 16	0.047
782VMW-111	16 - 18	0.06
782VMW-111	22 - 24	0.10

4.3.2 Soil Sample Results

Soil sample results are provided in Table 4-6. In the shallow (i.e., less than 20 ft bgs) samples, chlorinated hydrocarbons were indicated at 782VMW-107, with 1,1-DCE recorded at approximately 12 µg/kg, TCE at approximately 36 µg/kg, and cis-DCE at 2.5 F µg/kg. Petroleum-related hydrocarbons were reported at elevated levels at two locations: 782SB-90RE2 (2 to 4 ft bgs and 16 to 18 ft bgs), and 782VMW-104 (10 to 12 ft bgs).

4.4 SURFACE WATER DATA

Surface water sample results are provided in Table 4-7, and the 2002 chlorinated hydrocarbon and MTBE results are included in Figure 4-2. Note that except for one of the surface water samples (782SW-114), surface water samples were collected downstream of a concrete stormwater open channel located between sampling locations 782VMW-101 and -102, so the source of potential contamination present in these surface water samples is not definitive. Among the three seepage and four surface water samples collected in 2002 along Six Mile Creek (sampling locations are shown in Figure 4-2), only two VOCs were detected at levels above reporting limits: MTBE and benzene. VC was detected at seep sample location 782SW-114 (0.31 F µg/L), and below the reporting limit but above the detection limit (0.13 µg/L) at seep sample location 782SW-116 (0.17 F µg/L). However, at 782SW-114, the NYSDEC groundwater effluent limitation of 2 µg/L is applicable, so these vinyl chloride concentrations are compliant with regulatory limits.

MTBE was reported in seepage samples collected at 782SW-116 and -117 at 62.9 µg/L and 190 µg/L, respectively. Both seepage locations are downgradient of monitoring well 782VMW-102, where MTBE was also detected. Benzene was reported at 2.69 µg/L at surface water sampling location 782SW-120. Because benzene was not found at levels above the detection limit in any upstream samples, the source for the benzene may possibly be related to the petroleum contamination plume associated with Building 789, or from other sources upstream (i.e., the stormwater outfall from the Aprons, or other Petroleum Spill Sites).

Dissolved (ferrous) iron readings were also recorded for seepage samples 782SW-114, -116, and –117 during the 2002 sampling round. Additionally, field parameters were recorded at all surface water sampling locations, including redox levels. These results are included in the discussion for dissolved iron and redox, Sections 4.6.2 and 4.7.5, respectively.

In February 2003, only the surface water sampling locations were re-sampled, at locations 782SW-115, -118, -119, and -120. Results for all chlorinated solvents were below the detection limits. However, MTBE was reported at location 782SW-118 at 1.1 µg/L, at –119 at 1 µg/L, and at –120 at 1.1 µg/L. Xylenes (m+p) were also reported at 782SW-120 at 0.58 µg/L. The source for the MTBE is believed to be associated with Building 7001 and the southern MTBE plume delineated during this investigation, but the BTEX source is believed to be associated with the

Table 4-6
Soil Sampling Results
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample ID No.	NYSDEC TAGM 4046 Cleanup Level	Reporting Limit	782SB-90RE2		782VMW-104		782VMW-105			782VMW-105B			782VMW-107	782VMW-108	782VMW-109	782VMW-110	782VMW-111	
Depth BGS in ft			4	18	12	27	18	38	43	24	33	37	16	16	16	16	18	24
Date of Collection			1/15/02	1/15/02	1/18/02	1/18/02	1/15/02	1/16/02	1/16/02	1/23/02	1/23/02	1/23/02	1/24/02	1/28/02	1/29/02	1/29/02	1/30/02	1/30/02
VOCs in μg/kg																		
1,1- Dichloroethene	400	6.9	U	U	10.05 J	U	U	4.44 F	U	8.81	2.74 F	U	11.91	1.35 F	3.52 F	U	U	4.37 J
1,2,4-Trimethylbenzene	10,000	5.75	2739.78	2218.77	2005.39 J	U	U	U	U	U	U	U	U	U	U	U	U	U
1,3,5-Trimethylbenzene	3,300	5.75	1262.15	1079.28	1007.66 J	U	U	U	U	U	U	U	U	U	U	U	U	U
Acetone	200	57.5	U	100.4	U	7.9 F	5.5 F	4.6 F	6.4 F	U	4.2 F	U	U	5.8 F	U	U	3.1 F	33.5 F
Benzene	60	2.3	U	1.99 J	U	U	U	U	U	U	U	U	U	U	U	U	U	U
cis-1,2-Dichloroethene	300	5.75	U	10.52 J	U	U	U	21.55	U	U	U	35.91 J	2.48 F	U	U	U	U	U
Ethylbenzene	5,500	5.75	1056.48	1065.3	845.55 J	U	U	U	U	U	U	U	U	U	U	U	U	U
Isopropylbenzene	2,300	5.75	463.31	548.47	367.5 J	U	U	U	U	U	U	U	U	U	U	U	U	U
Xylene (m+p)	1,200	5.75	2594.27	3951.85	2612.41 J	U	U	U	U	U	U	U	U	U	U	U	U	U
n-Propylbenzene	3,700	5.75	799.88	341.67	797.35 J	U	U	U	U	U	U	U	U	U	U	U	U	U
Naphthalene	13,000	5.75	279.03	239.28	123.12 J	U	U	U	U	U	U	U	U	U	U	U	U	U
o-Xylene	1,200	5.75	929.04	U	1292 J	U	U	U	U	U	U	U	U	U	U	U	U	U
p-Isopropyltoluene	10,000	6.9	369.94	443.71	159.41 J	U	U	U	U	U	U	U	U	U	U	U	U	U
sec-Butylbenzene	10,000	5.75	265.98	298.39	158.83 J	U	U	U	U	U	U	U	U	U	U	U	U	U
Trichloroethene	700	5.75	U	U	U	U	U	21.09	U	U	23.9	538.54 J	35.91	U	2.94 F	U	1.42 F	U
Toluene	1,500	5.75	2.52 J	U	140.84 J	U	U	0.89 F	0.92 F	U	U	U	U	U	U	U	U	U

Notes
U -The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
F -The analyte was detected above the MDL, but below the RL.
J -The analyte was positively identified, the quantitation is approximate.
*The principal organic contaminant for groundwater applies to this substance.
▨ -Shading indicates substance exceeds TAGM 4046 Cleanup Levels.

Table 4-7
Six Mile Creek Surface Water Sampling Results
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Sample Location	NYSDEC Class GA	Reporting Limit	782SW-114	782SW-115		782SW-116	782SW-117	782SW-118	
Sample ID			782SW11401AA	782SW11401AA	782SW11501BA	782SW11601AA	782SW11701AA	782SW11801AA	782SW11801BA
Date of Collection			5/7/2002	5/7/2002	2/10/2003	5/7/2002	5/7/2002	5/7/2002	2/10/2003
Pump Intake Depth (ft TOIC)			Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
VOCs (µg/L)									
1,2-dichloroethane	0.6	0.6	U	0.11 F	U	U	U	U	U
1,2-dichlorobenzene	3	0.3	U	U	U	U	U	0.09 F	U
1,2,4-trimethylbenzene	5*	1	U	0.08 F	U	U	U	0.07 F	U
acetone	50	10	U	U	U	U	U	U	U
benzene	1	0.4	U	U	U	U	U	U	U
chlorbenzene	5*	0.5	U	0.15 F	.49 F	U	U	0.12 F	.48 F
cis-1,2-dichloroethene	5*	1	U	0.16 F	U	U	U	0.13 F	U
ethylbenzene	5*	1	U	U	U	U	U	U	U
xylene (m+p)	5*	2	U	U	U	U	U	U	U
MTBE	10	5	1.91 F	0.20 F	U	62.87	190.89	1.59 F	1.1
trichloroethylene (TCE)	5	1	U	0.16 F	U	U	U	0.14 F	U
trichlorofluoromethane	5*	1	U	U	.12 UJ	U	U	U	.12 UJ
vinyl chloride	2	1.1	0.31 F	U	U	0.17 F	U	U	U

Sample Location	NYSDEC Class GA	Reporting Limit	782SW-119		782SW-120	
Sample ID			782SW11901AA	782SW11901BA	782SW12001AA	782SW12001BA
Date of Collection			5/7/2002	2/10/2003	5/7/2002	2/10/2003
Pump Intake Depth (ft TOIC)			Surface Water	Surface Water	Surface Water	Surface Water
VOCs (µg/L)						
1,2-dichloroethane	0.6	0.6	U	U	U	U
1,2-dichlorobenzene	3	0.3	0.08 F	U	0.08 F	U
1,2,4-trimethylbenzene	5*	1	U	U	0.19 F	U
acetone	50	10	U	U	U	U
benzene	1	0.4	U	U	2.86	1
chlorbenzene	5*	0.5	U	.46F	U	.42 F
cis-1,2-dichloroethene	5*	1	0.13 F	U	0.11 F	U
ethylbenzene	5*	1	U	U	0.37 F	.23 F
xylene (m+p)	5*	2	U	U	0.87 F	0.58
MTBE	10	5	1.59 F	1	1.74 F	1.1
trichloroethylene (TCE)	5	1	0.14 F	U	0.12 F	U
trichlorofluoromethane	5*	1	U	.12 UJ	U	.12 UJ
vinyl chloride	2	1.1	U	U	U	U

Notes:
F -The analyte was detected above the MDL, but below the RL.
* The principal organic contaminant for groundwater applies to this substance.
▨ -Shading indicates substance exceeds NYS Groundwater Standards or Guidance Values.

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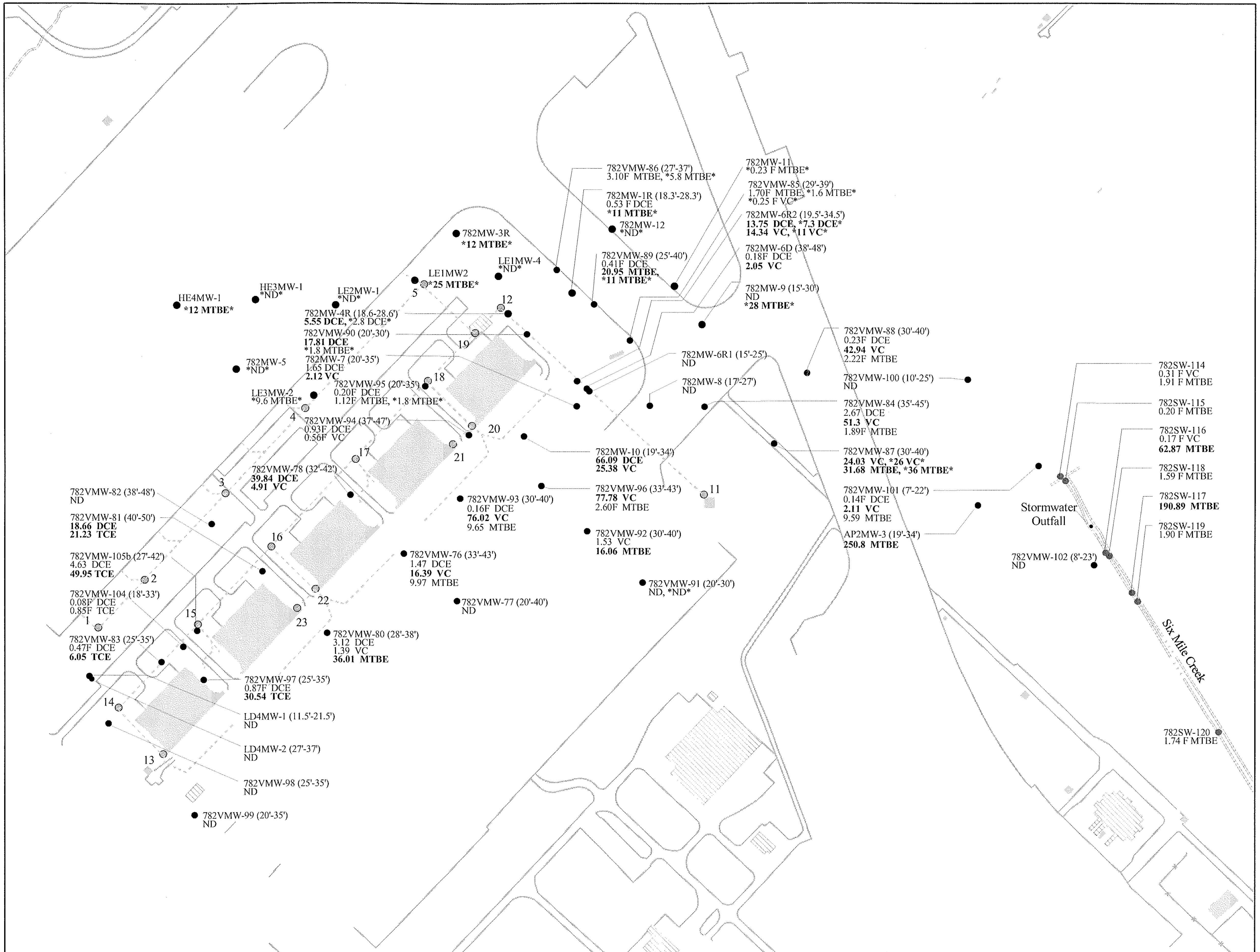
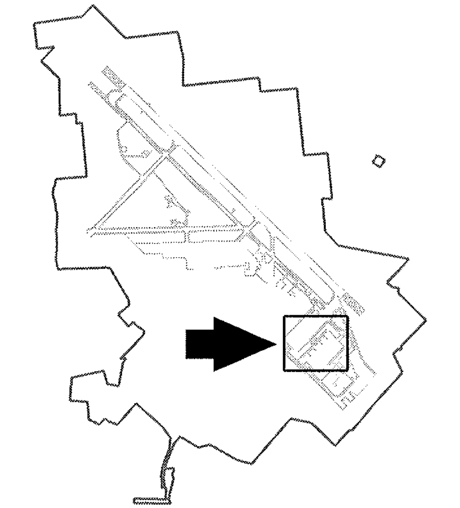


NOTE: The results from 782MW-1R, -4R, -6R1, -7, -8, and -9 were collected in August 1999.
The results bracketed with asterisks were collected in December 2002 associated with Apron 1 sampling (report pending).

N



● Groundwater Sampling Locations showing detections for cis-1,2-Dichloroethene, Trichloroethene, Vinyl Chloride, and MTBE (in µg/L, exceedances are shown in bold, screen interval (ft bgs) shown in parenthesis)

● Surface Water Sampling Locations showing detections for cis-1,2-Dichloroethene, Trichloroethene, Vinyl Chloride, and MTBE (in µg/L, exceedances are shown in bold, screen interval (ft bgs) shown in parenthesis)

○ Wash Waste Manhole (w/ID)

Nosedocks Washwaste System

Stream / Creek

Road

▨ Existing Building

▨ Previously Demolished Building

UNITED STATES AIR FORCE
GRIFFISS AIR FORCE BASE
ROME, NEW YORK

SCALE
100 0 100 200 300 400 Feet

Figure 4-2
Nosedocks / Apron 2
Permanent Monitoring Well Results

FPM group

former Building 789 Petroleum Spill (since BTEX compounds are detected only at the surface water sampling location farthest downstream).

4.5 PLUMES CHARACTERIZATION

4.5.1 Source Area Characterization

One likely source for the contamination associated with the Nosedocks/Apron 2 Chlorinated Plume is the Nosedocks Wash Waste system. TCE was detected in wells at locations adjacent or near to the wash waste system line and associated manholes, especially at Manhole 15 (where 782VMW-105 and -105b are located). The only other TCE detections across the site during February 2002 were at 782VMW-81 (43.1 µg/L at 41 ft bgs and 40.3 µg/L at 52 ft bgs) and -95 (9.1 µg/L at 29 ft bgs), which are also located adjacent to the Nosedocks Wash Waste System. According to the Final Decision Document/Closure Report for the Nosedocks Wash Waste System (PEER, 1999), during the excavation of the Nosedocks Wash Waste System, contaminated soils were observed below the pipe and in many cases extended beyond the reach of the excavator. Contaminated soils and two 15-ft sections of pipe between manhole 14 beginning 16 ft downstream and continuing to approximately 39 ft downstream of manhole 15 were left in place due to the presence of buried utilities. (One soil sample collected from 66 ft downstream of Manhole 14 from 15 ft bgs was submitted for VOC analysis including chlorinated compounds [EPA Method SW8240B], but none were detected [PEER, 1999].)

4.5.2 Chlorinated Hydrocarbon Plumes

A depiction of the extent of the areas contaminated with chlorinated hydrocarbons (or “plumes”) was created by identifying those sampling locations with chlorinated solvent concentrations above their respective NYS Class GA Groundwater Standards. The plumes for TCE, DCE, and VC, based on February 2002 data, are portrayed in Figure 4-3. The figure shows a simple two-dimensional interpretation of the data, where a location is considered within the plume extent for TCE, DCE, and/or VC, when a sample collected from any depth at that location indicated an exceedance(s) of the NYS Groundwater Standards. Figure 4-4 shows isoconcentration contours for total chlorinated hydrocarbons (the sum of TCE, DCE, and VC) for each vertical profile sampling location. The contours were derived from Hydropunch® sampling data only, using the four highest sampling intervals at each vertical profile well location.

Figures 4-3 and 4-4 illustrate the lateral extent of chlorinated hydrocarbon contamination. The vertical extent of contamination is illustrated in the cross-section shown in Figures 4-5 through 4-5b, also based on Hydropunch® data. Figure 4-5 shows the cross-section location, Figure 4-5a shows total chlorinated vertical plume contours along the selected cross-section “slice”, and Figure 4-5b shows TCE/DCE/VC vertical plume contours along the selected cross-section “slice.” The vertical profile sampling information was also entered into a three-dimensional modeling program to develop a more thorough concept of the plume extent. Figures from the three-dimensional model are included in Appendix H.

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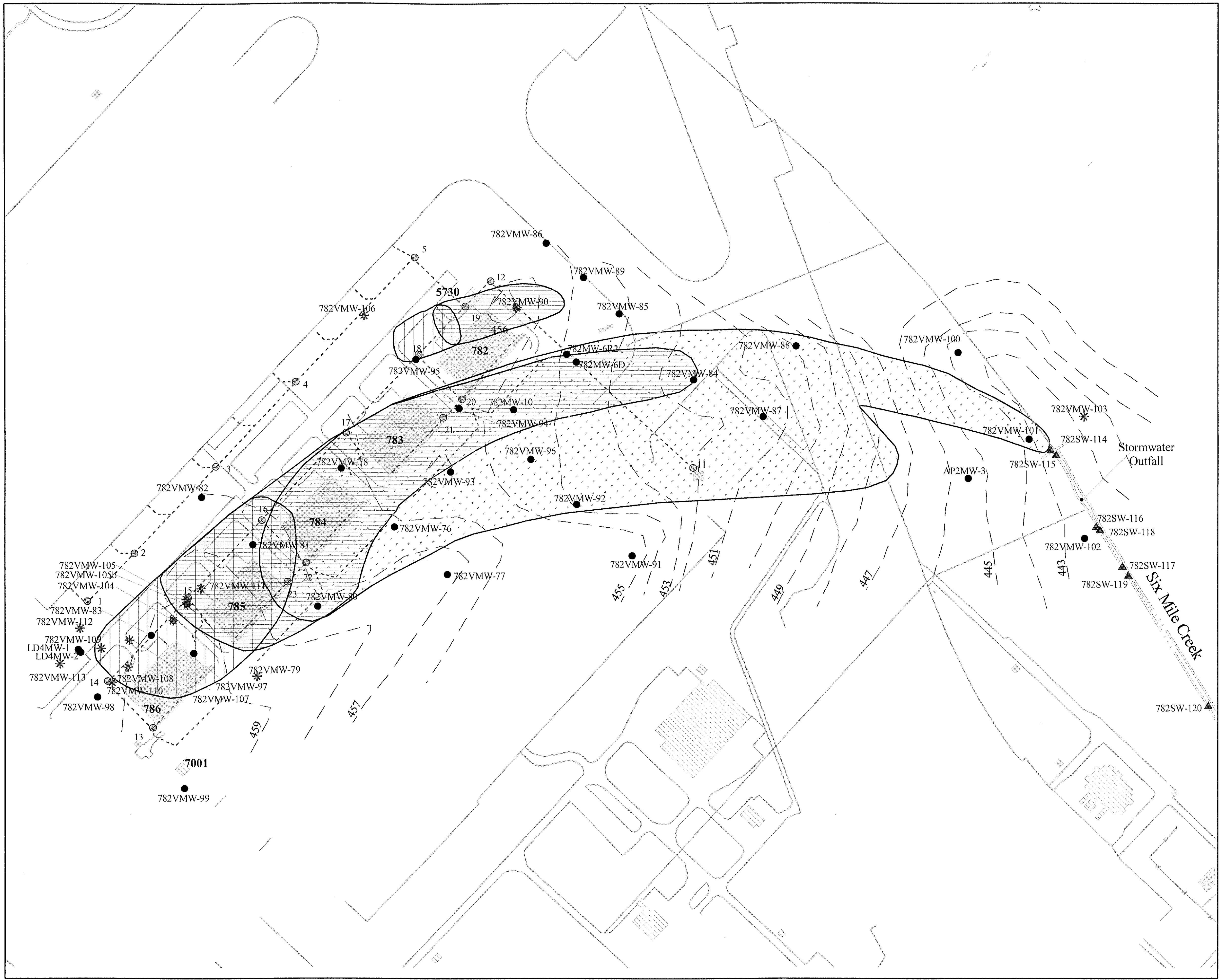

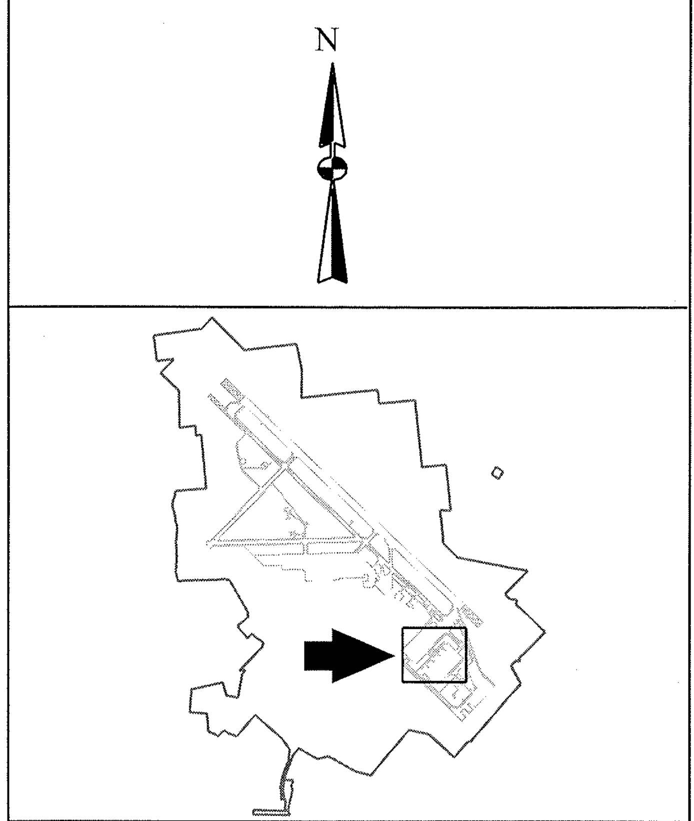

- ● LTM Monitoring Well
- ✳ Temporary Vertical Profile Well Location
- ▲ Surface Water Sampling Location

PLUME

- ▥ TCE (Concentration > 5 μg/L)*
- ▤ cis-DCE (Concentration > 5 μg/L)*
- ▨ VC (Concentration > 2 μg/L)*
- ○ Wash Waste Manhole
- ----- Nosedocks Washwaste System
- — — Groundwater Contour, 2/02 ft. MSL
- Stream / Creek
- Road

FACILITY

- ▒ Existing
- ░ Demolished

*Refers to the concentration in any one sample interval or monitoring well.

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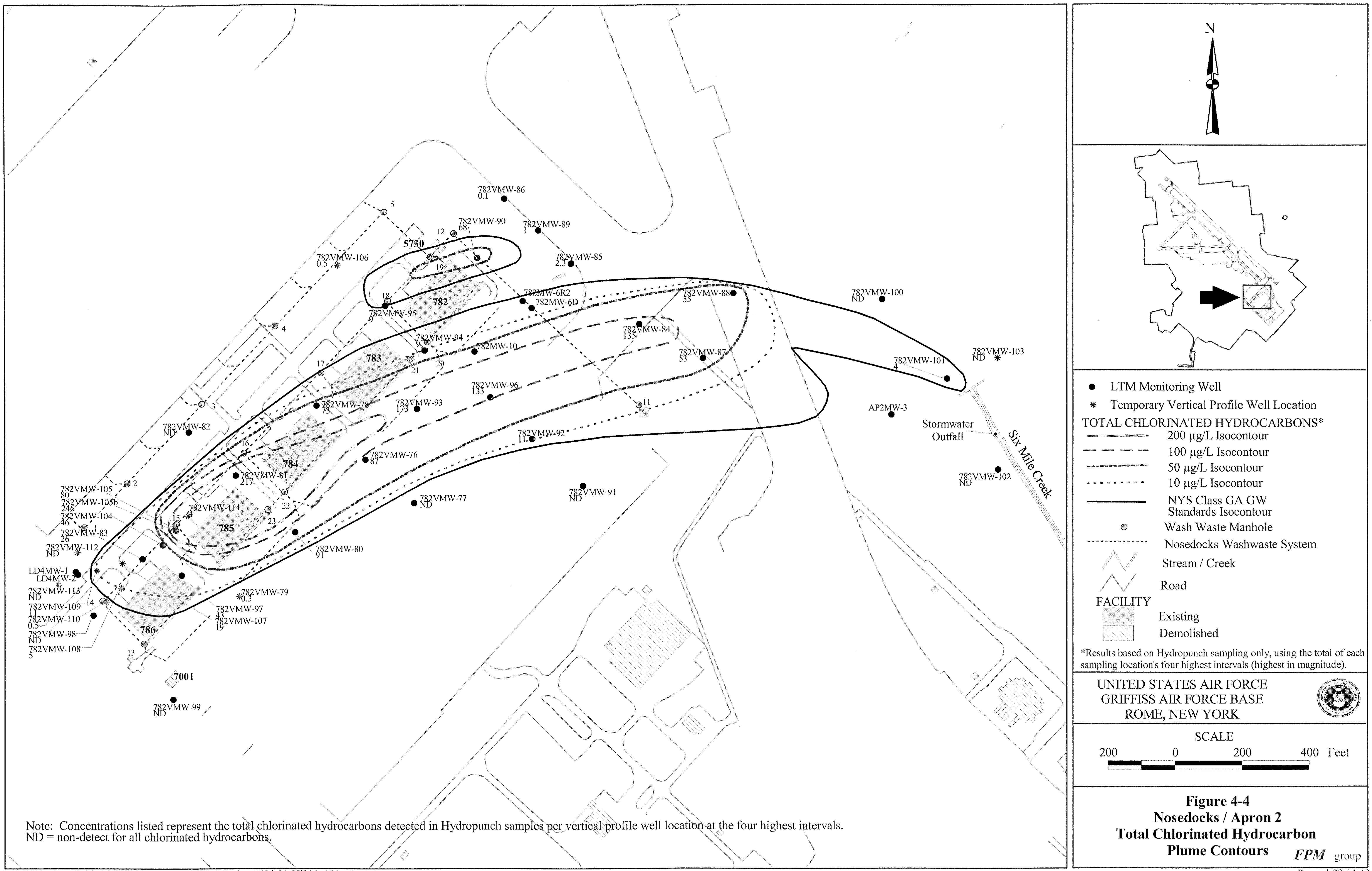
SCALE
100 0 100 200 300 400 Feet

Figure 4-3
Nosedocks / Apron 2
Chlorinated Hydrocarbon Plumes

FPM group

Y:\GIS Projects Folder\Griffiss Air Force Base\GIS Projects\684-01-02\bldg 782 - fig 4-1



Note: Concentrations listed represent the total chlorinated hydrocarbons detected in Hydropunch samples per vertical profile well location at the four highest intervals.
ND = non-detect for all chlorinated hydrocarbons.

- ● LTM Monitoring Well
- * Temporary Vertical Profile Well Location

TOTAL CHLORINATED HYDROCARBONS*

- 200 µg/L Isocontour
- 100 µg/L Isocontour
- 50 µg/L Isocontour
- 10 µg/L Isocontour
- NYS Class GA GW Standards Isocontour
- Wash Waste Manhole
- Nosedocks Washwaste System
- Stream / Creek
- Road

FACILITY
- ▨ Existing
- ▨ Demolished

*Results based on Hydropunch sampling only, using the total of each sampling location's four highest intervals (highest in magnitude).

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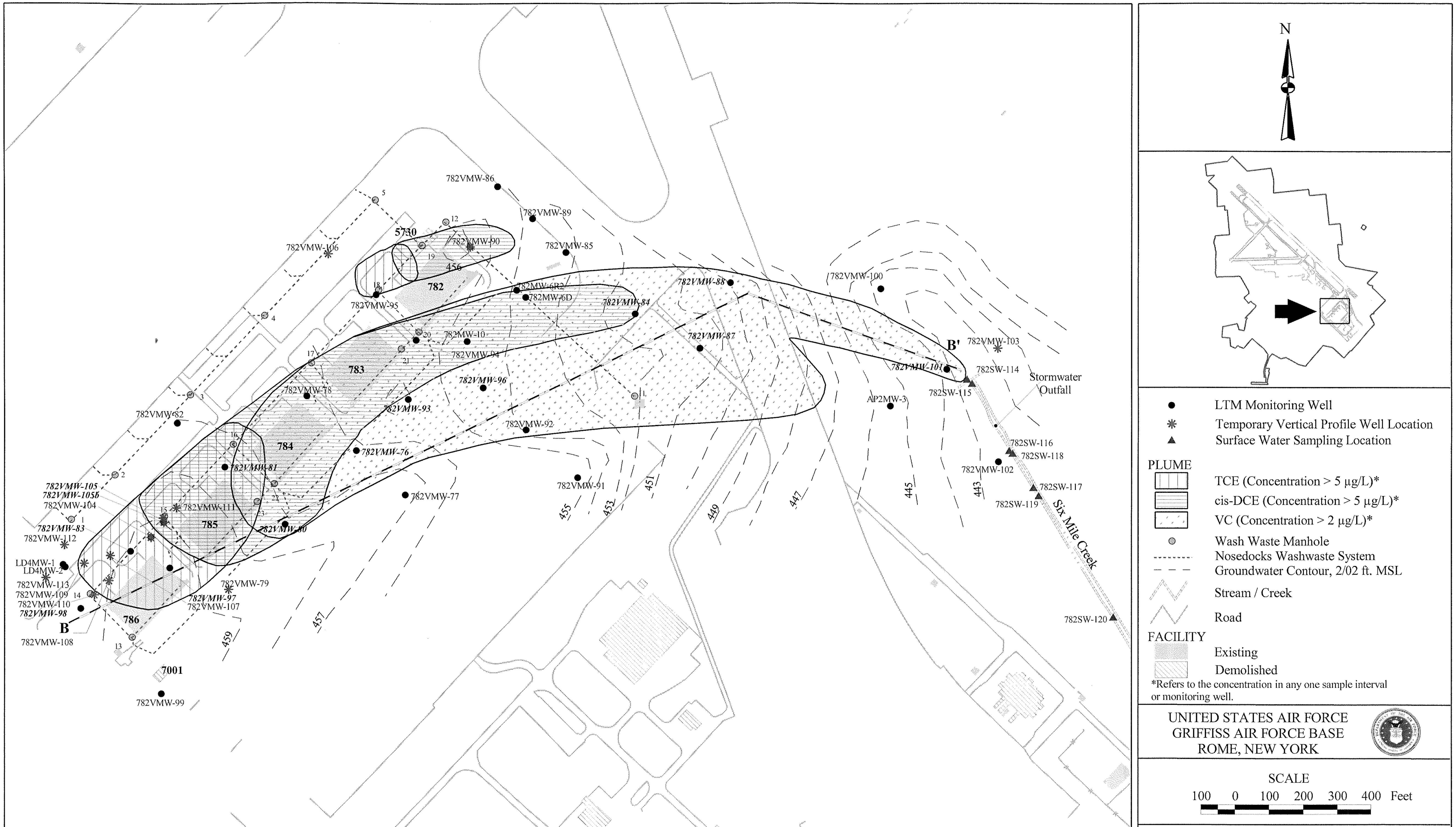
Figure 4-4
Nosedocks / Apron 2
Total Chlorinated Hydrocarbon
Plume Contours

FPM group



Note: Only those wells indicated ***bold and italicized*** are included in Figure 4-5a.

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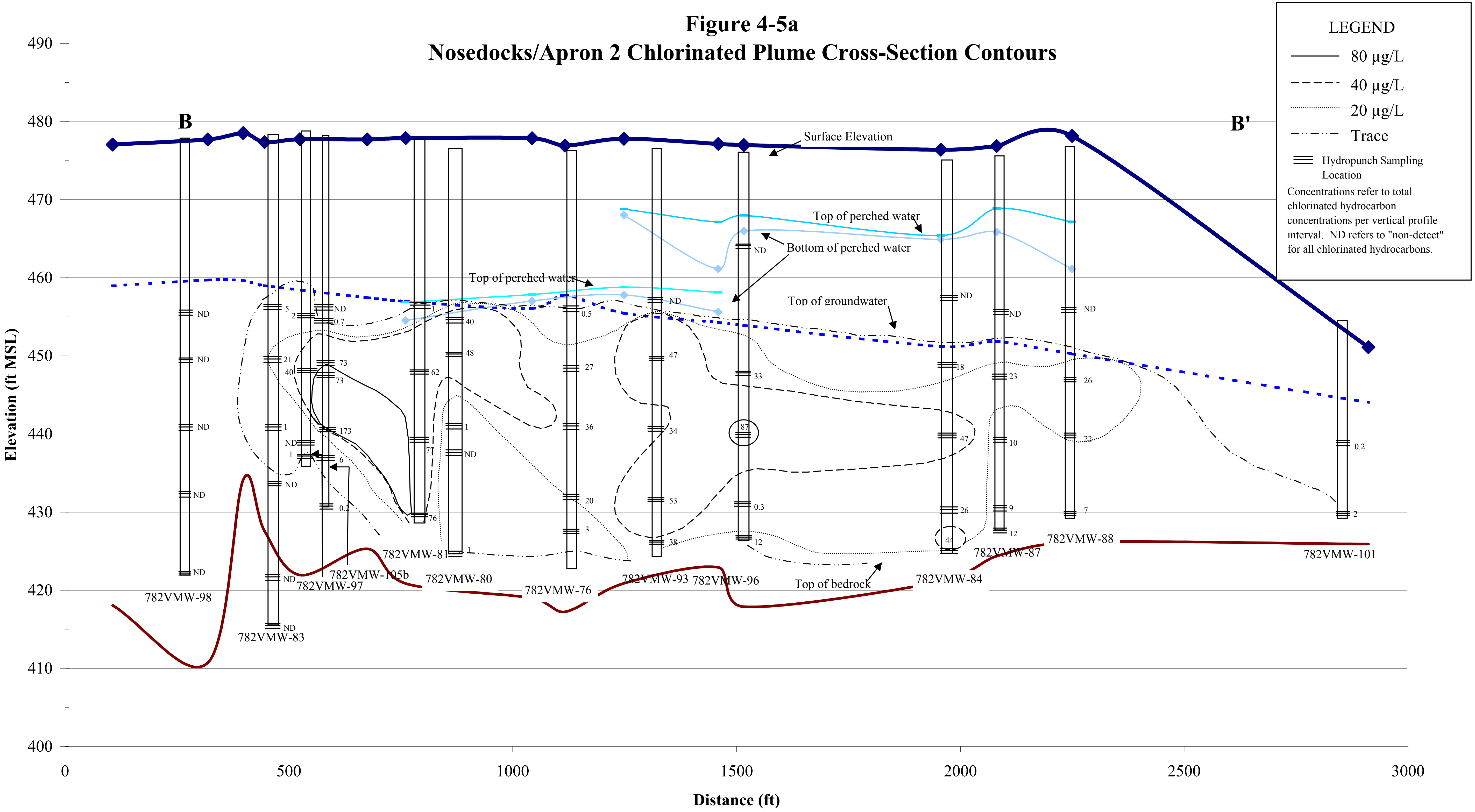
Figure 4-5
Nosedocks / Apron 2
Cross-Section Location B-B'

FPM group

Figure 4-5a
Nosedocks/Apron 2 Chlorinated Plume Cross-Section Contours



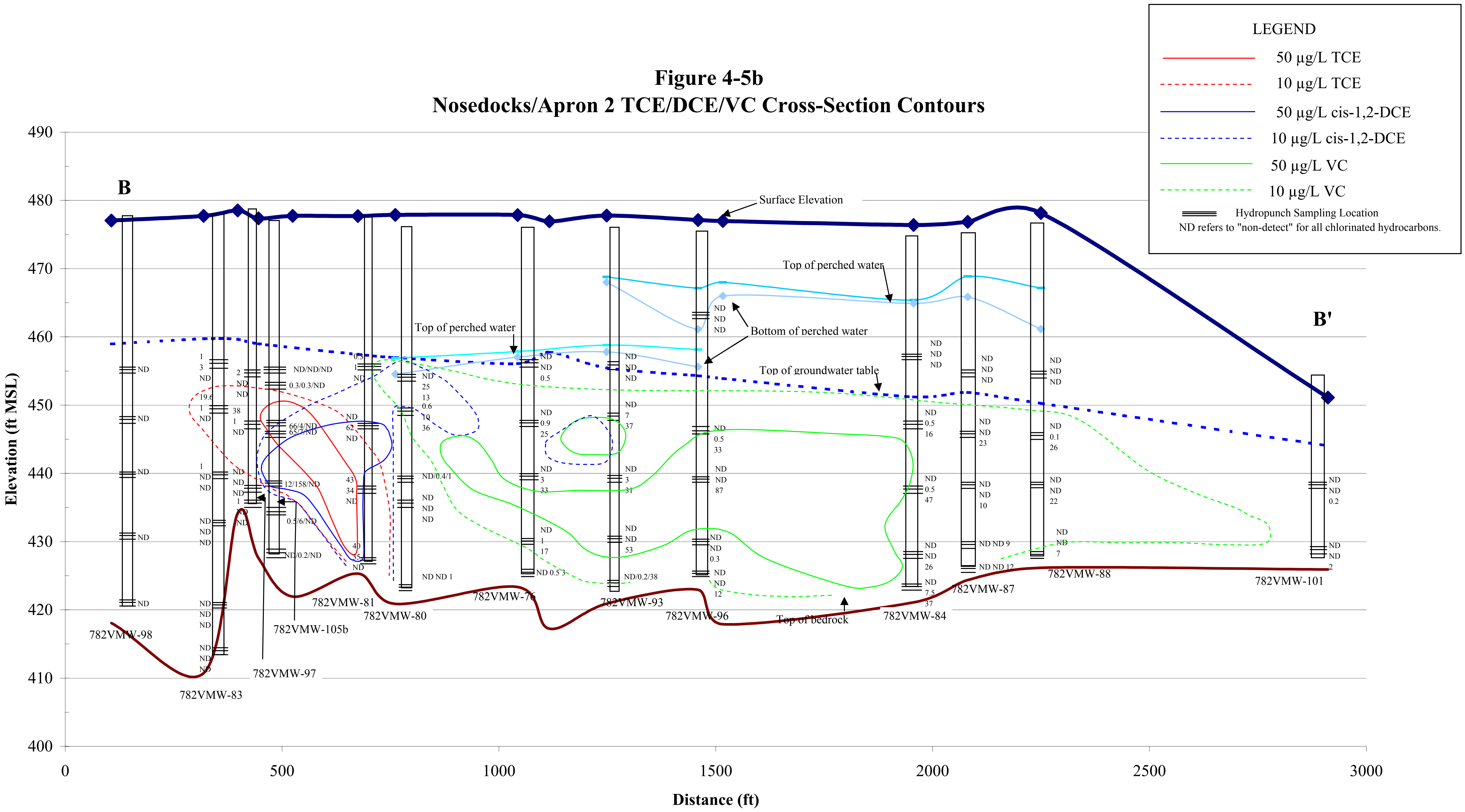


Figure 4-5b
Nosedocks/Apron 2 TCE/DCE/VC Cross-Section Contours

The data obtained from the vertical profiling indicate that the source area for the larger, southern chlorinated plume appears to be the former Nosedocks Wash Waste system, originating in the vicinity of Building 786 (possibly Manhole 15). The contamination has traveled both laterally, up to approximately 2,800 feet to the northeast/east towards Six Mile Creek, and vertically, approximately 33 feet downward from the approximate depth of the wash waste system at 16 ft bgs to approximately 55 ft bgs. The width of the plume is approximately 200 feet near Manhole 15/the Nosedocks Wash Waste System and 400 to 500 feet at the leading edge (where it appears to discharge to Six Mile Creek). The water table exhibits a very low gradient across the site (0.0066 ft/ft). The depth to groundwater ranges from approximately 6 feet to 28 feet with an average of about 20 feet across the site.

Figures 4-5a and 4-5b show that most of the downgradient extent of the chlorinated solvent plume is below the clay layer, which attributed to perched groundwater conditions, observed at several downgradient sampling locations: 782VMW-76, -78, -80, -84, -85, -92, -93, -94, -95, -96, and -100. It was not possible to confirm that the perched water layers were continuous across the locations, therefore not all perched layers are shown in Figure 4-5a and 4-5b. The groundwater elevation is based on the measurements taken from permanent monitoring wells, indicating that at some locations (i.e. 782VMW-84, -82, and -88) the shallowest sampling zones appear to be above the top of the groundwater table. [illegible] is noted that throughout the site, no chlorinated solvents were detected in the shallowest groundwater samples, collected at the top of the groundwater table and/or above the clay layer, where it was found, except in the vicinity of the source area (782VMW-107 and -109). The plume extends to the overburden immediately above bedrock at several locations, including 782VMW-76, -81, -84, -87, -88, -93, -96, and -101.

In contaminated wells, cis-DCE concentrations are less than VC concentrations, suggesting that VC may be accumulating in the aquifer in the vicinity between 782VMW-84 and -93. However, based on the positive ethene detection found at 782VMW-101, it appears that complete reductive dechlorination to ethene is ongoing. Additional samples indicated levels of ethene between the reporting limit and the detection limit. Due to its high volatility (Henry's constant = 9.35), ethene is not easily measured in field samples, and may have been present at higher levels but quickly volatilized during sample collection.

The larger, southern plume appears to be migrating towards Six Mile Creek, and levels in the downgradientmost wells suggest that the plume biodegrades prior to reaching the creek. Even if contaminated groundwater (vinyl chloride) reaches the creek, as measured in seep sample 782SW-114 (0.31 F µg/L), surface water samples in the creek do not indicate measurable levels of VC, which may attenuate upon discharging to the creek or prior to reaching the creek through the seeps, via volatilization or by ongoing bioremediation taking place in the sediment. The dimensionless Henry's constant of VC is approximately 2.3 (which is relatively high for a VOC: the dimensionless Henry's constant for TCE, cis-1,2-DCE, and trans-1,2-DCE are 0.41 and 0.138, and 0.275, respectively) making it very unlikely that VC would stay dissolved in surface water long enough to reach the creek. Thus, there are no current receptors from the contaminants in the plume. The more upgradient portions of the plume are located beneath actively used buildings. However, these buildings are serviced by a public water supply and there is no anticipated use of groundwater in the future due to ample municipal supply. The area downgradient is intended to remain as open space. Thus, unless plume migration to the creek ultimately occurs, no potential future receptors are anticipated.

The chlorinated plume on the north side of Building 782 appears to be separate from the main chlorinated solvent plume which extends from Manhole 15/the Nosedocks Wash Waste System to Six Mile Creek. The plumes are not considered to be connected due to the following observations: (a) upgradient/crossgradient well 782VMW-82 did not show any chlorinated solvent detections; (b) a relatively low concentration of TCE (9 µg/L)was found in the vicinity of 782VMW-95 near Manhole 18, which is likely a secondary, separate source area for the smaller northern plume; and (c) no vinyl chloride was detected in the vicinity of samples 782VMW-90 and -95, whereas vinyl chloride was found at most downgradient sampling locations for the main, southern chlorinated solvent plume, including at locations 782VMW-93 and -94.

The northern chlorinated plume has traveled laterally approximately 480 feet from the potential source area at Manhole 18 to the drainage swale area northeast of Building 782. The plume does not appear to have traveled vertically, since it was detected in two samples only at well locations 782VMW-90 and -95, at depths of 26 and 29 ft bgs, respectively. The width of the plume is approximated at 200 ft.

4.5.3 MTBE Plumes

The extent of the two MTBE plumes was also depicted by identifying those well locations with MTBE concentrations above 10 µg/L (the NYS Guidance Value) using the February 2002 data. The extent of the larger MTBE plume is approximately 2,700 feet long, whereas the shorter MTBE plume is less than 600 feet long; both are shown on Figure 4-6. The larger plume appears to overlap the southern side of the chlorinated solvent plume. This southern portion of the chlorinated solvent plume appears to proceed more quickly through the reductive dechlorination sequence to vinyl chloride than the northern portion of the plume, which is (a) closer to the potential source area (the Nosedocks Wash Waste System); and (b) characterized by a longer DCE extent. One possible explanation for this observation is that the MTBE (or petroleum compounds associated with the source of MTBE that have since been degraded) is actually serving as a carbon source and/or electron donor in the reductive dechlorination process, whereas the northern portion of the plume which does not overlap with the MTBE is carbon source and/or electron donor-limited.

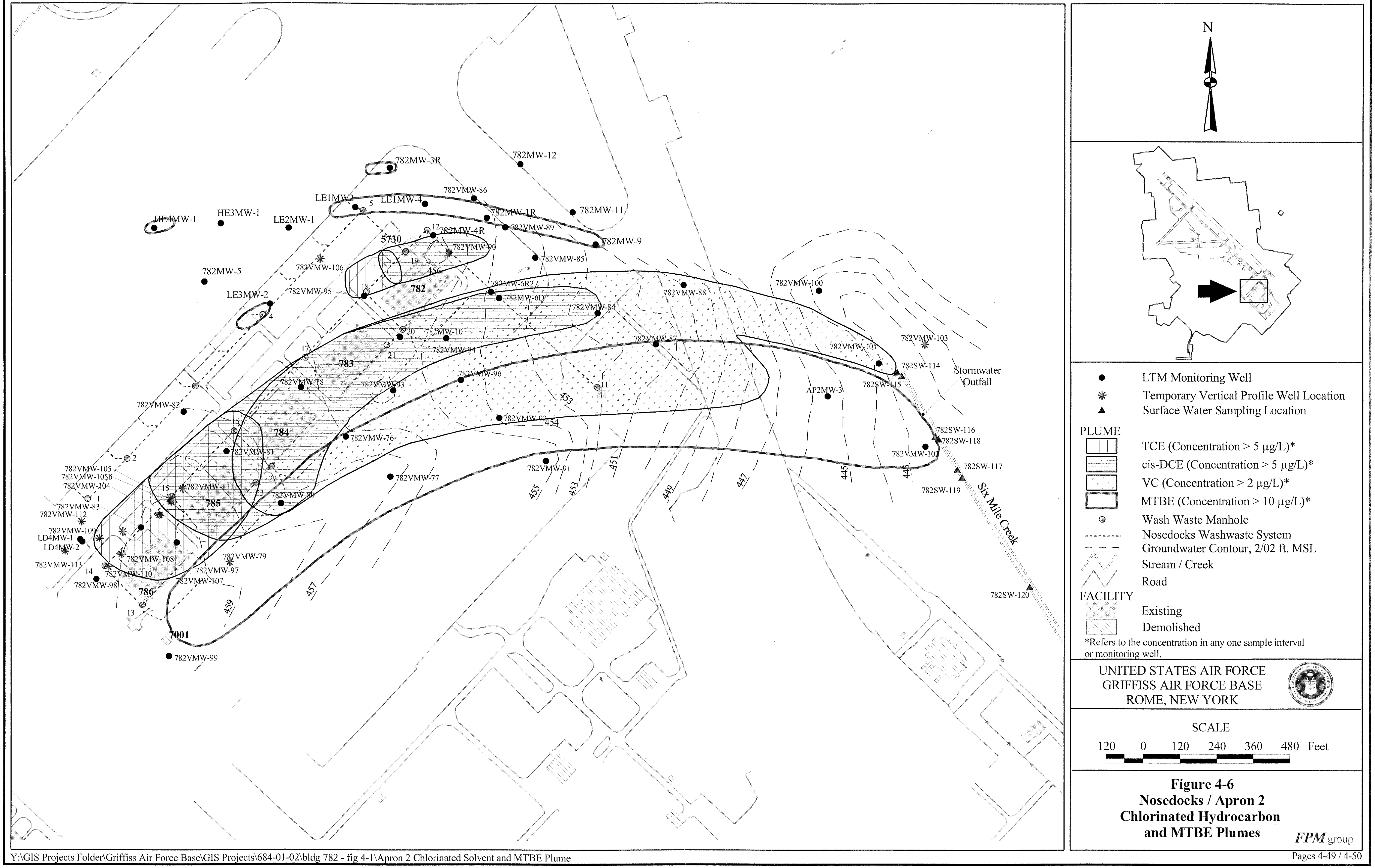


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Figure 4-6
Nosedocks / Apron 2
Chlorinated Hydrocarbon
and MTBE Plumes

FPM group

The larger MTBE plume extends laterally approximately 2,700 ft from the presumed source area near former Building 7001 to Six Mile Creek, and vertically from approximately 24 to 57 ft bgs at 782VMW-80 alone. The vertical migration appears to occur over a much shorter distance than the chlorinated plume. The width of the plume is approximately 360 ft and at least 240 ft at the leading edge where the plume discharges to Six Mile Creek. The highest hits were detected at Hydropunch® sample location 782VMW-102 at 14 ft bgs (251 µg/L), and permanent monitoring well location AP2MW-3 (251 µg/L), both just upgradient of Six Mile Creek. In 2003, MTBE was measured at 270 µg/L in AP2MW-3.

The northern MTBE plume is based on the results of four wells installed during this RI in the northeast vicinity of Building 782 – 782VMW-86, -89, -90, and -106. The highest hit (during Hydropunch® sampling) was 25.34 µg/L at 782VMW-86 at 29 ft bgs. This plume also exhibits only limited vertical migration, with detections above the reporting limit at depth intervals between 29 and 42 ft bgs. Note that MTBE results from the December 2002 LTM monitoring well sampling event conducted in conjunction with the Petroleum Spill Site Apron 1 were also used to delineate the limits of this plume, and are shown in Figure 4-2.

As discussed in Section 4.2.2 above, the source area for the larger MTBE plume does not appear to be related to Manhole 15/the Nosedocks Wash Waste System. The observation that the larger MTBE is confined to the south side of the main chlorinated plume, and the non-detect MTBE results for upgradient well 782VMW-99 in particular, suggest that the source area is probably related to former Building 7001. The source area for the smaller MTBE plume may be the former trench fire area associated with the Nosedocks 1 and 2 AOC, or the former jet fuel pipeline associated with Apron 1. These plumes are being investigated separately under the Petroleum Spill Sites LTM Program (FPM, 2002) (Building 7001 and Aprons 1 and 2).

4.6 GEOCHEMICAL INDICATORS

Groundwater samples collected during the RI were also analyzed for the following geochemical indicator parameters: nitrate, total (ferric and ferrous) and dissolved (ferrous [Fe^{2+}]) iron (the latter which was measured in the field using a Hach® kit), sulfate, sulfide, methane/ethane/ ethene, chloride, alkalinity, and total organic carbon. These parameters can be used to document if the groundwater conditions support biological degradation processes, particularly chlorinated hydrocarbon biodegradation. These parameters help to identify if groundwater conditions are aerobic or anaerobic, and to indicate what mechanisms may be working to assist in the biodegradation of remaining site contamination. For these purposes, monitoring wells 782VMW-98 and -99 were considered upgradient/background wells, since chlorinated hydrocarbons were reported below detection limits at both locations. The results for all parameters are shown in Table 4-8. Unless otherwise stated, the results between the 2002 and 2003 sampling rounds were generally consistent and did not indicate any major change in subsurface geochemical conditions.

Table 4-8
Geochemistry Results, Permanent Well Sampling
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Well ID	Sampling Date	Nitrate (mg/L)	Total Iron (mg/L)	Dissolved iron (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Chloride (mg/L)	Alkalinity (mg/L)	TOC (mg/L)
782VMW-76	2/26/2002	U	3.4	2.0	1.04	U				38.77	321	3.19
	2/4/2003	0.081	7.46	3.1	33.2	U				32.2	250	4.4
782VMW-77	2/26/2002	0.43 F	9.2	4.2	13.58	U				2.37	455	3.67
	2/5/2003	0.79	26.1	N/A	11.20	U				3.20	374	7.0
782VMW-78	2/26/2002	U	2.9	2.3	5.75	U				57.01	247	3.20
	1/31/2003	U	5.18	0.0	8.3	U				85.1	206	1.9
782VMW-80	2/22/2002	0.13 F	5.1	2.7	6.37	U				10.71 R	365	2.24
	2/3/2003	U	4.6 M	3.8	15.10	U				19.20	272	2.8
782VMW-81	2/21/2002	U	1.4	0.85	3.77	U	431.1	3.3 F	4.8 F	62.18 R	210	9.90
	1/30/2003	U	1.7 M	1.4	4.0	U				100	188	1.2
782VMW-82	2/22/2002	0.17 F	3.7	2.0	11.18 R	U				118.69 R	162	1.63
	1/30/2003	U	3.28	2.0	8.6	U				95	159	1.3
782VMW-83	2/28/2002	0.43 F	0.922	N/A	103.68 R	U				N/A	312	2.54
	2/4/2003	0.33	0.234	0.0	11.5	U				66.4	243	2.2
782VMW-84	2/21/2002	0.14 F	16.9	5.2	0.41 F	U	1031.9	0.69 F	U	44.97	315	15.87
	2/6/2003	U	17.1	7.4	2.9	U				44.0	269	7.1
782VMW-85	2/25/2002	0.15 F	14.8 J	3.6	0.28 J	U				81.07	340	N/A
	1/31/2003	U	17.7	2.9	3.2	U				124	243	3.6
782VMW-86	2/25/2002	U	30.1 J	4.4	0.46 J	U				105.09	333	N/A
	2/4/2003	U	19.1	3.8	61.9	U				146	254	8.0
782VMW-87	2/27/2002	0.14 F	22.1	7.0	0.16 J	U				28.17	252	8.33
	2/6/2003	U	23.3	6.1	3.0	U				21.0	320	8.1
782VMW-88	2/27/2002	0.14 F	12.2	3.3	0.15 J	U				32.68	323	7.38
	2/5/2003	U	13.2 M	6.9	2.70	U				50.60	422	7.3
782VMW-89	2/25/2002	0.15 F	16.2 J	3.8	0.14 J	U				58.83	321	N/A
	2/4/2003	U	20.0	5.1	56.6	U				65.6	242	5.7
782VMW-90	2/25/2002	U	35.7 J	4.8	0.25 J	U				50.38	294	N/A
	2/4/2003	U	34.3	5.1	21.2	U				112	201	9.1
782VMW-91	2/28/2002	U	44.8	3.8	40.37	U				U	514	12.72
	2/7/2003	U	41.6	4.0	52.8	U				168	484	10.1
782VMW-92	2/26/2002	0.15 F	18.3	N/A	0.24 F	U				19.12	372	5.10
	2/6/2003	U	18.7	4.8	2.0	U				30.1	284	6.4
782VMW-93	2/26/2002	0.14 F	7.1	2.4	0.46 F	U				26.57	309	4.62
	2/3/2003	U	6.0	4.5	10.50	U				27.70	241	4.4
782VMW-94	2/26/2002	U	3.0	0.4	0.14 F	U				174.80	243	3.78
	2/3/2003	U	1.2	1.0	2.80	U				228	185	2.5
782VMW-95	2/25/2002	0.14 F	5.1 J	2.5	4.84 J	U				55.34	329	N/A
	1/31/2003	U	14.5 M	2.4	2.2	U				34.4	263	4.3
782VMW-96	2/21/2002	0.15 F	5.6	2.8	0.24 F	U	609.9	1.8 F	U	29.83	310	4.07
	2/6/2003	0.062	3.84	3.8	2.9	U				26.5	247	4.5
782VMW-97	2/22/2002	0.82 F	0.1 F	0.0	12.45 R	U				14.19 R	257	2.17
	1/31/2003	2.4	U	0.0	9.1	U				21.0	211	2.5
782VMW-98	2/20/2002	1.48	0.1 J	0.0	10.83	1.800	6.8	U	U	17.69	209	0.90 F
	1/30/2003	1.2	0.063 F	0.0	5.1	U	6.8	U	U	25.9	166	U
782VMW-99	2/22/2002	0.69 F	0.6	0.0	9.83	U				43.18 R	147	7.08
	1/31/2003	2.2	0.566	0.0	10.8	U				50.2	232	1.2
782VMW-100	2/28/2002	U	3.5	0.0	25.37 R	U				2.19	174	2.61
	2/7/2003	U	5.26	0.0	11.7	U				27.8	166	2.7
782VMW-101	2/20/2002	0.13 F	11.8 J	4.3	0.74 F	U	8536.2	7.6	U	7.85	311	5.03
	1/30/2003	U	6.59	3.0	1.20	U				3.8	190	2.8
782VMW-102	2/20/2002	U	9.3 J	4.0	0.09 F	U	10428.9	U	0.89 F	24.77	377	5.61
	1/30/2003	U	11.3	5.0	U	U				15.5	271	4.5
782VMW-104	2/22/2002	0.16 F	20.7	3.1	6.67	U				4.36 R	255	3.73
	1/30/2003	U	21.7	3.4	4.6	U				24.6	194	3.6
782VMW-105B	2/21/2002	0.68 F	2.9	0.0	12.98	U	111.0	1.4 F	1.5 F	56.78	243	1.71
	1/30/2003	0.90	23.5	0.0	7.8	U				48.2	183	1.5
AP2MW-3	2/27/2002	U	13.7	4.3	0.08 J	U				22.14	360	6.76
	2/7/2003	U	13.8	6.0	2.6	U				27.5	288	5.8
782MW-6D	2/27/2002	0.16 F	10.4	2.6	0.09 J	U				124.98	250	3.07
	1/30/2003	U	11.4	4.2	U	U				216	202	3.1
782MW-6R2	2/27/2002	U	20.7	4.8	2.74 J	U				51.37	289	6.21
	2/4/2003	U	21.9	6.1	8.8	U				144	208	8.3
782MW-10	2/28/2002	0.35 F	15.8	2.8	8.57	U				34.38 R	289	5.17
	2/6/2003	U	41.8	4.0	15.8	U				42.4	233	10
786MW-30	2/10/2003	U	2.01 M	N/A	11.3	U				3.8	149	1.3

Notes:
U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.
F-The analyte was detected above the MDL but below the RL.
J - The analyte was positively identified, the quantitation is approximate.
R-The analyte was analized for, but the result was rejected.
N/A - Not available.

4.6.1 Nitrate

Nitrate levels were less than 1 mg/L at all wells across the plumes, ranging from <0.01 to 0.9 mg/L, with the exception of 782VMW-97, where nitrate was measured at 2.4 mg/L during the February 2003 sampling round. The highest nitrate levels were generally measured in upgradient/background wells 782VMW-98 and -99. The absence of nitrate in the plume wells suggests biological activity associated with nitrate reduction has consumed the available nitrate in the areas affected with relatively higher levels of chlorinated compounds.

4.6.2 Total and Dissolved Iron

Total iron is a measure of both ferric and ferrous (or dissolved) states of iron. Significantly higher levels of both total iron and ferrous were measured in the within-plume wells relative to the upgradient/background wells, with total iron levels generally ranging from 1.4 mg/L at 782VMW-81 to 44.8 mg/L at 782VMW-91, and dissolved iron detected above 0.4 mg/L at all wells except for 782VMW-100, -105B, and -97 (which also showed the lowest total iron levels). During the 2002 sampling round, no ferrous iron reading was collected for 782VMW-83, but was measured at 0.0 mg/L during the 2003 sampling round (and at location 782VMW-78). In some cases, higher total iron levels correlated with high sample turbidity levels (e.g., 782VMW-86 and -90). Background/ upgradient well 782VMW-98 and -99 reported total iron levels of 0.1 and 0.6 mg/L, respectively; neither well reported any ferrous iron. Ferrous iron levels between 3.4 and 3.8 mg/L were recorded at groundwater seepage locations 782SW-114, -116, and -117. The presence of ferrous iron above background levels is indicative of anaerobic consumption of organic carbon via iron reduction. It is interesting to note that this activity is not suggested at wells associated with the suspected source area, the former Nosedocks Washwaste System (i.e., wells 782VMW-97 and -105b), where TCE has been detected.

4.6.3 Sulfate/Sulfide

Sulfate was observed at elevated (i.e., above 10 mg/L) concentrations in the wells closer to the source area, including locations 782VMW-80, -83, -97, -98, -99, and -105b (during at least one sampling round). In the wells within the chlorinated plumes further downgradient, generally northeast of 782VMW-76, sulfate levels were generally lower than 1 mg/L. These higher concentrations of sulfate in upgradient wells represent a “geochemical reservoir” of alternate electron acceptors available to promote the degradation of organic carbon under anaerobic conditions. The relatively low levels of sulfate at the contaminated wells further downgradient reflect its “use” during anaerobic respiration. Sulfate levels above 20 mg/L outside of the source area were reported at locations mainly outside the plume boundaries – 782VMW-86, -89, and -91. Significant levels of sulfide were not reported in any within-plume wells, and sulfide was reported above the detection limit in 782VMW-98 only (1.8 mg/L).

4.6.4 Methane/Ethane/Ethene

Samples were submitted for methane/ethane/ethene for a limited number of wells during the 2002 sampling event only, including upgradient well 782VMW-98, within-plume wells 782VMW-105b, -81, -84, and -96, and downgradient wells 782VMW-101 and -102 (as listed in Table 2-1). Methane was detected only at trace levels at upgradient well 782VMW-98 (6.8 µg/L), but was measured at all within-plume and downgradient wells within the range from 111 µg/L up to 10.4 mg/L (at 782VMW-102). Ethene was reported non-detect at two locations 782VMW-98 (upgradient) and 782VMW-102 (crossgradient). Ethene was reported above the detection limit but below the reporting limit at four wells – 782VMW-81, -84, -96, and -105B – and at 7.6 µg/L at 782VMW-101. Ethane was reported above the detection limit but below the reporting limit at three locations – 782VMW-81, 102, and -105B. These results suggest that the reductive dechlorination process is working to reduce concentrations of chlorinated hydrocarbons in the subsurface.

4.6.5 Chloride

Compared to the chloride range reported for crossgradient wells during the 2002 sampling round 782VMW-77 (2.36 mg/L) and -91 (<0.01 mg/L), the chloride concentrations were generally higher at wells within the chlorinated plumes, with highest levels (above 100 mg/L) recorded at wells 782VMW-81, -82, -85, -86, -90, -91, -94, 782MW-6D, and 782MW-6R2. (Below-average chloride concentrations were also reported at upgradient well 782VMW-98.) The elevated chloride concentrations observed in wells associated with elevated chlorinated hydrocarbon levels suggests reductive dechlorination processes may have occurred, although higher chloride concentrations were not found at every within-plume well. Because the initial concentration of chlorinated hydrocarbons was initially low (as evidenced by the daughter product concentrations below 100 µg/L), it is possible that the dechlorination process of chlorinated hydrocarbons may not generate enough chloride to impact the groundwater in upgradient/near-source wells relative to downgradient wells (Wiedemeier et al., 1996).

4.6.6 Alkalinity

Compared to the alkalinity range reported for background, upgradient, and crossgradient wells— 786MW-30, 782VMW-81, -82, -98, -99, and -100 — (from 147 to 210 mg/L), alkalinity was somewhat higher at wells within the chlorinated plumes, and increased with distance from the source area (ranging from 243 to 514 mg/L). The elevated alkalinity observed in wells within the plumes suggests that active biodegradation has occurred. However, the alkalinity levels may be somewhat dissipated by the production of methane from carbon dioxide in the predominantly methanogenic environment in the downgradient extent of the plumes. It is also possible that due to low concentrations of initial chlorinated hydrocarbons, the biodegradation of organic compounds may not generate enough acid to impact the alkalinity of the groundwater (Wiedemeier et al., 1996).

4.6.7 Total Organic Carbon

Upgradient wells, wells outside of the plume (782VMW-82 and -100), and wells nearest the source area show generally lower TOC concentrations ranging from non-detect at 782VMW-98 to 2.7 mg/L at 782VMW-100 (during the 2003 sampling round). These low concentrations likely reflect primarily native organic carbon, or a depletion of TOC following anaerobic dechlorination activity. Wells further downgradient and within the plume had elevated TOC concentrations ranging from 1.9 mg/L at 782VMW-78 to 10 mg/L at 782MW-10, and reflect the presence of both natural and anthropogenic carbon sources.

4.7 FIELD PARAMETERS

Field parameter data collected during the RI are included in Table 4-9 and are summarized in the following sections.

4.7.1 Dissolved Oxygen (DO)

DO in within-plume wells ranged from 0.4 to 5.1 mg/L. For comparison, DO was reported at 782VMW-98 and -99 at 3.04 and 3.12 mg/L (2002) and 4.46 and 4.86 mg/L (2003), respectively. The relatively high DO level at 782VMW-83 (8.41 mg/L) can be attributed to the fact that it was sampled using a peristaltic pump instead of a bladder pump; the negative displacement on groundwater by the peristaltic pump can contribute to increased DO readings.

4.7.2 pH

Hydrocarbon-degrading microbes are active within a pH range of 6 to 8 standard units (s.u.). Based upon field pH data collected since September 1995, site conditions are within this range (from 6.32 [782VMW-87] to 7.90 [782VMW-94], 2002 sampling readings). The relatively high pH (12.25) at 782VMW-99 may be indicative of leakage of cement through the well screen. Some readings during 2003 were also relatively high (above 9) at 782VMW-78, -85, -86, -89, -90, -95, and AP2MW-3). Except for 782VMW-78, these locations are associated with the former trench fire/drainage swale area and exhibit petroleum-related contamination; alternatively, these values may be associated with a positive bias with the pH meter. No significant difference in pH was observed in background well 782VMW-98 relative to affected wells.

Table 4-9
Field Parameters Results, Permanent Well Sampling
Nosedocks/Apron 2 Chlorinated Plume, Griffiss AFB

Well ID	Sampling Date	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/cm)	Redox (mV)	Temperature (°C)	Turbidity (NTU)
782VMW-76	2/26/2002	0.82	7.00	670	-135	13.01	28.8
	2/4/2003	5.08	7.15	442	-53	6.30	123.0
782VMW-77	2/26/2002	0.82	6.76	797	-94	11.11	423.0
	2/5/2003	2.47	6.82	634	115	3.60	979.0
782VMW-78	2/26/2002	0.79	6.89	620	-170	12.35	162.0
	1/31/2003	4.83	9.71	497	-119	11.80	87.6
782VMW-80	2/22/2002	0.56	7.21	663	-115	9.79	231.0
	2/3/2003	0.67	6.85	481	-9	10.93	48.2
782VMW-81	2/21/2002	0.89	7.62	550	-190	12.04	138.0
	1/30/2003	1.43	7.66	473	-35	10.64	90.8
782VMW-82	2/22/2002	0.63	7.27	691	-176	9.47	115.0
	1/30/2003	3.69	8.73	491	-126	10.80	143.0
782VMW-83	2/28/2002	8.41	7.01	859	89	7.23	327.0
	2/4/2003	0.83	7.28	482	62	10.10	19.6
782VMW-84	2/21/2002	0.46	7.09	693	-133	12.42	50.9
	2/6/2003	1.52	6.87	594	-46	11.28	14.2
782VMW-85	2/25/2002	0.82	6.74	809	-132	11.96	116.0
	1/31/2003	0.84	9.36	645	-103	10.30	46.1
782VMW-86	2/25/2002	0.62	6.69	990	-121	10.98	999.0
	2/4/2003	1.10	9.42	692	-99	9.60	167.0
782VMW-87	2/27/2002	0.70	6.32	765	-115	9.31	136.0
	2/6/2003	0.63	6.84	609	-91	10.34	-10.0
782VMW-88	2/27/2002	0.78	6.45	675	-109	10.39	173.0
	2/5/2003	0.88	6.78	565	-30	8.38	99.1
782VMW-89	2/25/2002	1.04	6.77	785	-126	11.18	109.0
	2/4/2003	0.95	9.42	522	-111	9.80	57.6
782VMW-90	2/25/2002	0.82	6.42	706	-116	11.74	999.0
	2/4/2003	0.60	9.12	568	-106	11.70	51.8
782VMW-91	2/28/2002	2.31	6.48	1270	-89	2.95	285.0
	2/7/2003	0.80	6.73	1730	-109	10.42	-2.3
782VMW-92	2/26/2002	0.91	6.59	777	-135	13.00	234.0
	2/6/2003	0.63	6.83	596	-62	12.05	188.0
782VMW-93	2/26/2002	2.14	7.02	614	-134	12.46	262.0
	2/3/2003	0.92	7.16	437	-63	10.39	88.0
782VMW-94	2/26/2002	0.56	7.90	1220	-257	12.23	137.0
	2/3/2003	0.95	7.72	747	-71	9.88	15.5
782VMW-95	2/25/2002	0.56	6.59	818	-131	11.64	88.6
	1/31/2003	0.58	9.52	480	-127	12.00	82.2
782VMW-96	2/21/2002	1.12	7.20	613	-103	11.31	188.0
	2/6/2003	2.05	7.05	495	35	8.73	22.7
782VMW-97	2/22/2002	0.72	7.19	519	19	11.25	67.9
	1/31/2003	3.66	6.63	389	141	12.60	40.3
782VMW-98	2/20/2002	3.12	7.24	490	79	13.56	-10.0
	1/30/2003	4.46	8.15	343	206	11.50	114.0
782VMW-99	2/22/2002	3.04	12.25	1420	-108	9.11	324.0
	1/31/2003	4.86	6.97	443	100	10.10	88.8
782VMW-100	2/28/2002	3.42	6.97	386	26	2.29	659.0
	2/7/2003	5.26	7.19	329	385	4.09	303.0
782VMW-101	2/20/2002	0.42	6.83	615	-131	9.49	123.0
	1/30/2003	2.70	7.85	333	-70	8.10	109.0
782VMW-102	2/20/2002	0.35	6.93	794	-124	9.94	48.3
	1/30/2003	2.40	7.91	510	-76	10.20	712.0
782VMW-104	2/22/2002	0.79	7.00	486	-126	11.58	101.0
	1/30/2003	2.34	6.89	440	-42	9.90	142.0
782VMW-105B	2/21/2002	0.69	7.45	665	3	12.66	462.0
	1/30/2003	0.93	7.31	463	95	12.03	>1000
AP2MW-3	2/27/2002	0.75	6.53	715	-106	10.11	122.0
	2/7/2003	0.70	9.68	531	-111	10.20	-5.2
782MW-6D	2/27/2002	0.63	6.77	865	-125	10.71	224.0
	1/30/2003	2.12	8.08	805	-100	12.30	84.0
782MW-6R2	2/27/2002	0.43	6.71	722	-135	11.50	242.0
	2/4/2003	0.40	6.66	613	-72	10.45	9.9
782MW-10	2/28/2002	0.74	6.62	650	-122	11.59	28.0
	2/6/2003	5.98	6.83	572	-94	13.41	186.0

4.7.3 Temperature

Site groundwater temperatures ranged from 7.23 to 13.56°C (2002) and 3.6 to 12.6°C (2003). This temperature ranges would not inhibit biodegradation. The solubility of DO is also temperature-dependent, with oxygen being more soluble in cold than in warm water. Two exceptions of particularly cold temperature were recorded in 2002 at 782VMW-91 and -100, at 2.95 and 2.29°C, respectively (these locations also exhibited higher DO concentrations relative to neighboring wells, 2.31 and 3.42 mg/L, respectively). The groundwater at 782VMW-91 is outside of the plumes and the well is screened across a relatively shallower interval than the other wells; the groundwater at 782VMW-100 is also shallow.

4.7.4 Specific Conductance

Specific conductance is a measure of a groundwater's ability to conduct electricity. As the concentration of ions in solution increases, the specific conductance increases. Typically, more affected wells (i.e., containing high levels of contaminants) exhibit higher specific conductances than less affected wells. The specific conductances for 782VMW-98 and -100, for example, were 490 and 386 µS/cm, respectively, while those wells occurring within the plume generally exhibited conductances averaging approximately 700 µS/cm. The relatively high specific conductance at 782VMW-99 (1,420 µS/cm) may also indicate potential bentonite encroachment through the screen.

4.7.5 Redox (Reduction/Oxidation Potential)

Redox levels were generally negative within and adjacent to the chlorinated plumes, indicating a reduced environment resulting from anaerobic degradation activity (see Section 5.1.1.1.1 for an explanation). Upgradient and source area wells exhibited relatively higher (positive) redox levels, including 782VMW-97, -98, -99, and -105b. Negative redox levels were also recorded at groundwater/seepage locations 782SW-114, -116, and -117, ranging from -77 to -115 mV, and at surface water sampling locations 782SW-115, -118, -119, and -120, ranging from -7 to -47 mV (2002). Positive redox levels were recorded only in the following groundwater monitoring wells – 782VMW-77, -83, -96, -97, -98, -99, -100, -105B. The relatively high redox level at 782VMW-83 can be attributed to the fact that the groundwater was collected in an open cup using a negative-displacement peristaltic pump, whereas all other samples from permanent monitoring wells for field parameters measurement were collected in a closed cup using a positive-displacement bladder pump. Exposure of the groundwater to atmospheric air tends to aerate the groundwater during measurement of the field parameters. It should be noted, however, that the peristaltic pump was used strictly to purge monitoring well 782VMW-83 prior to sample collection. The bottles of groundwater samples from 782VMW-83 submitted to the laboratory for analysis were filled by removing the sample tubing *prior* to the groundwater reaching the peristaltic pump head, limiting backflow, and then slowly releasing the pressure so that the bottles could be filled by gravity flow.

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5.0 CONTAMINANT FATE AND TRANSPORT

This section summarizes the physical and chemical characteristics of the site that are used to define the site conceptual model, including source materials, potential routes, and mechanisms for migration of contaminants through each environmental medium (i.e., soil, groundwater, and surface water). Because of the varied nature and distribution of chlorinated compounds, they are typically difficult to locate, delineate and remediate with active measures.

5.1 FATE AND TRANSPORT OF CHLORINATED HYDROCARBONS

The chlorinated hydrocarbon volatile organic compounds identified in the groundwater at concentrations greater than potential ARARs include TCE; cis-1,2-DCE; vinyl chloride; and trans-1,2-DCE. The latter three compounds are typical intermediate degradation products that can be produced during the reductive dechlorination of TCE under anaerobic conditions (although the percent production of cis-DCE is much higher than trans-DCE for biodegradation).

Based on the results of a survey conducted among several (at least 15) studies, the median half-lives of these chlorinated compounds encountered in the subsurface are as follows: TCE, 201 days (based on 56 studies, with five indicating recalcitrance); DCE (all isomers), 234 days (based on 44 studies, with none indicating recalcitrance); VC, 80 days (based on 15 studies, with none indicating recalcitrance) (Suarez, Monica P. and Hanadi S. Rifai, *Biodegradation Rates for Fuel Hydrocarbons and Chlorinated Solvents in Groundwater*, Bioremediation Journal 3(4):337-362, 1999). These results are most likely influenced by the fact that most sites included in the study show accumulation of cis-DCE (i.e., the anaerobic reductive dechlorination process stops at cis-DCE and does not continue to vinyl chloride and ethene). The decay rates, or half-lives, for these chemicals are also highly site-specific due to varying amounts of contaminant concentrations and appropriate bacteria, both temporally and spatially. For this site, the groundwater results indicate that reductive dechlorination processes are continuing through ethene, albeit slowly from accumulated concentrations of vinyl chloride.

Vinyl chloride and its parent COCs were found dissolved in the groundwater only, at concentrations indicating no free product. Chlorinated hydrocarbon compounds can occur as DNAPLs in their pure states such that they tend to sink through the groundwater column toward the bottom of the aquifer. The concentrations encountered across the site did not necessarily increase with depth, and indicated that the source area was small, and that perhaps the parent compound, TCE, dissolved completely into the groundwater phase before sinking to the bottom of the aquifer.

Vertical and horizontal transport in the aqueous phase of the soil-water interface is a possible transport process. As a class, volatiles exhibit a wide range of solubility in water. Organic chemicals move in the groundwater system by advection and dispersion, and transport is retarded by adsorption, hydrophobic partitioning and biological and chemical degradation. All of these factors influence the direction and rate of transport as well as the ultimate fate of organic contaminants in a groundwater system. Site COCs can be transported in the direction of groundwater flow, and could reach Six Mile Creek via groundwater discharge. Once reaching the creek, partitioning into sediment may occur by adsorption, into surface water by dissolution, and into air by volatilization. Biodegradation processes can also occur. Generally, VOCs have a low potential for bioaccumulation in aquatic systems. There is little potential for off-site migration of these compounds in surface water, as discussed in Section 4.5.

The groundwater VOC and geochemistry results (discussed is Section 4.6 and 4.7) indicate that anaerobic conditions are favorable for reductive dechlorination processes, and that these processes are actively working to reduce site concentrations of chlorinated solvents. DCE produced biologically by the reductive dechlorination of TCE is almost 100% cis-DCE, whereas manufactured DCE is mostly 1,1-DCE and only contains 10-20% cis-DCE. The results overwhelmingly indicate the presence of cis-DCE and minimal, if any, concentrations of 1,1-DCE across the length of the plume, and provide evidence that intrinsic in-situ reductive dechlorination is a major degradative pathway governing the fate of TCE at this site. The dissolved total organic carbon (TOC) levels observed across the site, though not extremely high, support a hypothesis that (non-toxic) organic matter (or perhaps the co-contaminant, MTBE and/or its petroleum-related constituents which may have degraded) is present in the aquifer to serve as an electron donor or a cosubstrate for the biodegradation of the chlorinated compounds present in the plume.

5.1.1 BIOCHLOR Groundwater Simulations

BIOCHLOR is a screening model developed through AFCEE to simulate natural attenuation based on the Domenico analytical solute transport model, and simulates 1-D advection, 3-D dispersion, linear adsorption, and biotransformation via reductive dechlorination. Although this model was developed for the purposes of simulating natural attenuation, BIOCHLOR shall be used in this instance to simulate fate and transport processes, and to specifically confirm that biodegradation processes are especially working to decrease chlorinated solvent compound concentrations across the length of the plume compared to physical transport processes only.

To help demonstrate the impact of biodegradation on the fate and transport of the observed dissolved chlorinated solvent compounds at the Nosedocks/Apron 2, BIOCHLOR was used to simulate solute transport with biotransformation for two scenarios:

- Simulation A: No biodegradation
- Simulation B: Includes biodegradation, at rates relatively similar to those observed from field data

For simulation B, the field data used for comparison was the 2002 monitoring well data for the northern part of the main plume, which is probably electron donor- (or cosubstrate-) limited. The wells included were starting at the source area at 782VMW-81, followed by 782VMW-78, -93, -84, and extending to 782VMW-88; this pathway is depicted in Figure 5-1. The southern part of the main plume, which commingles with MTBE, was not included in the simulation since the presence of MTBE may influence biodegradation rate coefficients, or the bacterial composition and/or population in the subsurface. Also, the available data for both the southern part of the main plume and the northern TCE/cis-DCE plume (near Building 782/Nosedock 1) were deemed insufficient for this effort.

The most simple version of the BIOCHLOR model employs one “reaction-zone,” which assumes a uniform set of decay rate coefficients across the entire length of the plume. This is simplistic since, for example, spatially-varying biodegradation constants (such as those employed when using a two reaction-zone model) may be dependent upon the presence or absence of the appropriate bacteria across the length of the plume (i.e., bacteria capable of reductively dechlorinating VC may not be present in the upgradient portion of the plume where TCE is found). Alternatively, there may be an excess of fermentable substrates close to the source area, enabling rapid biotransformation, but comparatively slower biotransformation further downgradient where fermentable substrates have been depleted. Nevertheless, the one reaction-zone model was chosen for Simulation B to avoid multiple unknown variables.

In general, the BIOCHLOR model makes the following simplifying assumptions:

(1) It assumes simple groundwater flow conditions (the model does not allow for vertical flow gradients);
(2) It assumes uniform hydrogeologic and environmental conditions over the entire model area (i.e., the model does not account for microzones of various soil types, hydraulic conductivities, etc.); and
(3) It assumes a vertical plane source area of constant concentration, but does allow for source area decay. Some source area decay was accounted for in Simulation B, since the source area at 782VMW-81 has exhibited levels of both TCE and the daughter product, cis-DCE.

These simplifications notwithstanding, BIOCHLOR was used to conservatively simulate contaminant fate and transport at the Nosedocks/Apron 2 vicinity.

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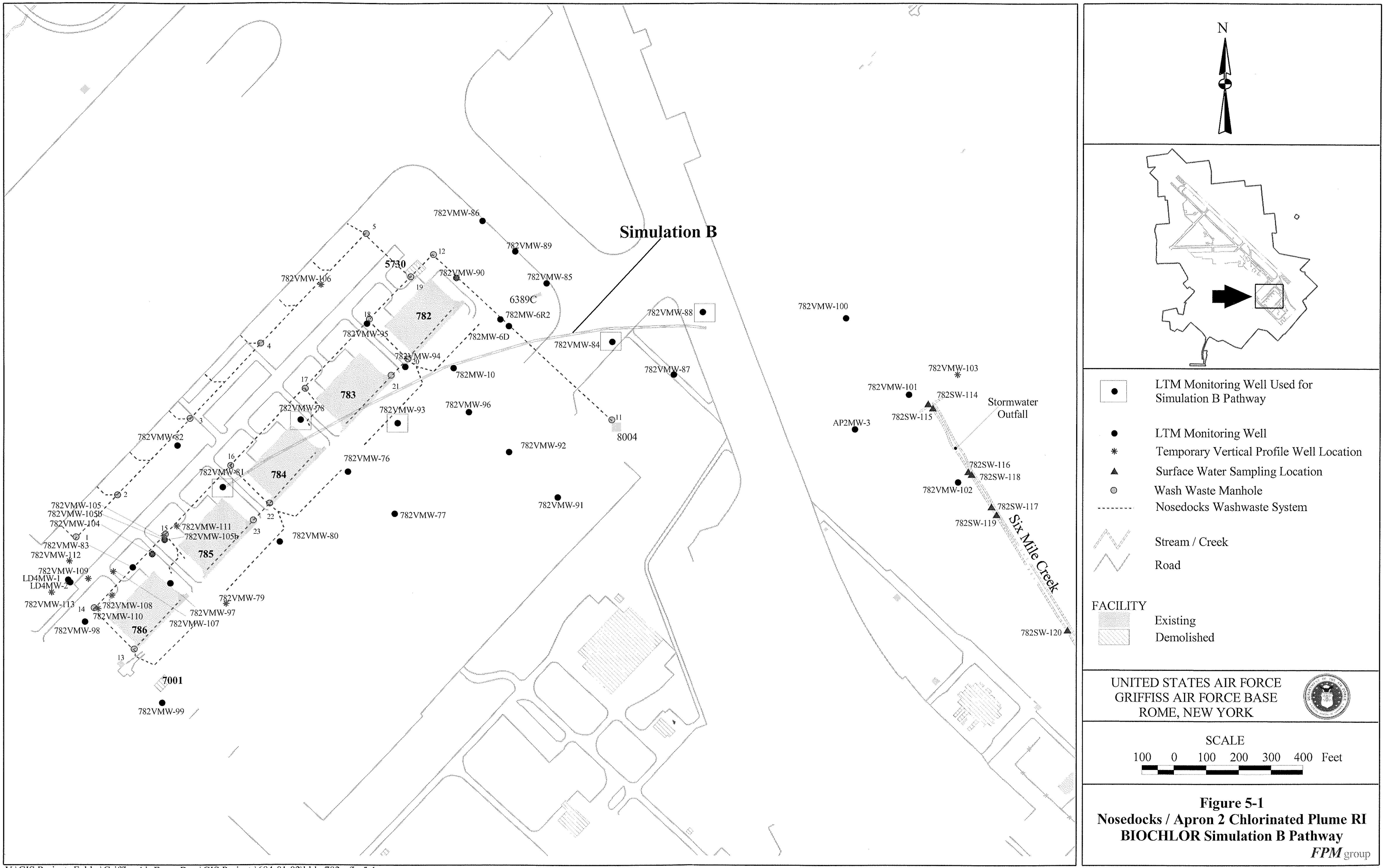

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Figure 5-1
Nosedocks / Apron 2 Chlorinated Plume RI
BIOCHLOR Simulation B Pathway

FPM group

5.1.1.1 Reductive Dechlorination Screening Protocol

To test for the appropriateness of using BIOCHLOR to predict plume migration rates and extent, BIOCHLOR incorporates a checklist of the factors to consider to confirm that biodegradation is indeed occurring. The checklist includes a scoring system that requires concentrations of electron acceptors, parent and daughter chlorinated solvents, methane, TOC, chloride, and redox, temperature, and pH measurements. These data are evaluated based on whether or not they are characteristic of the reductive dechlorination biotransformation process, and a total score above 20 signifies "strong evidence for anaerobic biodegradation of chlorinated organics." By inputting the results from the RI Nosedocks/Apron 2 Chlorinated Plume 2002 sampling event, the site yielded a score of 26. The score sheet is provided as Figure 5-2. Based on this evidence, it was deemed appropriate to proceed with using the BIOCHLOR screening tool for simulation purposes. The following section describes the geochemical parameters and field parameters as they are expected to vary in the presence of active reductive dechlorination pathways.

5.1.1.2 Geochemical Parameters for Reductive Dechlorination

Microorganisms obtain energy for cell production and maintenance by catalyzing the transfer of electrons from electron donors to electron acceptors. This process results in the oxidation of the electron donor (which, during aerobic respiration, is often the contaminant of concern), and the reduction of the electron acceptor. In most scenarios, dissolved oxygen (DO) is the primary electron acceptor. After DO is consumed, anaerobic microorganisms generally use electron acceptors in the following order of preference – nitrate, ferric iron, sulfate, and carbon dioxide (AFCEE Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater, Wiedemeier et al., 1996). During reductive dechlorination, dechlorinating microorganisms use the chlorinated hydrocarbon as an electron acceptor, not as a source of carbon, and hydrogen is used as the electron donor. Reductive dechlorination has been demonstrated under nitrate- and iron-reducing conditions, but the most rapid biodegradation rates, affecting the widest range of chlorinated aliphatic hydrocarbons, occur under sulfate-reducing and methanogenic conditions. Anaerobic destruction of chlorinated hydrocarbons is thus associated with the depletion of these competing electron acceptors, thus, the reduction of nitrate, solubilization of iron, reduction of sulfate, and production of methane.

Oxygen is the most thermodynamically preferred electron acceptor and is normally depleted in areas with relatively higher chlorinated hydrocarbon concentrations. The range of values observed in the affected areas across the site indicates anaerobic to weakly aerobic conditions, and was measured in 2002, for example, at less than 1 mg/L at several locations across the length of the chlorinated plume.

Figure 5-2
BIOCHLOR Biodegradation Assessment Scoring Sheet

Biodegradation Screening Protocol

The following is taken from the USEPA protocol (USEPA, 1998). The results of this scoring process have no regulatory significance.

Interpretation	Score
Inadequate evidence for anaerobic biodegradation* of chlorinated organics	0 to 5
Limited evidence for anaerobic biodegradation* of chlorinated organics	6 to 14
Adequate evidence for anaerobic biodegradation* of chlorinated organics	15 to 20
Strong evidence for anaerobic biodegradation* of chlorinated organics	>20

* reductive dechlorination

Score: 26

Scroll to End of Table

Analysis	Concentration in Most Contam. Zone	Interpretation	Yes	No	Points Awarded
Oxygen*	<0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations	●	○	3
	>5mg/L	Not tolerated; however, VC may be oxidized aerobically	○	●	0
Nitrate*	<1 mg/L	At higher concentrations may compete with reductive pathway	●	○	2
Iron II*	>1 mg/L	Reductive pathway possible; VC may be oxidized under Fe(III)-reducing conditions	●	○	3
Sulfate*	<20 mg/L	At higher concentrations may compete with reductive pathway	●	○	2
Sulfide*	>1 mg/L	Reductive pathway possible	○	●	0
Methane*	<0.5 mg/L	VC oxidizes	○	●	0
	>0.5 mg/L	Ultimate reductive daughter product, VC Accumulates	●	○	3
Oxidation Reduction Potential* (ORP)	<50 millivolts (mV)	Reductive pathway possible	●	○	1
	<-100mV	Reductive pathway likely	●	○	2
pH*	5 < pH < 9	Optimal range for reductive pathway	●	○	0
	5 > pH >9	Outside optimal range for reductive pathway	○	●	0
TOC	>20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	○	●	0
Temperature*	>20°C	At T >20°C biochemical process is accelerated	○	●	0
Carbon Dioxide	>2x background	Ultimate oxidative daughter product	○	○	0
Alkalinity	>2x background	Results from interaction of carbon dioxide with aquifer minerals	○	●	0
Chloride*	>2x background	Daughter product of organic chlorine	●	○	2
Hydrogen	>1 nM	Reductive pathway possible, VC may accumulate	○	○	0
	<1 nM	VC oxidized	○	○	0
Volatile Fatty Acids	>0.1 mg/L	Intermediates resulting from biodegradation of aromatic compounds; carbon and energy source	○	○	0
BTEX*	>0.1 mg/L	Carbon and energy source; drives dechlorination	●	○	2
PCE*		Material released	○	●	0
TCE*		Material released	●	○	0
		Daughter product of PCE [a/]	○	●	0
DCE*		Material released	○	●	0
		Daughter product of TCE. If cis is greater than 80% of total DCE it is likely a daughter product of TCE[a/]; 1,1-DCE can be a chem. reaction product of TCA	●	○	2
VC*		Material released	○	●	0
		Daughter product of DCE[a/]	●	○	2
1,1,1-Trichloroethane*		Material released	○	●	0
DCA		Daughter product of TCA under reducing conditions	○	●	0
Carbon Tetrachloride		Material released	○	●	0
Chloroethane*		Daughter product of DCA or VC under reducing conditions	○	●	0
Ethene/Ethane	>0.01 mg/L	Daughter product of VC/ethene	●	○	2
	>0.1 mg/L	Daughter product of VC/ethene	○	●	0
Chloroform		Material released	○	●	0
		Daughter product of Carbon Tetrachloride	○	●	0
Dichloromethane		Material released	○	●	0
		Daughter product of Chloroform	○	●	0

* required analysis.

a/ Points awarded only if it can be shown that the compound is a daughter product (i.e., not a constituent of the source NAPL).

SCORE

Reset

End of Form

After the DO is consumed, nitrate is used as an alternate electron acceptor for anaerobic biodegradation of organic carbon via denitrification. In this process, nitrate (NO_3^-) is converted to nitrite (NO_2^-); therefore, nitrate depletion relative to background conditions can be an indication of biological activity. Furthermore, in the protocol, it states that for reductive dechlorination to occur, nitrate concentrations in the contaminated portion of the aquifer must be less than 1 mg/L (Wiedemeier et al., 1996). During either monitoring round, nitrate was measured above 1 mg/L in the upgradient wells only – 782VMW-98, -99, and 782VMW-97 (the latter of which can be considered upgradient to the southern plume degradation activity).

After DO and nitrate have been depleted by microbial activity, ferric iron (Fe^{3+}) is used as an electron acceptor during anaerobic biodegradation of organic carbon. Ferric iron is reduced to ferrous iron (Fe^{2+}), which is soluble in groundwater, and is therefore an indicator of microbial degradation activity. The presence of elevated total iron concentrations, typically observed in groundwater from wells affected by fuel compounds and/or vinyl chloride, suggests the solubilization of iron is occurring. The amount of ferrous iron produced is dependent on the concentration of bioavailable iron in the groundwater; areas with little to no bioavailable iron will not exhibit an increase in ferrous iron concentrations. During both monitoring rounds, ferrous iron was measured at levels above 1 mg/L in several within-plume wells, but less than 1 mg/L at wells in the source area (782VMW-81 [2002 only] and -105b), and upgradient wells (782VMW-98 and -99).

Sulfate is the next thermodynamically preferred alternate electron acceptor and is used by microbes once the oxygen, nitrate, and ferric iron have been depleted by anaerobic biodegradation. Sulfate is converted to sulfide in the subsurface during anaerobic biodegradation, often forming hydrogen sulfide gas, which produces a "rotten egg" odor. This process results in a depletion of sulfate and the production of sulfide. Sulfide may not always be detected in groundwater samples, however, because it commonly forms metal sulfide precipitates and falls out of solution. Concentrations of sulfate greater than 20 mg/L may result in competition for electron donor (hydrogen) between sulfate reducers and dechlorinators (Wiedemeier et al., 1996). During both monitoring rounds, sulfate was measured at levels less than 20 mg/L across the site, except for locations 782VMW-76 (2003 only), -83 (2002 only, and the sulfate result was associated with "R", indicating the result was rejected), -86 (2003 only), -89 (2003 only), -91, and -100 (2002 only). The latter four locations are outside the boundaries of the main, southern chlorinated plume. Sulfide was detected only in one upgradient well, 782VMW-98.

During methanogenesis, carbon dioxide is used as an electron acceptor, and is reduced to methane, or acetate is split to form carbon dioxide and methane. Methanogenesis occurs after oxygen, nitrate, bioavailable ferric iron, and sulfate have been depleted in the groundwater. The presence of methane dissolved in groundwater indicates highly reducing conditions, and is often characteristic of those conditions conducive for reductive dechlorination. In 2002, the methane concentrations increased directly with distance from the source area, with levels at 782VMW-

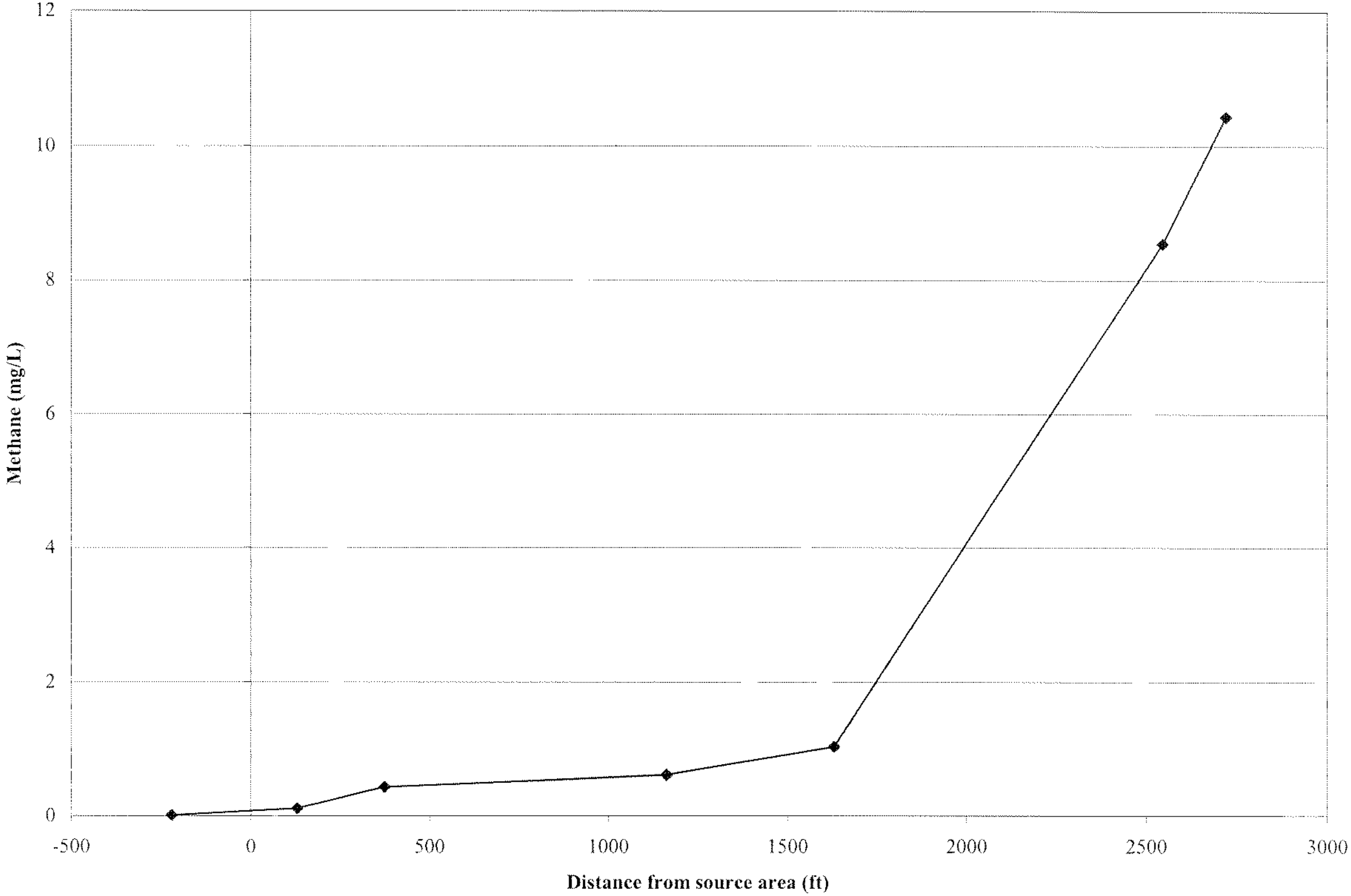
101 and -102 recorded at 8.5 mg/L and 10.4 mg/L, respectively (Figure 5-3). (Methane/ethane/-ethane analysis was not conducted for samples collected in 2003.) These results suggest that strongly reducing conditions are present in the subsurface, and may help to promote natural biodegradation of chlorinated hydrocarbons via reductive dechlorination.

The reduction of vinyl chloride to ethene is the last step in the reductive dechlorination pathway. Groundwater conditions indicating ethene production with simultaneous vinyl chloride reduction is a strong indicator that reductive dechlorination is actively working to reduce chlorinated hydrocarbon concentrations to non-toxic byproducts. The reduction of ethene to ethane is a possibility at sites exhibiting extremely reducing conditions. In most cases, the reduction of ethene to ethane is not observed until the vinyl chloride concentrations have been nearly exhausted (de Bruin et al., 1992). In 2002, ethene was recorded at measurable levels approaching 10 μg/L at downgradientmost well location 782VMW-101.

During reductive dechlorination of chlorinated hydrocarbons, chloride is released into the groundwater. This results in chloride concentrations in affected groundwater that are elevated relative to background conditions. Elevated chloride concentrations in affected and downgradient wells indicate that chlorinated hydrocarbons are being actively biodegraded, and chloride is being liberated. Because chloride behaves as a conservative tracer as it travels through groundwater, it is also observed downgradient of areas contaminated with high levels of chlorinated solvents. In 2002, chloride was measured at levels greater than twice the upgradient concentration (36 mg/L) at several locations, including: 782VMW-76, 78, -81, -82, -84, 85, -86, -89, -90, -94, -95, and -105b, 782MW-6D, and -6R2. In 2003, chloride was similarly reported at levels greater than twice the upgradient concentration (52 mg/L) at 782VMW-78, -81, -83, -85, -86, -89, -90, -91, -94, 782MW-6D, and -6R2.

The total alkalinity of a groundwater is indicative of an aquifer's capacity to buffer an acid, and results from the presence of hydroxides, carbonates, and bicarbonates of elements such as calcium, magnesium, sodium, potassium, or ammonia. These species result from the dissolution of rocks (primarily carbonate rocks), the transfer of carbon dioxide from the atmosphere, and biodegradation activity. When carbon dioxide is produced, it increases the alkalinity, and can therefore be an indicator of biological activity. In anaerobic systems where carbon dioxide is used as an electron acceptor, it is reduced by methanogenic bacteria during methanogenesis, and methane is produced. During reductive dechlorination, hydrogen ion is also released, which may decrease the alkalinity. In general, areas contaminated with fuel hydrocarbons exhibit a higher total alkalinity than background areas. Changes in alkalinity are most pronounced during aerobic respiration, denitrification, iron reduction, and sulfate reduction. Alkalinity was not a major indication of reductive dechlorination in this study, as results from 2002 indicated only wells outside the plume boundaries with levels more than twice the background concentration at 782VMW-98 (418 mg/L). In 2003, locations 782VMW-77 and -88 were reported within the plume boundaries with alkalinity concentrations higher than twice the background concentration.

Figure 5-3
Methane Concentrations in Groundwater Along the Length of Chlorinated Plume



Total organic carbon (TOC) is a measure of all the carbon present in the groundwater including both natural carbon and that from human activities. TOC is important because during reductive dechlorination, chlorinated hydrocarbon compounds are used as electron acceptors, and this dehalorespiration requires an appropriate source of carbon for microbial growth in order for this process to occur. Microbes may use both forms of carbon for growth. During both monitoring rounds, TOC was reported at every sampling location at levels below 20 mg/L, which may indicate that TOC is a limiting factor for further plume degradation.

Hydrocarbon-degrading microbes are active within a pH range of 6 to 8 standard units (s.u.). Based on 2002 results, with the exception of 782VMW-99, where a cement leakage through the screen is suspected, site conditions are within this range (from 6.32 [782VMW-87] to 7.90 [782VMW-94]).

Groundwater temperature affects the rate of biodegradation, and for every 10 °C increase in temperature between 5 and 25 °C, biodegradation rates may double. The temperature range of groundwater across the site was measured in 2002 from 2.95 to 13.56 °C.

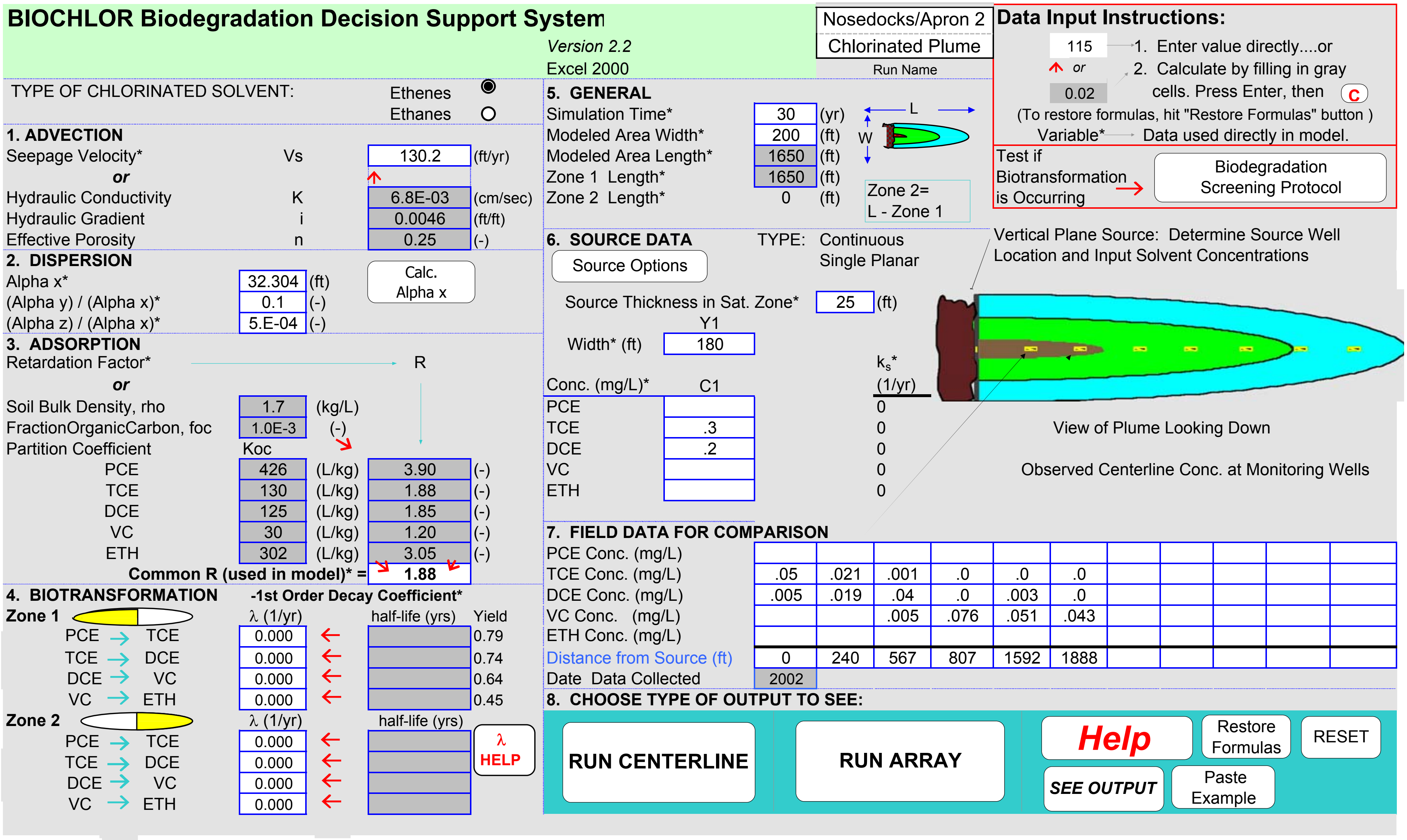
The redox potential of groundwater is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. The redox potential of groundwater typically ranges from –400 mV to +800 mV. Positive redox values (redox > 0) indicate oxidizing (and generally aerobic) conditions (i.e., loss of electrons) and negative values (redox < 0) indicate reducing (and generally anaerobic) conditions (i.e., gain of electrons). Redox conditions are usually mediated by biological activity. Negative redox measurements are favorable for indicating reductive dechlorination, especially when levels are less than -100 mV. Such readings were recorded at several locations across the site.

5.1.1.3 BIOCHLOR Data Input Factors

Figures 5-4 and 5-5 depict the BIOCHLOR Excel spreadsheet model for data input and assumptions for Simulations A and B, respectively. The following sections summarize the data input into the model simulations, using site-specific information where possible.

Figure 5-4

BIOCHLOR Data Input, Simulation A



BIOCHLOR Biodegradation Decision Support System

Version 2.2

Excel 2000

Nosedocks/Apron 2
Chlorinated Plume
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 → Biodegradation Screening Protocol

TYPE OF CHLORINATED SOLVENT: Ethenes ● Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	130.2	(ft/yr)
or			
Hydraulic Conductivity	K	6.8E-03	(cm/sec)
Hydraulic Gradient	i	0.0046	(ft/ft)
Effective Porosity	n	0.25	(-)

2. DISPERSION

Alpha x*	32.304	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	5.E-04	(-)

Calc. Alpha x

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.7	(kg/L)		
FractionOrganicCarbon, foc	1.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	3.90	(-)
TCE	130	(L/kg)	1.88	(-)
DCE	125	(L/kg)	1.85	(-)
VC	30	(L/kg)	1.20	(-)
ETH	302	(L/kg)	3.05	(-)

Common R (used in model)* = 1.88

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.000		0.79
TCE → DCE	0.000		0.74
DCE → VC	0.000		0.64
VC → ETH	0.000		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*	30	(yr)
Modeled Area Width*	200	(ft)
Modeled Area Length*	1650	(ft)
Zone 1 Length*	1650	(ft)
Zone 2 Length*	0	(ft)

Zone 2= L - Zone 1

6. SOURCE DATA TYPE: Continuous Single Planar

Source Options

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations

Source Thickness in Sat. Zone* 25 (ft)

Width* (ft) Y1 180

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE		0
TCE	.3	0
DCE	.2	0
VC		0
ETH		0

View of Plume Looking Down

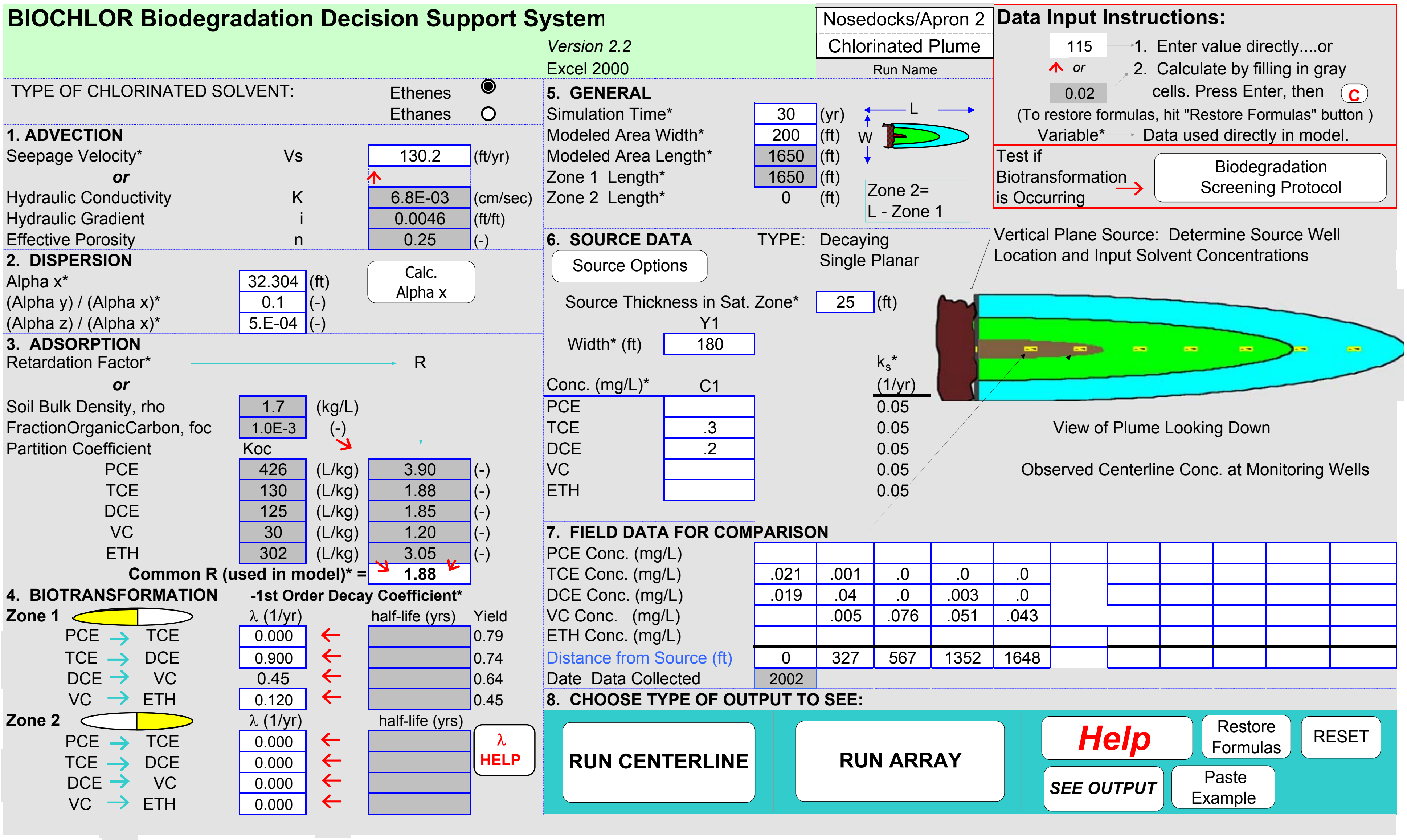
Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)	.05	.021	.001	.0	.0	.0					
DCE Conc. (mg/L)	.005	.019	.04	.0	.003	.0					
VC Conc. (mg/L)			.005	.076	.051	.043					
ETH Conc. (mg/L)											
Distance from Source (ft)	0	240	567	807	1592	1888					
Date Data Collected	2002										

8. CHOOSE TYPE OF OUTPUT TO SEE:

Figure 5-5
BIOCHLOR Data Input, Simulation B



BIOCHLOR Biodegradation Decision Support System

Version 2.2
Excel 2000

Nosedocks/Apron 2
Chlorinated Plume
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 → Biodegradation Screening Protocol

TYPE OF CHLORINATED SOLVENT: Ethenes ● Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	130.2	(ft/yr)
or			
Hydraulic Conductivity	K	6.8E-03	(cm/sec)
Hydraulic Gradient	i	0.0046	(ft/ft)
Effective Porosity	n	0.25	(-)

2. DISPERSION

Alpha x*	32.304	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	5.E-04	(-)

Calc. Alpha x

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.7	(kg/L)		
FractionOrganicCarbon, foc	1.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	3.90	(-)
TCE	130	(L/kg)	1.88	(-)
DCE	125	(L/kg)	1.85	(-)
VC	30	(L/kg)	1.20	(-)
ETH	302	(L/kg)	3.05	(-)
Common R (used in model)* =			**1.88**	

4. BIOTRANSFORMATION **-1st Order Decay Coefficient***

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.000		0.79
TCE → DCE	0.900		0.74
DCE → VC	0.45		0.64
VC → ETH	0.120		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*	30	(yr)
Modeled Area Width*	200	(ft)
Modeled Area Length*	1650	(ft)
Zone 1 Length*	1650	(ft)
Zone 2 Length*	0	(ft)

L
W
Zone 2= L - Zone 1

6. SOURCE DATA TYPE: Decaying Single Planar

Source Options

Source Thickness in Sat. Zone* 25 (ft)

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations

	Y1	
Width* (ft)	180	
Conc. (mg/L)*	C1	k_s* (1/yr)
PCE		0.05
TCE	.3	0.05
DCE	.2	0.05
VC		0.05
ETH		0.05

View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)	.021	.001	.0	.0	.0						
DCE Conc. (mg/L)	.019	.04	.0	.003	.0						
VC Conc. (mg/L)		.005	.076	.051	.043						
ETH Conc. (mg/L)											
Distance from Source (ft)	0	327	567	1352	1648						
Date Data Collected	2002										

8. CHOOSE TYPE OF OUTPUT TO SEE:

5.1.1.3.1 Advection Factors

For the purposes of modeling the seepage velocity, or groundwater flow rate, across the site, which was considered to extend from the source area near 782VMW-81 to the edge of Apron 2 near monitoring well 782VMW-88, the following equation was used:

$$V = \frac{K(i)}{n} \times 365$$

where K=hydraulic conductivity, i=hydraulic gradient, and n=effective porosity. For the Nosedocks/Apron 2 site-specific conditions, the hydraulic conductivity was estimated at 19.38 ft/day. This value was derived by using the hydraulic conductivity value derived for the loose, coarse gravel (19.38 ft/day) and converting to cm/sec. The hydraulic conductivity for the medium to fine sand, loose to dense, is much less (2.67 ft/day), and corresponds to a much lower groundwater seepage velocity. The hydraulic conductivity for the gravel layer was chosen because (a) the chlorinated solvent concentrations encountered between 25 and 35 ft bgs, where the gravel was most often encountered, were used; and (b) the results are considered more conservative with groundwater traveling towards Six Mile Creek at a faster rate. The hydraulic gradient was calculated at 4.6×10^{-3} ft/ft, corresponding to the mainly flat topography across the Apron (only results from the wells installed on Apron 2 and the immediate vicinity were used). The effective porosity was assumed to be 0.25, corresponding to a “commonly used value for silts and sands” according to the BIOCHLOR manual (*BIOCHLOR User’s Manual, Version 1.0,* EPA/600/R-00/008, January 2000). These values correspond to an overall seepage velocity of approximately 130 ft/yr.

5.1.1.3.2 Dispersion Factors

Dispersion refers to the process whereby solute will be spatially distributed longitudinally (along the direction of groundwater flow), transversely (perpendicular to groundwater flow) and vertically (downward), due to the combined effects of mechanical mixing and chemical diffusion in the aquifer. For the two-zone biotransformation option, the user must specify a fixed value for longitudinal dispersivity (although according to the BIOCHLOR manual, the longitudinal dispersivity is more likely a parameter which varies with distance). This value was approximated at approximately 32 feet (using the Xu and Eckstein formula as provided in BIOCHLOR). The ratio of the transverse dispersivity to the longitudinal dispersivity was estimated at 0.1, which is “commonly used” according to the BIOCHLOR manual. Finally, the ratio of the vertical dispersivity to the longitudinal dispersivity was estimated at 5×10^{-4}, as a conservative estimate of vertical dispersion, assuming full source area depth penetration.

5.1.1.3.3 Adsorption Factors

Adsorption to the soil matrix can reduce the concentration of solute moving through the groundwater. The retardation factor is the ratio of the groundwater seepage velocity to the rate the organic chemicals migrate in the groundwater, and depends on both aquifer and constituent properties. Although BIOCHLOR allows for the input of separate retardation factors for each individual constituent, the model ultimately calculates a median retardation factor and uses a single retardation factor value in all calculations. The model calculates the retardation factor automatically for each chlorinated solvent from organic carbon partition coefficients, aquifer matrix bulk density, and fraction organic carbon, and the user is prompted to input the aquifer matrix bulk density and the fraction organic carbon. For simplicity, and without actual field data to corroborate these values, "commonly used" values, as provided in the BIOCHLOR manual, were used: 1.7 kg/L for bulk density, and 0.001 for fraction organic carbon. The default organic carbon partition coefficient values provided in the BIOCHLOR manual were applied, which resulted in an overall retardation coefficient of 1.88.

5.1.1.3.4 Biotransformation Factors

To simulate the fate and transport that would be expected if no biodegradation were occurring (Simulation A), the biotransformation factors, or first-order decay rate coefficients, were set to zero. For Simulation B, which includes biodegradation, the first-order decay coefficients were selected within the range of decay coefficients that have been encountered in the literature (according to those provided in the BIOCHLOR manual). Field data close to the centerline of the plume (as discussed in Section 5.1.1) were compared to the modeled concentrations to help derive the best-fit first-order decay rate coefficients. Because field data shows that TCE is reduced to cis-DCE over relatively shorter distances than cis-DCE to VC, or VC to ethene, a high decay rate for TCE was selected. Decay rates for cis-DCE and VC were selected within the lower range to reflect substrate-limited conditions. Although the matchup of the model to the TCE plume was only approximate, particular attention was given to match the results of the cis-DCE and VC results over the distance of the entire modeled length of the plume during the trial-and-error process.

The following table provides the decay coefficients which were used for the BIOCHLOR Simulation B.

Table 5-1
BIOCHLOR Simulation B Decay Rates

Constituent	Decay Rates (1/yr)	BIOCHLOR Acceptable Range (1/yr)
TCE	0.9	0.05 to 0.9
cis-DCE	0.45	0.18 to 3.3
VC	0.12	0.12 to 2.6

Note: No PCE was observed across the site at concentrations above the NYS Class GA Groundwater Standards; therefore, PCE was not included in the model.

5.1.1.3.5 General Factors

In this section of the model, physical dimensions of the plume are entered and approximated, including the plume model area length and width. The plume length was estimated at approximately 1,650 feet (this distance corresponds to the approximate distance from the vicinity of the Nosedocks Wash Waste System at 782VMW-81 to monitoring well 782VMW-88), and the plume width at 200 ft. Also, the simulation time is estimated as the time between the original release and the date the field data were collected. This value was estimated at approximately 30 years (e.g., a TCE spill(s) occurred about 1974, or the source area input levels correspond to 1974 residual concentrations from a previous spill[s]).

5.1.1.3.6 Source Data Factors

The source area thickness in the saturated zone, the source area width, and the initial concentrations of TCE are all input factors for BIOCHLOR in this section. The thickness of the dissolved solvent in the source area was estimated at approximately 25 ft, since concentrations of chlorinated solvents were measured as shallow as 22 ft bgs, and as deep as 43 ft bgs. Because samples were not collected continuously, 25 ft was considered to be a conservative estimate that includes the entire span of source area thickness. The source area width was unknown, but was approximated at 200 ft. The source area concentration for TCE was estimated at 300 μg/L and for cis-DCE at 200 μg/L. These levels were chosen based on the apparent concentrations remaining after 30 years assuming a source area decay rate of 0.05/yr (this was chosen based on reasonable rates encountered in the literature, provided in the BIOCHLOR manual). Such remaining levels correspond to 67 μg/L TCE and 45 μg/L cis-DCE, which are within the range of levels found during this investigation within the source area of the Nosedocks Wash Waste System. It should be noted that these source area concentrations were chosen for model screening purposes only and should not be interpreted as actual original source area concentrations.

5.1.1.4 BIOCHLOR Model Simulation Results

Using this simple Domenico model, the plume extent was approximated over a 30-yr period. The plume results for Simulation A are shown in Figure 5-6. According to the model, the TCE plume extends the entire length of the model area, with TCE concentrations ranging from 300 µg/L at the source area to 160 µg/L near the edge of Apron 2 in the vicinity of 782VMW-88. Similarly, cis-DCE concentrations extend the length of the model area from 200 µg/L at the source area to 110 µg/L at 782VMW-88. Since this model assumes no biodegradation, no VC or ethene is produced.

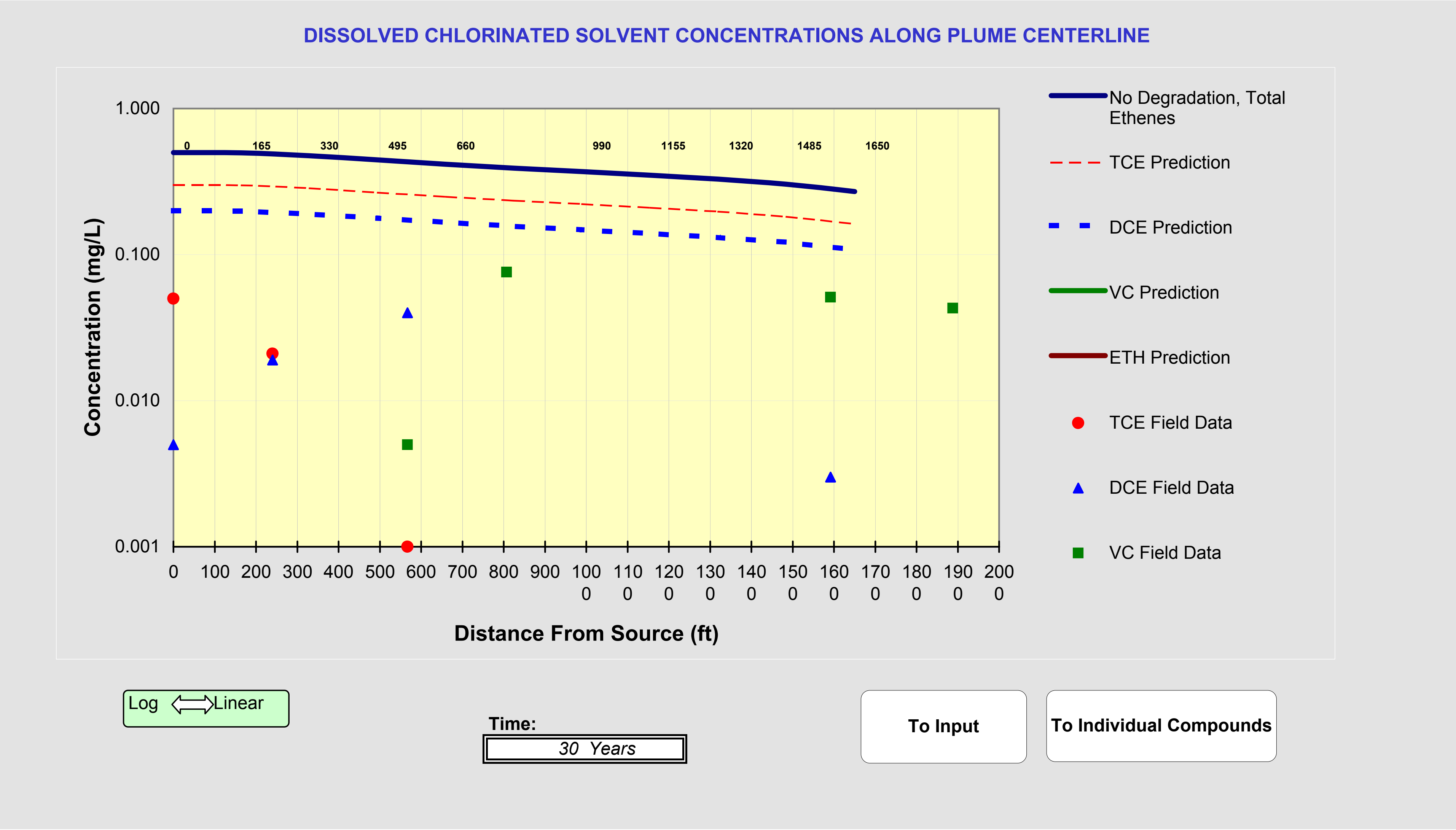
The plume results for Simulation B are shown in Figure 5-7. According to the model, the TCE plume is depleting within approximately 800 ft of the source area, the cis-DCE plume extends across the entire length of the model area, but depletes to approximately 1 µg/L in the vicinity of 782VMW-88, and the VC plume forms after approximately 165 ft, peaks at approximately 800 ft (when most of the parent product, TCE, is depleted), and slowly degrades throughout the remaining length of the plume, to approximately 34 µg/L at 1,650 ft. The model also predicts ethene production from a point at about 165 ft downgradient from the source area through the length of the plume. Looking at the modeled TCE concentrations that transport by advection/dispersion but do not undergo biotransformation across the length of the plume (but do undergo biodegradation within the source area), the TCE level was predicted at 114 µg/L to a point 1,650 ft downgradient of the source area.

Although the predicted levels in Simulation B do not match field data exactly, there is a generally good correlation between observed and predicted levels (i.e., the overall trends are consistent). This general correspondence between Simulation B predicted levels and field observations confirms that the decreasing COC concentrations over distance observed across the site can be attributed primarily to biotransformation processes (i.e., reductive dechlorination).

The actual field results may differ from the Simulation B results for several reasons:

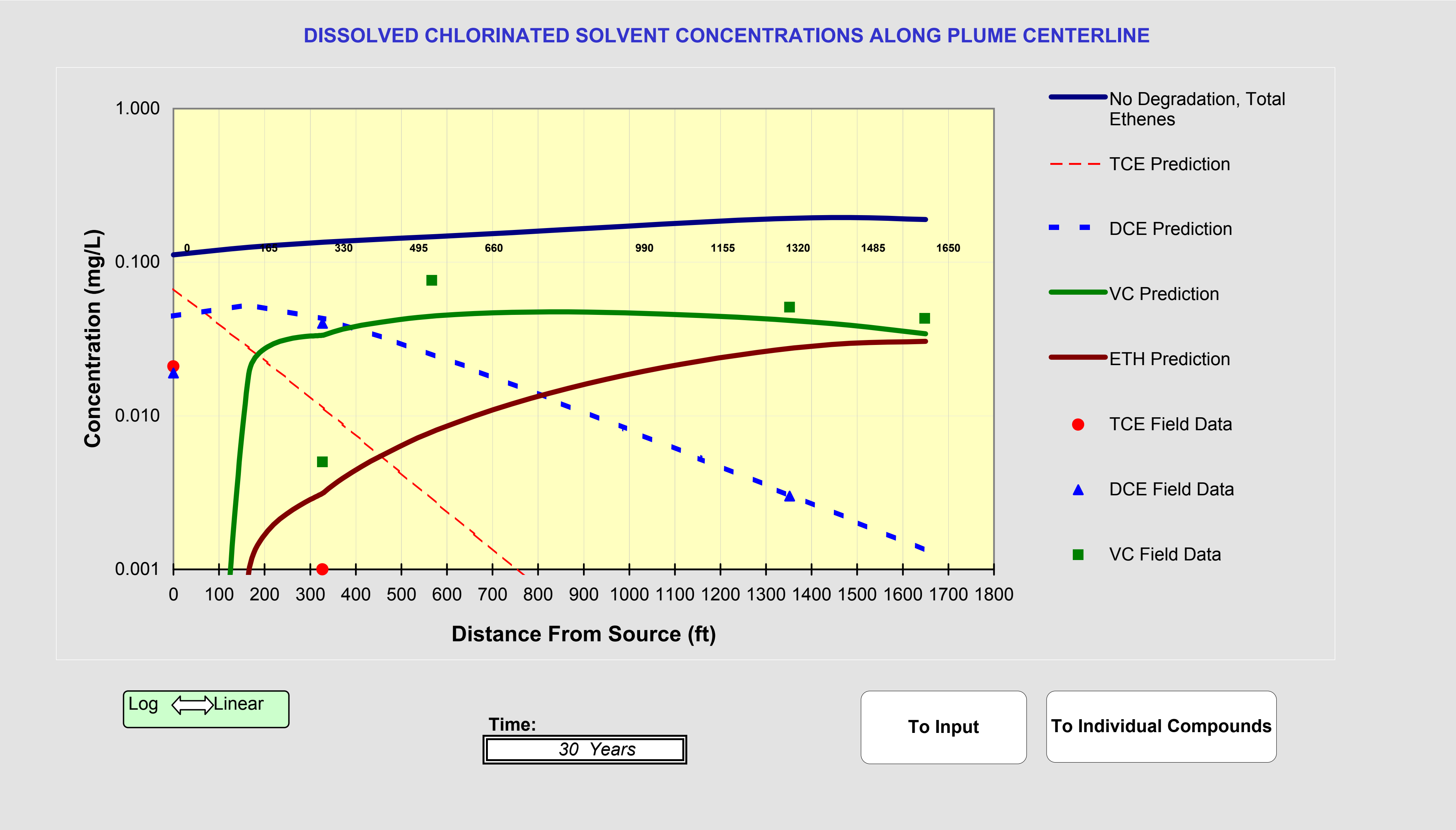
- Assumptions used to derive the seepage velocity, dispersivity, and adsorption factors are subject to uncertainty due to limited data.
- The source area decay rate may be inaccurate. Future rounds of data should verify whether the assumption of source area decay was valid or invalid.
- The rate constant estimates were derived purely from trial and error to best fit the field data. However, this field data in itself is subject to uncertainty inherent in sampling methods and lab analyses, and the model is highly influenced by which wells were

Figure 5-6
BIOCHLOR Modeling Results, Simulation A



Time: 30 Years

Figure 5-7
BIOCHLOR Modeling Results, Simulation B



selected to represent "centerline" concentrations, and their location within the LTM network. The biodegradation rate coefficients derived during Simulation B are subject to statistical uncertainty since they were based on fitting five data points (or the results of five monitoring wells obtained during the 2002 sampling round).

- The BIOCHLOR model assumes that the sequential reductive dechlorination processes are first-order reactions, with *constant* first-order rate coefficients across the site reaction zones. It assumes that only the substrate (TCE/cis-DCE/VC) is limiting, and the amount of bacteria (and the specific population of reductively dechlorinating bacteria) across the site is constant. However, a bacterial population is likely to vary both temporally and spatially, which means that the reaction rate is also highly variable. Actual biodegradation rates may be higher than those indicated using the BIOCHLOR model.

Field data shows that biodegradation processes (via reductive dechlorination), including VC reduction to ethene, are working, albeit slowly, to decrease the dissolved chlorinated solvent concentrations. The simulations modeled using BIOCHLOR do not provide – and were not intended to provide – an accurate numerical solution for predicting the COC concentrations across the site. This level of modeling can be conducted more rigorously using a less simplistic model during the Feasibility Study, if deemed necessary.

5.2 FATE AND TRANSPORT OF PETROLEUM-RELATED CONTAMINANTS

Volatile organic compounds from petroleum-related sources include MTBE, benzene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; ethylbenzene; isopropylbenzene; m,p-xylene; n-propylbenzene; naphthalene; o-xylene; p-isopropyltoluene; toluene; and sec-butylbenzene. VOCs identified in subsurface soil include benzene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; ethylbenzene; isopropylbenzene; m,p-xylene; n-propylbenzene; naphthalene; o-xylene; p-isopropyltoluene; toluene; and sec-butylbenzene.

Each of the petroleum-related VOCs have densities less than that of water. Therefore, if sufficient quantities of these volatiles are released, they may form a light nonaqueous phase liquid (LNAPL). These compounds typically migrate vertically in the vadose zone under the influence of gravity and capillary forces, just as water does. If a sufficient quantity of LNAPL is present, it will eventually reach the capillary zone or water table. However, much of the LNAPL may remain behind, trapped in the vadose zone. In the core of a thick zone of mobile LNAPL, the water table may be depressed by the weight of the LNAPL. The LNAPL can migrate in the capillary zone following the direction of groundwater flow and volatilize within the vadose zone.

The groundwater VOC results suggest that some portion of the petroleum-related constituents (MTBE in particular) may be used as a precursor to the ultimate electron donor (hydrogen) for reductive dechlorination, or as a carbon source to support continuing biodegradation of the chlorinated compounds present in the plume. In comparison to the northern portion of the main chlorinated solvent plume, biodegradation of the southern portion of the main plume, which is commingled with the MTBE large plume (as depicted in Figure 4-6), was observed to have progressed more quickly through the step-wise reductive dechlorination pathway, and to complete dechlorination prior to reaching Six Mile Creek (i.e., no VC was observed at monitoring well AP2MW-3). (A smaller MTBE plume was also identified in conjunction with the northern chlorinated plume, but the available data is not sufficient for modeling purposes). Further delineation of the MTBE plume and the petroleum VOC "hot spots" in the vicinity of the site is being investigated under the Petroleum Spill Sites LTM Work Plan Addendum I (FPM, January 2002) and Addendum II (FPM, May 2002), for Building 786, Building 789, Building 7001, Apron 1, and Apron 2.

6.0 DATA EVALUATION AND BASELINE RISK ASSESSMENT

A baseline risk assessment was conducted for the Nosedocks/Apron 2 Chlorinated Plume, based on the concentrations of VOCs and metals encountered in the groundwater across the site to determine if these chemicals pose a risk to human and/or ecological receptors. Analytical results collected at the Nosedocks/Apron 2 Chlorinated Plume indicate that chlorinated VOCs were detected in 23 of the 35 monitoring wells sampled. The baseline risk assessment included a data evaluation, human health risk assessment and an environmental evaluation.

6.1 DATA QUALITY ASSURANCE AND QUALITY CONTROL EVALUATION

The following section includes an evaluation of the Quality Assurance/Quality Control (QA/QC) procedures and results utilized during the permanent monitoring well sampling event conducted at the Nosedocks/Apron 2 Chlorinated Plume to ensure the precision, accuracy, representativeness, completeness, and comparability of the data generated. It highlights and summarizes conclusions drawn on the quality and usability of the analytical results.

A complete (100%) data validation was performed on the samples collected during the permanent monitoring well sampling event. The types of environmental samples included groundwater, soils and associated QC samples. The QA/QC requirements used for the groundwater and soil sample analysis were as specified in the AFCEE Quality Assurance Project Plan (QAPP) Version 3.1, with variances as provided in Appendix I. The variances were pre-approved by an AFCEE chemist prior to initial sampling. The analytical methods employed included the complete list of VOCs by EPA method SW8260.

The data were validated according to the protocols and QC requirements of the respective analytical methods and the QAPP. For data usability purposes all values were further evaluated, including positive and non-detect results that were qualified “R” (Rejected) according to the QAPP. The data usability analysis was based on the reviewer’s professional judgment and on an assessment of how this data would fare with respect to the U.S. Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) National Functional Guidelines for Organic Data Review (February 1994). For example, AFCEE QAPP-rejected positive results that were considered usable according to EPA’s guidelines were flagged “J”. Similarly, usable non-detect values were flagged “UJ”.

The data validation review assessed the following QA/QC criteria:

- Reporting and method detection limits
- Holding times, sample preservation and storage
- GC/MS tuning criteria
- Initial calibration
- Second source calibration verification

- Continuing calibration
- Method, ambient, equipment, and trip blanks
- Surrogate spike results
- Field duplicate results
- Matrix spikes/matrix spike duplicates (MS/MSD)
- Internal standard areas and retention times
- Laboratory control samples (LCS)
- Data system printouts
- GC chromatograms and mass spectra
- Qualitative and quantitative compound identification
- Chain-of-custody (CoC)
- Case narrative, AFCEE forms, and deliverables compliance

The items listed above were evaluated in terms of compliance with AFCEE QAPP and USEPA criteria and protocols, and highlights are discussed in the following sections. The analytical results were qualified accordingly and these qualified analytical results can be found in Appendix G.

6.1.1 Record Keeping

Project logbooks, consisting of bound books with hard covers and sequentially numbered pages, were maintained on a daily basis by each of the field team members in charge of a specific task. These logbooks contain detailed records of all activities related to specific field tasks and specific references to other field documents used on a daily basis. The front of each logbook shows the project name, logbook number, and the dates of use.

Possession of all samples was tracked from the time of sample collection through sample analysis by the use of AFCEE CoC forms.

6.1.2 Blank Sample Results

Assessment of field or laboratory conditions that may contribute to contamination of the environmental samples was conducted by evaluating the chemical results of field blank and laboratory method blank samples. The field blanks utilized were equipment blanks, ambient blanks and trip blanks. The method blanks included preparation blanks, calibration blanks, extraction blanks and matrix spike blanks. According to the QAPP, for blank sample results that have contaminants present greater than the reporting limit (RL), associated sample positive results for the particular analyte are considered estimated and are flagged with a “B” qualifier.

6.1.3 Equipment Blank Samples

Equipment blank samples are samples of laboratory reagent grade water that have been poured into, over, or through the dedicated or decontaminated sampling equipment, collected in laboratory-supplied sample containers, and transported to the laboratory for analysis. Equipment blanks were collected on a daily basis for each matrix (water and/or soil) sampled that day and were analyzed for the full suite of analytes that were sampled for that day. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures.

Several types of sampling equipment may be utilized during a field program. Each type of sampling equipment used during the investigation was utilized in the preparation of equipment blank samples. The type of equipment that was used for the preparation of equipment blanks was recorded on a daily basis in the project logbooks. An evaluation of the equipment blank sample results was performed during the data validation and the associated samples were qualified accordingly.

6.1.4 Ambient Blank Samples

Ambient blank samples are samples of laboratory reagent grade water that have been poured into a VOC sample vial at the sampling site (in the same vicinity as the associated samples). Ambient blank samples are handled like environmental samples and are transported to the laboratory for VOC analysis. These blanks are used to assess the potential introduction of contaminants from ambient sources to the samples during sample collection. The ambient blanks were collected on a daily basis when VOC analysis was required and were obtained in a location that was evaluated to be downwind of a potential VOC source.

An evaluation of the ambient blank sample results was performed during the data validation and the associated samples were qualified accordingly.

6.1.5 Trip Blank Samples

The trip blank samples consist of VOC sample vials filled in the laboratory with reagent grade water, transported to the sampling site, handled like an environmental sample, and returned to the laboratory for analysis. Trip blank samples are collected only when VOC analysis is required. These blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. One trip blank sample accompanies each cooler of samples sent to the laboratory for analysis of VOCs.

An evaluation of the trip blank sample results was performed during the data validation process and the associated samples were qualified accordingly.

6.1.6 Method Blank Samples

The purpose of laboratory method blank analyses is to determine the existence and magnitude of contamination resulting from laboratory activities. The method blanks are carried through the complete sample preparation and analytical procedure. If problems with any blanks exist (i.e., concentrations of constituents are detected above detection limits), all associated data is carefully evaluated to determine whether or not there is inherent variability in the data or if the problem is an isolated occurrence. Various types of method blanks were employed for this investigation, including preparation blanks, calibration blanks, extraction blanks, and matrix spike blanks.

The presence of analytes in a method blank at concentrations equal to or greater than the RL indicates a need for corrective action. Corrective action shall be performed by the laboratory to eliminate the source of contamination prior to proceeding with the analysis.

An evaluation of the method blank sample results was performed during the data validation process and the associated samples were qualified accordingly.

6.1.7 Field Duplicate Samples

Field duplicate samples were collected during the field sampling. These samples were used to assess the general precision of the sample results. The field duplicate samples were second samples collected at the same location as the primary samples immediately following the collection of the primary samples using identical recovery equipment and techniques. The duplicate samples were managed in an identical manner as the primary samples during sample storage, transportation, and analysis. The duplicate samples were assigned blind identification numbers so that laboratory personnel could not identify them. The frequency of collection for these QC samples was approximately 1 in 10, as per the FSP.

Using professional judgment, it is difficult to consider any set of field duplicate samples to be truly representative of a site or sampling event. Therefore, for relative percent difference (RPD) control limit exceedances, only the parent-duplicate sample set was qualified and not all the samples collected on the same sampling date as recommended by the QAPP. Hence, based on exceedances positive results were considered estimated flagged “J” and non-detects flagged “UJ”.

The evaluation of the field duplicate sample results was performed during the data validation process and appropriate flags were applied. In general for reporting purposes, to err on the side of conservatism, the higher of the concentrations from the parent-duplicate sample sets were used.

6.1.8 Matrix Spike/Matrix Spike Duplicate Results

Data for matrix spike/matrix spike duplicates (MS/MSD) are generated to determine long-term precision and accuracy of the analytical method on various matrices. Generally, these data alone cannot be used to evaluate the precision and accuracy of individual samples. A matrix spike and matrix spike duplicate analysis is an aliquot of sample spiked with known concentrations of all the analytes in the method. According to the AFCEE QAPP, the MS/MSD result is used to assess whether the sample matrix may bias the results.

The AFCEE recommended frequency of analysis is one MS/MSD per 20 samples. Exceedances of either percent recovery (%Rec) of spike concentrations or RPD between the MS and MSD results, according to the QAPP require a “M” (matrix effect) qualifier for the specific analyte in all samples collected from the same site matrix as the parent. However, due to the varied nature of environmental samples, such as locations, depths, physical characteristics (dissolved and suspended solids, turbidity, pH, organic content, etc.), it is difficult to assign one MS/MSD sample set as truly representative of an entire site matrix. Therefore, based on the definition of this type of QA/QC sample, using professional judgment it is deemed inappropriate to qualify more than the actual parent sample due to a %Rec or RPD exceedance. This approach is in accordance with the EPA National Functional Guidelines, which states that the MS/MSD results are not used alone to qualify the entire data package, however, can be used in conjunction with other QC criteria to determine the need for some qualification of the data. Thus the data validation following this approach, for instances when specific analytes exceed QC limits in the MS/MSD analysis, results are qualified “M” in the parent sample only.

6.1.9 Laboratory Control Sample Results

Laboratory control samples (LCS) are control samples spiked with all analytes of interest at known concentrations. These analyses are used to assess the overall laboratory performance pertaining to the analytical method. The QAPP includes method-specific QC acceptance criteria for the % Rec of the spike compounds. The LCS results are used to evaluate each AFCEE analytical batch and to determine if the method is in control. The LCS results cannot be used as the continuing calibration verification. Whenever an analyte in an LCS is outside the acceptance limit, corrective action shall be performed by the laboratory. If the corrective action is ineffective in resolving the exceedance, then that analyte in all the associated samples (samples within the AFCEE analytical batch) are qualified. Incorporating the applicable guidance of the QAPP, the USEPA National Functional Guidelines, and professional judgment, the following flagging criteria were developed: when the % Rec is greater than the upper control limit, all positive results within the same analytical batch are considered estimated and flagged “J;” when the % Rec is less than the lower control limit, positive values are flagged “J” and non-detects are flagged “UJ.” An evaluation of the LCS results was performed during the data validation and the associated samples were qualified accordingly.

6.1.10 Data Usability Results

The data are valid and usable with qualifications as indicated in the data review as discussed above. The qualified results (annotated laboratory data sheets) can be found in Appendix G. The data qualifiers are summarized as follows:

J	The analyte was positively identified; the quantitation is an estimation.
U	The analyte was analyzed for but not detected. The associated value is at or below the Method Detection Limit (MDL).
UJ	The analyte was analyzed for but not detected, however, the MDL is approximate and may or may not represent the actual limit of quantitation.
F	The analyte was positively identified but the associated numerical value is below the RL.
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
B	The analyte was found in the associated blank as well as in the sample.
M	A matrix effect was present.
S	Applied to all field screening data.
T	Tentatively-identified compound, using gas chromatography/mass spectroscopy (GC/MS).

Data flagging was performed according to the conventions described in the AFCEE QAPP (Version 3.1), USEPA National Functional Guidelines, and the reviewer's professional judgment. According to the QAPP, when multiple qualifiers are prescribed, the data review process assigned a final qualifier reflecting the most severe qualifier. The QAPP and applicable USEPA final data qualifiers for definitive data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are R, M, F, J, B, UJ and U.

6.2 HUMAN HEALTH EVALUATION

The purpose of the human health evaluation was to establish whether contaminants present at the Nosedocks/Apron 2 Chlorinated Plume could pose a potential health risk to individuals under current and foreseeable future land uses in the absence of remediation. The human health evaluation includes the identification of chemicals of potential concern, exposure assessment, toxicity assessment, risk characterization, and uncertainty evaluation.

6.2.1 Identification of Contaminants of Potential Concern

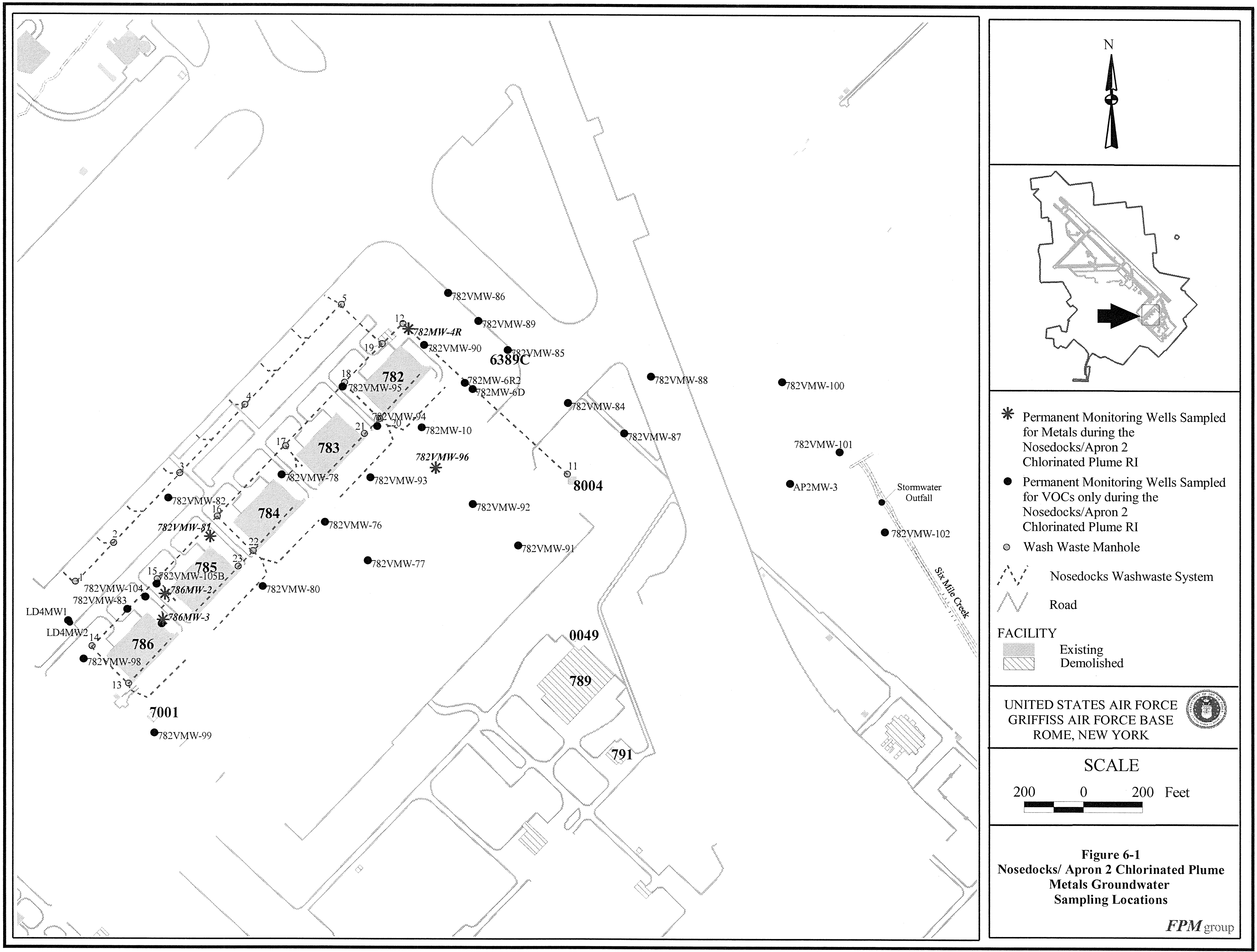
6.2.1.1 Historical Review of Nearby Areas of Concern

A historical review of the groundwater data collected during the RI (Law, 1996) for two AOCs located within the vicinity of the Nosedocks/Apron 2, Building 786 Contaminated Soil and Nosedocks 1 and 2, was conducted. Baseline risk assessments had been performed for these sites, which were monitored for VOCs, semivolatile organic compounds (SVOCs), metals, polychlorinated biphenyls (PCBs)/Pesticides, glycols, and total recoverable petroleum hydrocarbons (TRPH). The results of these risk assessments identified metals as a potential contributor to site risk, especially in consideration of the scenario for the ingestion of groundwater by industrial workers. For example, at Building 786, arsenic and manganese in groundwater were identified as contributors to the overall noncarcinogenic risk, and arsenic was identified as a main contributor to the carcinogenic risk attributed to the site. At Nosedocks 1 and 2, manganese in groundwater was identified as a contributor to the overall noncarcinogenic risk. It was therefore deemed appropriate to collect groundwater samples for metals analysis from permanent wells as part of the Nosedocks/Apron 2 Chlorinated Plume RI, to obtain a more comprehensive assessment of total risk.

6.2.1.2 Additional Groundwater Sampling for Metals Analysis

Based on the results of the 1996 RI for AOCs (Law, 1996), the following locations were chosen for groundwater sample collection for metals analysis, which were nearest those locations that had the highest metals concentrations, including 786MW-2 (where the highest arsenic reading was recorded at Building 786), 786MW-3 (where the highest manganese hit was recorded at Building 786), and 782MW-4 (where the highest manganese hit was recorded at Nosedocks 1 and 2): 786MW-2, 786MW-3, 782MW-4R (782VMW-4 has since been found dry and was replaced with 782MW-4R), 782VMW-81, and 782VMW-96. These wells were chosen based on either their known high metals detections (the former three wells) or their location relative to the plume extent and well screen intervals. (The chlorinated solvent constituents were identified primarily in the deeper aquifer samples, so it follows that the metals samples should also be collected from at or near these depths). These locations are shown in Figure 6-1. Samples were collected in August 2002 and submitted for metals analysis using EPA Method SW6010B and mercury analysis using EPA Method SW7470. Results are presented in Table 6-1.

All groundwater samples collected during the 2003 sampling round were submitted for metals analysis, in addition to VOCs and geochemical parameters. These results are included in Table 4-4.



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ROME, NEW YORK

Figure 6-1
Nosedocks/ Apron 2 Chlorinated Plume
Metals Groundwater
Sampling Locations

FPM group

Table 6-1
Groundwater Analytical Results, Metals Sampling
Nosedocks/Apron 2 Chlorinated Plume

WELL ID	--	786MW-2		786MW-3		782VMW-96		782VMW-81		782MW-4R	
SAMPLE ID	NYSDEC GW STANDARDS	786M0219AB		786M0319AB		782VM9632AB		782VM8135AB		782M04R25AB	
		total	soluble	total	soluble	total	soluble	total	soluble	total	soluble
DATE OF COLLECTION		8/13/02	8/13/02	8/13/02	8/13/02	8/13/02	8/13/02	8/13/02	8/13/02	8/13/02	8/13/02
Depth to Groundwater (ft BTOC)	--	19	19	19	19	32	32	35	35	25	25
Metals (µg/L)											
aluminum	--	U	U	39.3 F	U	125 F	U	43.7 F *	U	U	U
antimony	3	U	U	U	U	U	U	U	U	U	U
arsenic	25	13.8 F	13.8 F	U	12.1 F	U	14.1 F	U	7.7 F *	7.1 F	24.8
barium	1000	77.9	60.7	21.6	22	582	549 M	290	267	133	110
beryllium	--	U	U	U	U	U	U	U	U	U	U
cadmium	5	U	U	U	U	U	U	U	U	U	U
calcium	--	104000 B	101000	91100 B	95900	93700 M	93000 M	53000 B *	53800 *	105000 B	104000
chromium	50	U	U	U	U	U	U	U	U	U	U
cobalt	--	U	U	U	U	U	U	U	U	3.6 F	3.6 F
copper	200	U	2.9 F	U	2.2 F	U	2.6 F	U	1.9 F *	U	1.9 F
iron	300	9180	1870	U	U	3920 M	1440 M	577 *	37.1 F *	26200	18400
lead	25.0	U	2.7 F	U	U	U	U	U	U	5.0	5.5
magnesium	--	13000	13000	12900	13700	18500	18900	15200 *	15500 *	14400	14500
manganese	300	1370 B	1340 B	36.6 B	2.2 F	1380	1400 M	432 B *	457 B *	6160 B	6220 B
mercury	1	U	U	U	U	U	U	U	U	U	U
molybdenum	--	U	U	U	U	U	U	6.0 F	5.8 F	U	U
nickel	100	U	U	U	U	U	1.8 F	U	3.2 F	U	U
potassium	--	3310	3180.00	2990	3040	4750	4690	9320	8820	2590.00	2510
selenium	10	U	6.4 F	U	7.4 F	U	8.8 F	U	U	U	8.7 F
silver	50	U	U	U	U	U	U	U	U	U	U
sodium	20000	22300	23000	24100	26300	16600	17300	45700	45500	5620	5650
thallium	--	U	U	U	U	U	U	U	U	U	U
vanadium	--	U	U	U	U	U	U	U	U	U	U
zinc	--	U	9.4 F	U	6.1 F	U	6.8 F	U	U	U	5.8 F

Notes:

▨ - Indicates concentration exceeds the NYS Class GA Groundwater Standard (upgradient only) and two times the upgradient concentration.

-- - Indicates no NYS Class GA Groundwater Standard.

B - The analyte was found in an associated blank, as well as in the sample.

F - The analyte was positively identified but the associated numerical value is below the Reporting Limit (RL).

NA - Not Available.

U - The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.

* - Indicates that the higher numerical value of the duplicate sample is given.

6.2.1.3 Selection of Chemical Hazard Identification

For the purpose of evaluating exposure to groundwater, it was assumed that future industrial workers might be exposed to groundwater at the site should groundwater be used as a potable water supply in the future (see Section 6.2.2). Groundwater samples collected from the 19 wells within the large, southern chlorinated solvent plume (i.e., as listed in Table 6-2) during both permanent monitoring well sampling rounds (2002 and 2003) comprised the groundwater data set used for the risk assessment. The data collected during both rounds were screened for the selection of chemicals of potential concern (COPCs) by comparing the maximum concentration of each contaminant detected against the EPA Region 9 Preliminary Remediation Goals (PRGs). For screening purposes, only those results from wells 782VMW-81 and -96 were used from the 2002 sampling round for metals. The quantitation of risk includes only those locations associated with the southern chlorinated plume. The results of this risk assessment are therefore limited to the plume extent and should not be attributed to the entire site.

Table 6-2
Nosedocks/Apron 2 Monitoring Wells and Primary Plume Associations[1]

Monitoring Well	Plume Association
782VMW-76	Southern Chlorinated
782VMW-78	Southern Chlorinated
782VMW-80	Southern Chlorinated
782VMW-81	Southern Chlorinated
782VMW-83	Southern Chlorinated
782VMW-84	Southern Chlorinated
782VMW-87	Southern Chlorinated
782VMW-88	Southern Chlorinated
782VMW-92	Southern Chlorinated
782VMW-93	Southern Chlorinated
782VMW-94	Southern Chlorinated
782VMW-96	Southern Chlorinated
782VMW-97	Southern Chlorinated
782VMW-101	Southern Chlorinated
782VMW-104	Southern Chlorinated
782VMW-105b	Southern Chlorinated
782MW-6R2	Southern Chlorinated
782MW-6D	Southern Chlorinated
782MW-10	Southern Chlorinated
782VMW-77	*Southern MTBE*
AP2MW-3	*Southern MTBE*
782VMW-102	*Southern MTBE*
782VMW-86	*Northern MTBE*
782VMW-89	*Northern MTBE*
782VMW-90	*Northern Chlorinated*
782VMW-95	*Northern Chlorinated*
782VMW-98	*Upgradient*
782VMW-99	*Upgradient*
782VMW-82	*Crossgradient*
782VMW-85	*Crossgradient*
782VMW-91	*Crossgradient*
782VMW-100	*Crossgradient*

Notes:
[1] Based on results shown in Figure 4-6.
Wells not associated with the southern chlorinated plume were not included in the data set used for the quantitative risk assessment. Results from wells LD4MW-1, LD4MW-2, and 786MW-30 were not included in the data set since these wells were installed to monitor primarily petroleum-related constituents, and are not screened across the same depth interval as those wells listed above, which were installed to monitor the chlorinated plume(s).

The validated laboratory analytical data were used to determine the presence or absence of chemicals that may pose a risk to human health. Seven VOCs (benzene, ethylbenzene, MTBE, PCE, TCE, cis-DCE, and vinyl chloride) and two metals (arsenic and manganese) were selected as COCs from groundwater samples. Table 6-3 provides the frequencies of detection and concentration ranges of COCs detected in the groundwater samples. The groundwater sampling locations and analytical results were discussed in Section 4.0. The Occurrence, Distribution, and Selection of Chemicals of Potential Concern are summarized in Table 6-4.

Table 6-3
Frequency of Detection and Exceedance of Screening Criteria for Groundwater Samples from Nosedocks/Apron 2 Wells
Nosedocks/Apron 2 Chlorinated Plume, Former Griffiss AFB, Rome, NY

Parameter	Frequency of Detection, 2002	Frequency of Detection, 2003	Range of Detected Concentration (µg/L)	Frequency of Detection Above Screening Criteria	Screening Criteria: EPA Region 9 PRG (µg/L)
PCE	1/19	2/19	0.25 F – 0.7	1	0.66
TCE	5/19	7/19	0.21 F – 49.95	12	0.028
cis-1,2-DCE	16/19	11/19	0.08 F – 66.09	2	61
VC	14/19	15/19	0.56 F – 100	29	0.02
Benzene	3/19	5/19	0.15 F – 0.77	6	0.34
MTBE	10/19	11/19	0.24 F – 41	6	13
Ethylbenzene	1/19	1/19	0.51 F – 5.6	1	2.9
Arsenic[a]	0/2[b]	4/19	5.8 F – 20.8 F	9	0.045
Manganese[a]	0/2[b]	19/19	789 B – 5040 B	18	880

[a] Based on total results only (not soluble results).
[b] Includes wells 782VMW-81 and 782VMW-96 only (these are the only two wells sampled in 2002 within the southern chlorinated plume and screened across the appropriate depth interval).

Table 6-4
Occurrence, Distribution, and Selection of Chemicals of Potential Concern
Nosedocks/Apron 2 Chlorinated Plume

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (N/C) (4)	Potential C Value	Potential C Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Aquifer-Tap Water	7440382	Arsenic, inorganic	5.8F	20.8F	µg/L	782VMW-104	4/19	4.6	20.8F	NA	0.045 C	25	NYS GW	Y	ASL
	71432	Benzene	0.15F	0.77	µg/L	782MW-6R2	8/38	0.09-0.15	0.77	NA	0.34 C	0.7	NYS GW	Y	ASL
	156592	Dichloroethylene,1,2-cis	0.08F	66.09	µg/L	782MW-10	27/38	0.05-0.13	66.09	NA	61 N	5	NYS GW	Y	ASL
	100414	Ethylbenzene	0.51F	5.6	µg/L	782VMW-104	2/38	0.09-0.18	5.6	NA	2.9 C	5	NYS GW	Y	ASL
	7439965	Manganese (Water)	789B	5040B	µg/L	782VMW-97	19/19	0.24	5040B	NA	880 N	300	NYS GW	Y	ASL
	1634044	Methyl tert-Butyl Ether (MTBE)	0.24 F	41	µg/L	782VMW-80	21/38	0.06-0.23	41	NA	13 C	10	NYS GW	Y	ASL
	127184	Tetrachloroethylene	0.25F	0.7	µg/L	782VMW-105b	3/38	0.18-0.27	0.7	NA	0.66 C	5	NYS GW	Y	ASL
	79016	Trichloroethylene	0.21F	49.95	µg/L	782VMW-105b	12/38	0.09-0.17	49.95	NA	0.028 C	5	NYS GW	Y	ASL
	75014	Vinyl Chloride	0.56F	100	µg/L	782VMW-93	29/38	0.11-0.21	100	NA	0.02 C	2	NYS GW	Y	ASL

Footnote Instructions:

(1) F indicates that the result was above the Method Detection Limit but below the reporting limit.

B Indicates that the analyte was detected above the reporting limit in an associated field blank.

(2) Maximum concentration reported from either monitoring round (2002 or 2003) used for screening.

(3) To date, no background study has been completed.

(4) All compounds were screened against the Preliminary Remediation Goals (PRGs) Table, EPA Region 9, October 1, 2002 for tap water.

(5) Rationale Codes:

Selection Reason: Above Screening Level (ASL)

Definitions: NA = Not Applicable
C = carcinogen
N = noncarcinogen

6.2.2 Exposure Assessment

6.2.2.1 Selection of Exposure Pathways

Under existing and proposed future land use scenarios for the Nosedocks/Apron 2 vicinity, receptors may be at risk through potential exposure to chemicals detected in groundwater. The current and planned future land use for this site is industrial. It is assumed that people may work in the flight maintenance facilities and periodic site maintenance will continue. The hypothetical use of groundwater as industrial process water or as a source of potable water for industrial workers was considered in the event that future industrial use of the site will include use of groundwater beneath the site as a water supply. This scenario is highly improbable due to the ready access to existing water supplies for the base and the City of Rome. Nevertheless, if groundwater is used for process water, industrial workers could potentially be exposed to chemicals in groundwater through ingestion, dermal contact, and inhalation of volatiles. The Selection of Exposure Pathways is summarized in Table 6-5.

The pathway for potential vapor intrusion into the Nosedocks was dismissed as a complete exposure pathway since the results of vertical profile sampling indicated that the chlorinated solvent plume was mainly associated with the coarse, gravelly sand interval which underlies a perched groundwater layer for most of the site. Since the VOCs associated with the chlorinated plumes have not been detected in the perched groundwater layer above the main aquifer, it is assumed that the potential for vapor intrusion into the buildings from the deeper subsurface is highly unlikely.

6.2.2.2 Exposure Point Concentration Derivation

The exposure point concentration (EPC) was calculated by first taking the temporal average from the two rounds of sampling, and then calculating the 95 percent UCL (upper confidence limit) on the arithmetic mean concentration. If the 95 percent UCL exceeded the maximum detected concentration, the maximum temporal average value was used as the exposure point concentration (as was the case for cis-DCE and VC). The Exposure Point Concentration Summary is included as Table 6-6. The UCLs were calculated by using the EPA's program *ProUCL*, available over the internet, which was developed to specifically calculate EPCs for risk assessments. *ProUCL* is a program that works within Microsoft® Excel and tests normality or lognormality of the data distribution, and computes a conservative and stable UCL of the population mean. For those cases when the data is not normally or lognormally distributed, the program also provides recommendations for the use of non-parametric UCLs (ProUCL User's Guide, Version 2.1, May 2003, www.epa.gov/ nerlesd1/tsc/form.htm).

TABLE 6-5
SELECTION OF EXPOSURE PATHWAYS
NOSEDOCKS/APRON 2 CHLORINATED PLUME

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Aquifer - Tap Water	Industrial Workers	Adult	Ingestion	Quantitative	Considered in RI (Law, 1996)
						Dermal	Quantitative	Considered in RI (Law, 1996)
						Inhalation	Quantitative	Considered in RI (Law, 1996)

TABLE 6-6
EXPOSURE CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NOSEDOCKS/APRON 2 CHLORINATED PLUME

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (3)
Aquifer-Tap Water	Arsenic, inorganic	µg/L	4.63	9.93 (NP1)	20.8F	9.93	µg/L	95% UCL	Note (3)
	Benzene	µg/L	0.14	0.29 (NP1)	0.55	0.290	µg/L	95% UCL	Note (3)
	Dichloroethylene,1,2-cis	µg/L	8.18	64.98 (T1)	61.05	61.05	µg/L	max	Note (1)
	Ethylbenzene	µg/L	0.22	0.910 (NP1)	3.06	0.910	µg/L	95% UCL	Note (3)
	Manganese (Water)	µg/L	2017	2563 (T2)	5040B	2563	µg/L	95% UCL	Note (2)
	Methyl tert-Butyl Ether (MTBE)	µg/L	6.46	32.06 (NP2)	38.51	32.06	µg/L	95% UCL	Note (4)
	Tetrachloroethylene	µg/L	0.15	0.274 (NP1)	0.67	0.274	µg/L	95% UCL	Note (3)
	Trichloroethylene	µg/L	5.59	35.74 (NP2)	47.48	35.74	µg/L	95% UCL	Note (4)
	Vinyl Chloride	µg/L	19.01	331.4 (T1)	88.01	88.01	µg/L	max	Note (1)

Footnote Instructions:

Half the method detection limit was used as a proxy concentration for non-detects.

(1) Distributions: (T1) ProUCL recommended 99% Chebyshev (MVUE) UCL; (NP1) ProUCL recommended 95% Chebyshev (Mean, Std) UCL.
(T2) ProUCL recommended 95% H-UCL; (NP2) ProUCL recommended 99% Chebyshev (Mean, Std) UCL.

(2) Statistics: Maximum Detected Value (Max); 95% UCL (as calculated in Notes)

(3) Rationale Notes: (1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.
(2) Shapiro-Wilk W test indicates data are log-normally distributed. The 95% H-UCL was used (per EPA's ProUCL program).
(3) These data are not log-normally distributed; the Chebyshev 95% nonparametric UCL was used (per EPA's ProUCL program).
(4) These data are not log-normally distibuted; the Chebyshev 99% nonparametric UCL was used (per EPA's ProUCL program).

The following assumptions were specific to the derivation of the exposure point concentration in the risk assessment:

- All data qualified with a "U" indicating that the constituent was not detected above the laboratory detection limit were replaced with a value equal to one-half the laboratory detection limit before the calculation of the 95 percent UCL;
- Only groundwater data were included in the calculation of the 95 percent UCL (i.e., surface water samples and soil samples were excluded). It is assumed that the industrial worker works inside an industrial facility or shop and thus exposure to soil would be minimal, as compared to other occupational receptors.
- For metals data, the total (as opposed to soluble) results were used to determine the exposure point concentrations.

For each COPC listed in Table 6-3, a *ProUCL* spreadsheet is included in Appendix J, showing the statistics used to derive the appropriate EPC (the calculations upon which the ProUCL spreadsheets are based [i.e., listings of temporal averages for each well] are also included in Appendix J). It should be noted that for two compounds, cis-DCE and vinyl chloride, the maximum temporal average concentration from the 2002 and 2003 rounds was used as the EPC, since the 95% UCL as recommended using *ProUCL* exceeded the maximum temporal average for these compounds.

For the inhalation of volatiles from industrial use of groundwater (e.g., washing vehicles), ambient air concentrations were estimated by multiplying the exposure point concentration with a conversion factor of 6.29×10^{-3} L/m^3. The conversion factor is based on the Simple Box Model and the conservative assumption that 100 percent of the volatiles in groundwater will be released to the air, as was used in the RI Baseline Risk Assessments for the AOCs (Law, 1996).

The values used for the RI (Law, 1996) for each exposure parameter and the assumptions used in their derivation (e.g., frequency and duration of exposure), as well as intake values for each exposure pathway evaluated, were also used in this risk assessment. The Values Used for Intake Calculations are summarized in Tables 6-7a and b for the groundwater and air exposure media, respectively. Dermal exposures to analytes in water were adjusted to absorbed dose estimates using chemical-specific permeability constants (Kp values). The permeability constants used to calculate absorbed doses through dermal contact with contaminated groundwater were obtained from the Risk Assessment Information System website, http://risk.lsd.ornl.gov/index.shtml, maintained by the US Department of Energy. Further risk parameters related to dermal exposure were calculated using equations from the Interim Supplemental Guidance (Part E) to the *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (RAGS)*, which provides a consistent methodology for assessing the dermal pathway for Superfund human health risk assessments. The parameters associated with assessing the dermal absorbed dose (DAD) per event for each COPC are summarized in Table 6-8.

TABLE 6-7a
VALUES USED FOR DAILY INTAKE CALCULATIONS FOR GROUNDWATER
REASONABLE MAXIMUM EXPOSURE
NOSEDOCKS/APRON 2 CHLORINATED PLUME

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name (1)
Ingestion	Industrial Workers	Adult	Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.1	mg/L	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg/day) = CWxIR-WxEFxEDx1/BWx1/AT
				IR-W	Ingestion Rate of Water	1	L/day	EPA, 1991	
				EF	Exposure Frequency	250	day/yr	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989a	
				AT-N	Averaging Time - Non-cancer	9,125	days	EPA, 1989a	
Dermal	Industrial Workers	Adult	Aquifer-Tap Water	CW	Chemical Concentration in Water	See Table 3.1	mg/L	See Table 3.1	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EV x ED x EF x SA x 1/BW x 1/AT where for organic compounds, Absorbed Dose per Event (DA-event) (mg/cm2-event) = 2 FA x Kp x CW x CF x SQRT{(6 x tau-event x t-event)/pi} or DA-event = FA x Kp x CW x {(t-event/(1 + B)) + 2 x tau-event x ((1 + (3 x B) + (3 x B x B))/(1 + B)2)} and where for inorganic compounds, DA-event = Kp x CW x CF x t-event
				FA	Fraction Absorbed Water	chemical-specific	--	EPA, 2001	
				Kp	Permeability Constant	chemcial-specific	cm/hr	EPA, 2001	
				SA	Skin Surface Area	3,070	cm2	EPA, 2001	
				tau-event	Lag time per event	chemical-specific	hours/event	EPA, 2001	
				t-event	Event Duration	2	hours/event	EPA, 2001	
				B	Ratio of permeability constant of a compound through the statum corneum relative to its permeability coefficient across the viable epidermis	chemical-specific	--	EPA, 2001	
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	250	days/yr	EPA, 2001	
				ED	Exposure Duration	25	years	EPA, 2001	
				CF	Volumetric Conversion for water	0.001	L/cm3	--	
				BW	Body Weight	70	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-cancer	9,125	days	EPA, 2001	

Footnote Instructions:

(1) Ingestion Intake developed from RAGS D guidance. Dermal Intake developed from RAGS E guidance.

EPA 1989a: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 1991: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

EPA 2001: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim.

TABLE 6-7b
VALUES USED FOR DAILY INTAKE CALCULATIONS FOR AIR
REASONABLE MAXIMUM EXPOSURE
NOSEDOCKS/APRON 2 CHLORINATED PLUME

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name (1)
Inhalation	Industrial Workers	Adult	Aquifer-Tap Water	CA	Chemical Concentration in Air	6.29e-3*EPC	mg/m3	Reference (1)	Inhalation Intake (mg/kg/day) = CAxIR-AxETxEFxEDx1/BWx1/AT
				IR-A	Inhalation Rate of Air	2.5	m3/hr	EPA, 1991	
				ET	Exposure Time	2	hr/day	EPA, 1991	
				EF	Exposure Frequency	250	days/yr	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989a	
				AT-N	Averaging Time - Non-cancer	9,125	days	EPA, 1989a	

Footnote Instructions:

(1) EPC = Exposure Point Concentration. From RI, (Law, 1996), Volume 1 - Figure 5.10.

EPA 1989a: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 1991: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

EPA 2001: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim.

TABLE 6-8
ASSESSING THE DERMAL ABSORBED DOSE PER EVENT
NOSEDOCKS/APRON 2 CHLORINATED PLUME

	Permeability Constant (=Kp) (cm/hr) [1]	Molecular Weight (g/mol)	B[2]	tau-event[3]	t*[4]	which is greater - tevent or t*[5]	FA[6,7]	Daevent/Cw[8]
Arsenic, Inorganic	1.00E-03	77.95	0.003395742	0.286885963	0.688526311	tevent	na	0.002
Benzene	1.50E-02	78.11	0.050988382	0.287478453	0.689948287	tevent	1	0.03760762
Dichloroethylene, 1,2-cis-	0.0149	96.94	0.056424072	0.366482549	0.879558117	tevent	1	0.039744008
Ethylbenzene	4.90E-02	106.17	0.19418856	0.412801531	0.990723674	tevent	1	0.130166726
Manganese (Water)	1.00E-03	54.94	0.002850828	0.213232451	0.511757883	tevent	na	0.002
Methyl tert-Butyl Ether (MTBE)	0.00257	88.15	0.009280491	0.327212058	0.785308939	tevent	1	0.006790214
Tetrachloroethylene	3.30E-02	165.83	0.163445189	0.890917109	2.138201061	t*	1	0.121752608
Trichloroethylene	1.20E-02	131.39	0.052904066	0.571443503	1.371464406	tevent	1	0.037232472
Vinyl Chloride	5.60E-03	62.5	0.017027649	0.23506572	0.564157727	tevent	1	0.013690036

[1] Obtained from Exhibits B-3 (for organics) or 3-1 (inorganics), RAGS E, except for cis-1,2-DCE and MTBE (obtained from Toxicity Metadata at RAIS website, http://risk.lsd.ornl.gov/index.shtml).

[2] Calculated from B = Kp*(MW^0.5)/2.6, MW = molecular weight.

[3] Calculated from tauevent = 0.105*(10^(0.0056*MW)).

[4] Calculated from t* = 2.4*tauevent (B was less than 0.6 in all cases).

[5] Assumes tevent = 2 hours.

[5] FA = Fraction absorbed (NA = not available or relevant for inorganics).

[7] MTBE FA was assumed to be 1.0 based on Exhibit A-5, RAGS E.

[8] For inorganics, DAevent/Cw = Kp*tevent. For organics, Daevent/CW=2*FA*Kp*(((6*tauevent*tevent)/PI)^0.5) when tevent is less than or equal to t*.

When tevent is greater than t*, Daevent/Cw = F*Kp*((tevent/(1+B))+(2*tauevent*((1+(3*B)+(3*B^2))/((1+B)^2)).

6.2.3 Toxicity Assessment

The toxicity assessment provides information regarding the potential for a specific chemical to cause adverse health effects in humans and characterizes the relationship between the dose of a chemical and the incidence of adverse health effects in the exposed population. The systemic and carcinogenic effects of chemicals are evaluated based on reference doses (RfDs) and cancer slope factors. The following sections describe toxicity values used to evaluate potential risks from exposure to chemicals at the site.

6.2.3.1 Toxicity Values for Noncarcinogenic and Carcinogenic Effects

The EPA has developed toxicity values that reflect the magnitude of the adverse noncarcinogenic and carcinogenic effects from exposure to specific chemicals. The toxicity values for COCs detected in the site groundwater were obtained from the Integrated Risk Information System (IRIS, 2002), now available on-line. If the toxicity values were not provided in IRIS, secondary sources included the Health Effects Assessment Summary Tables for 1995 (HEAST, 1995) and the National Center for Environmental Assessment (NCEA, 1996). These values were all summarized at the Risk Assessment Information System website, http://risk.lsd.ornl.gov/index.shtml, maintained by the US Department of Energy, and were current as of September 2003.

For noncarcinogenic effects, chronic RfDs were used because potential exposure is likely to occur over an extended period of time. The Non-cancer Toxicity Data for Oral/Dermal and Inhalation are included in Tables 6-9 a and b, respectively. For carcinogenic effects, several constituents detected in the groundwater are considered human carcinogens or suspected human carcinogens. Cancer slope factors were available for most of the carcinogenic COCs detected. The Cancer Toxicity Data for Oral/Dermal and Inhalation are included in Tables 6-10 a and b, respectively. For the dermal route of exposure, the dermal RfDs and slope factors were calculated using the gastrointestinal absorption factor (ABS_{GI}) for each compound, and converting the oral RfD and cancer slope factor appropriately (i.e., the dermal RfD corresponds to the Oral Chronic RfD*ABS_{GI}, and the dermal cancer slope factor corresponds to the oral slope factor/ABS_{GI} [in accordance with the *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual, Part E*]).

6.2.4 Risk Characterization

The risk characterization integrates the results of exposure and toxicity assessments into quantitative and qualitative expressions of risk associated with exposure to COCs. Risks that the industrial worker might experience are determined by combining the relevant pathways with appropriate exposure factors into a risk scenario. Quantitative estimates of carcinogenic risk and noncarcinogenic benchmark values were calculated across the site. Risk estimates were

TABLE 6-9a
NON-CANCER TOXICITY DATA
ORAL/DERMAL
NOSEDOCKS/APRON 2 CHLORINATED PLUME

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Arsenic, inorganic	Chronic	3E-04	mg/(kg-day)	0.41	1.23E-04	mg/(kg-day)	NA	3	IRIS	09/21/2003
	Subchronic	5E-03	mg/(kg-day)	0.41	2.05E-03	mg/(kg-day)	NA	3	NA	09/21/2003
Benzene	Chronic	4E-03	mg/(kg-day)	0.97	3.88E-03	mg/(kg-day)	NA	300	IRIS	09/21/2003
Dichloroethylene,1,2-cis	Chronic	1E-02	mg/(kg-day)	1.00	1.00E-02	mg/(kg-day)	Blood	3000	NA	09/21/2003
	Subchronic	1E-01	mg/(kg-day)	1.00	1.00E-01	mg/(kg-day)	Blood	3000	NA	09/21/2003
Ethylbenzene	Chronic	1E-01	mg/(kg-day)	0.97	9.70E-02	mg/(kg-day)	Liver/Kidney	1000	IRIS-WD	09/21/2003
	Subchronic	1.1E-01	mg/(kg-day)	0.97	1.07E-01	mg/(kg-day)	Liver/Kidney	1000	IRIS-WD	09/21/2003
Manganese (Water)	Chronic	4.6E-02	mg/(kg-day)	0.04	1.84E-03	mg/(kg-day)	NA	1	IRIS	09/21/2003
	Subchronic	5.0E-03	mg/(kg-day)	0.04	2.00E-04	mg/(kg-day)	NA	1	IRIS-WD	09/21/2003
Methyl tert-Butyl Ether (MTBE)	Chronic	--	--	0.80	--	mg/(kg-day)	NA	--	--	--
Tetrachloroethylene	Chronic	1E-02	mg/(kg-day)	1.00	1.00E-02	mg/(kg-day)	NA	1000	IRIS	09/21/2003
	Subchronic	1E-01	mg/(kg-day)	1.00	1.00E-01	mg/(kg-day)	NA	1000	HEAST	09/21/2003
Trichloroethylene	Chronic	3E-04	mg/(kg-day)	0.15	4.50E-05	mg/(kg-day)	NA	NA	NCEA	09/21/2003
Vinyl Chloride	Chronic	3E-03	mg/(kg-day)	1.00	3.00E-03	mg/(kg-day)	Liver	30	IRIS	09/21/2003

Footnote Instructions:

(1) Source: Risk Assessment Information System, September 2003. http://risk.lsd.ornl.gov/cgi-bin/tox/TOX_select?select=nrad

Definitions:

NA = Not available
IRIS = Integrated Risk Information System
HEAST = Health Effects Assessment Summary Table, 1995
NCEA = National Center for Environmental Assessment
IRIS-WD = Value withdrawn from IRIS

TABLE 6-9b
NON-CANCER TOXICITY DATA
INHALATION
NOSEDOCKS/APRON 2 CHLORINATED PLUME

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Benzene	Chronic	3E-02	mg/m3	8.57E-03	mg/kg/day	NA	300	IRIS	09/21/2003
Dichloroethylene,1,2-cis	Chronic	--	mg/m3	--	mg/kg/day	NA	--	--	--
Ethylbenzene	Chronic	1E+00	mg/m3	2.86E-01	mg/kg/day	NA	300	IRIS-WD	09/21/2003
	Subchronic	1E+00	mg/m3	2.90E-01	mg/kg/day	NA	300	IRIS-WD	09/21/2003
Methyl tert-Butyl Ether (	Chronic	3E+00	mg/m3	8.57E-01	mg/kg/day	Liver/Kidney	100	IRIS	09/21/2003
Tetrachloroethylene	Chronic	6E-01	mg/m3	1.71E-01	mg/kg/day	Kidney	30	IRIS-WD	09/21/2003
Trichloroethylene	Chronic	4E-02	mg/m3	1.14E-02	mg/kg/day	NA	NA	NCEA	09/21/2003
Vinyl Chloride	Chronic	1E-01	mg/m3	2.86E-02	mg/kg/day	Liver	30	IRIS	09/21/2003

Footnote Instructions:

(1) Calculated from RfC * 20 m3/day/70 kg, as described in the Risk Assessment Information System, September 2003. http://risk.lsd.ornl.gov/cgi-bin/tox/TOX_select?select=nrad

Definitions:
NA = Not available
IRIS = Integrated Risk Information System
HEAST = Health Effects Assessment Summary Table, July 1997
NCEA = National Center for Environmental Assessment

TABLE 6-10a
CANCER TOXICITY DATA
ORAL/DERMAL
NOSEDOCKS/APRON 2 CHLORINATED PLUME

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Arsenic, inorganic	1.50	1/(mg/kg-day)	0.41	3.659	1/(mg/kg-day)	A	IRIS	09/21/2003
Benzene	0.055	1/(mg/kg-day)	0.97	0.057	1/(mg/kg-day)	A	IRIS	09/21/2003
Dichloroethylene,1,2-cis	--	1/(mg/kg-day)	1	--	1/(mg/kg-day)	D	--	--
Ethylbenzene	--	1/(mg/kg-day)	0.97	--	1/(mg/kg-day)	B2	--	--
Manganese (Water)	--	1/(mg/kg-day)	0.04	--	1/(mg/kg-day)	D	--	--
Methyl tert-Butyl Ether (MTBE)	--	1/(mg/kg-day)	0.8	--	1/(mg/kg-day)	NA	--	--
Tetrachloroethylene	0.052	1/(mg/kg-day)	1	0.052	1/(mg/kg-day)	NA	Provisional[1]	09/21/2003
Trichloroethylene	0.40	1/(mg/kg-day)	0.15	2.667	1/(mg/kg-day)	NA	NCEA	09/21/2003
Vinyl Chloride	1.40	1/(mg/kg-day)	1	1.40	1/(mg/kg-day)	A	IRIS	09/21/2003

Footnote Instructions:

(1) Source: Risk Assessment Information System, September 2003. http://risk.lsd.ornl.gov/cgi-bin/tox/TOX_select?select=nrad

Definitions:		
	A	Human carcinogen
	B2	Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.
	D	Not classifiable as a human carcinogen.
	NA	Not available.
	IRIS	Integrated Risk Information System
	NCEA	National Center for Environmental Assessment
	Provisional1	As provided by the Superfund Technical Support Center, NCEA.

TABLE 6-10b
CANCER TOXICITY DATA
INHALATION
NOSEDOCKS/APRON 2 CHLORINATED PLUME

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Benzene	7.8E-03	1/(mg/m^3)	2.73E-02	1/(mg/kg-day)	A	IRIS/Calc	09/21/2003
Dichloroethylene,1,2-cis	--	1/(mg/m^3)	--	1/(mg/kg-day)	D	--	--
Ethylbenzene	1.1E-03	1/(mg/m^3)	3.85E-03	1/(mg/kg-day)	B2	NCEA/Calc	09/21/2003
Methyl tert-Butyl Ether (MTBE)	--	1/(mg/m^3)	--	1/(mg/kg-day)	NA	--	--
Tetrachloroethylene	5.8E-04	1/(mg/m^3)	2.03E-03	1/(mg/kg-day)	NA	Provisional1/Calc	09/21/2003
Trichloroethylene	--	1/(mg/m^3)	4.00E-01	1/(mg/kg-day)	NA	NCEA	09/21/2003
Vinyl Chloride	8.8E-03	1/(mg/m^3)	3.08E-02	1/(mg/kg-day)	A	IRIS/Calc	09/21/2003

Definitions:		
	A	Human carcinogen
	B2	Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.
	D	Not classifiable as a human carcinogen.
	NA	Not available.
	IRIS	Integrated Risk Information System
	NCEA	National Center for Environmental Assessment
	Provisional1	As provided by the Superfund Technical Support Center, NCEA.

calculated using the appropriate 95 percent UCL as recommended by EPA's *ProUCL* program. Pathway risk estimates were summed to obtain the total risk from exposure to an industrial worker. Table 6-11 includes the chronic hazard index estimates and carcinogenic risks for the industrial worker exposed to potential COCs via groundwater ingestion, dermal contact with groundwater (considered during washing activities only), and inhalation of VOCs from groundwater.

6.2.4.1 Noncarcinogenic Health Effects Characterization

The benchmark level for evaluating noncarcinogenic effects, according to the EPA, is a hazard index (HI) of 1.0. A hazard index of 1.0 or less indicates that exposure to potential contaminants is not expected to result in adverse noncarcinogenic health effects. The potential noncarcinogenic health effects arising from exposure to groundwater as measured in permanent monitoring wells across the Nosedocks/Apron 2 Chlorinated Plume can be summarized for the industrial worker at 3.38. This cumulative hazard index exceeds the benchmark value, and includes the calculated hazard indices for ingestion of groundwater, dermal exposure to groundwater, and inhalation of volatiles released from groundwater at 2.38, 0.996, and 0.00193, respectively. Of the volatile organic COCs, trichloroethene and vinyl chloride were the greatest contributors to the ingestion of groundwater pathway hazard index with hazard quotients (HQs) of 1.17 and 0.287, respectively. Manganese and arsenic posed the greatest HQs of the metals COCs for ingestion of groundwater at 0.545 and 0.324, respectively.

6.2.4.2 Carcinogenic Risk

The NCP defines the target risk range for exposure to carcinogenic compounds as an excess upper bound lifetime risk within the range 10^{-4} to 10^{-6}. This translates to one excess cancer in a population of ten thousand to one excess cancer in a population of one million. Potential risks from exposure to carcinogens across the Nosedocks/Apron 2 Chlorinated Plume were evaluated for industrial workers' exposure to groundwater. The cumulative risk from exposure to contaminants in groundwater as measured in permanent monitoring well samples by industrial workers is 5.92×10^{-4}, which exceeds the EPA's target risk range. The pathway-specific risks from ingestion, dermal exposure to groundwater, and inhalation of volatiles released from groundwater as measured in permanent monitoring wells were 5.33×10^{-4}, 5.70×10^{-5}, and 1.87×10^{-6}, respectively. Vinyl chloride was the major volatile organic COC risk contributor for this exposure scenario for the ingestion pathway (4.31×10^{-4}).

6.2.4.3 Risk Characterization Evaluation

The Summary of Receptor Risks and Hazards for Chemicals of Potential Concern is provided in Table 6-12. The baseline risk assessment for industrial/commercial use indicates that the levels of VC in the groundwater exceed EPA's carcinogenic risk range, and TCE poses a

TABLE 6-11
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
NOSEDOCKS/APRON 2 CHLORINATED PLUME

Scenario Timeframe:	Future
Receptor Population:	Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Aquifer - Tap Water	Ingestion	Arsenic, inorganic	9.93E-03	mg/L	3.469E-05	mg/kg-day	1.5	1/(mg/kg-day)	5.2E-05	9.713E-05	mg/kg-day	3.00E-04	mg/kg-day	3.24E-01
				Benzene	2.90E-04	mg/L	1.012E-06	mg/kg-day	0.0550	1/(mg/kg-day)	5.6E-08	2.833E-06	mg/kg-day	4.00E-03	mg/kg-day	7.08E-04
				Dichloroethylene,1,2-cis	6.10E-02	mg/L	2.133E-04	mg/kg-day	--	1/(mg/kg-day)	--	5.973E-04	mg/kg-day	1.00E-02	mg/kg-day	5.97E-02
				Ethylbenzene	9.10E-04	mg/L	3.180E-06	mg/kg-day	--	1/(mg/kg-day)	--	8.905E-06	mg/kg-day	1.00E-01	mg/kg-day	8.91E-05
				Manganese (Water)	2.56E+00	mg/L	8.958E-03	mg/kg-day	--	1/(mg/kg-day)	--	2.508E-02	mg/kg-day	4.60E-02	mg/kg-day	5.45E-01
				Methyl tert-Butyl Ether (MTBE)	3.21E-02	mg/L	1.120E-04	mg/kg-day	--	1/(mg/kg-day)	--	3.137E-04	mg/kg-day	--	mg/kg-day	--
				Tetrachloroethylene	2.74E-04	mg/L	9.584E-07	mg/kg-day	0.052	1/(mg/kg-day)	5.0E-08	2.683E-06	mg/kg-day	1.00E-02	mg/kg-day	2.68E-04
				Trichloroethylene	3.57E-02	mg/L	1.249E-04	mg/kg-day	0.40	1/(mg/kg-day)	5.0E-05	3.497E-04	mg/kg-day	3.00E-04	mg/kg-day	1.17E+00
				Vinyl Chloride	8.80E-02	mg/L	3.076E-04	mg/kg-day	1.40	1/(mg/kg-day)	4.3E-04	8.612E-04	mg/kg-day	3.00E-03	mg/kg-day	2.87E-01
			Exp. Route Total		DA-event		DAD				5.3E-04					2.4E+00
			Dermal	Arsenic, inorganic	1.99E-08	mg/cm2-event	2.130E-07	mg/kg-day	3.66	1/(mg/kg-day)	7.8E-07	6.0E-07	mg/kg-day	1.23E-04	mg/kg-day	4.85E-03
				Benzene	1.09E-08	mg/cm2-event	1.168E-07	mg/kg-day	0.0567	1/(mg/kg-day)	6.6E-09	3.3E-07	mg/kg-day	3.88E-03	mg/kg-day	8.43E-05
				Dichloroethylene,1,2-cis	2.43E-06	mg/cm2-event	2.603E-05	mg/kg-day	--	1/(mg/kg-day)	--	7.3E-05	mg/kg-day	1.00E-02	mg/kg-day	7.29E-03
				Ethylbenzene	1.18E-07	mg/cm2-event	1.271E-06	mg/kg-day	--	1/(mg/kg-day)	--	3.6E-06	mg/kg-day	9.70E-02	mg/kg-day	3.67E-05
				Manganese (Water)	5.13E-06	mg/cm2-event	5.500E-05	mg/kg-day	--	1/(mg/kg-day)	--	1.5E-04	mg/kg-day	1.84E-03	mg/kg-day	8.37E-02
				Methyl tert-Butyl Ether (MTBE)	2.18E-07	mg/cm2-event	2.335E-06	mg/kg-day	--	1/(mg/kg-day)	--	6.5E-06	mg/kg-day	--	mg/kg-day	--
				Tetrachloroethylene	3.34E-08	mg/cm2-event	3.582E-07	mg/kg-day	0.052	1/(mg/kg-day)	1.9E-08	1.0E-06	mg/kg-day	1.00E-02	mg/kg-day	1.00E-04
				Trichloroethylene	1.33E-06	mg/cm2-event	1.427E-05	mg/kg-day	2.67	1/(mg/kg-day)	3.8E-05	4.0E-05	mg/kg-day	4.50E-05	mg/kg-day	8.88E-01
				Vinyl Chloride	1.20E-06	mg/cm2-event	1.293E-05	mg/kg-day	1.40	1/(mg/kg-day)	1.8E-05	3.6E-05	mg/kg-day	3.00E-03	mg/kg-day	1.21E-02
			Exp. Route Total								5.70E-05					9.96E-01
		Exposure Point Total									5.90E-04					3.38E+00
	Exposure Medium Total										5.90E-04					3.38E+00
	Air	Water Vapors from cleaning trucks	Inhalation	Benzene	2.90E-04	mg/L	3.18E-08	mg/kg-day	2.7E-02	1/(mg/kg-day)	8.7E-10	8.91E-08	mg/kg-day	8.6E-03	mg/kg-day	1.04E-05
				Dichloroethylene,1,2-cis	6.10E-02	mg/L	6.71E-06	mg/kg-day	--	--	--	1.88E-05	mg/kg-day	--	mg/kg-day	--
				Ethylbenzene	9.10E-04	mg/L	1.00E-07	mg/kg-day	3.9E-03	1/(mg/kg-day)	3.9E-10	2.80E-07	mg/kg-day	2.9E-01	mg/kg-day	9.79E-07
				Methyl tert-Butyl Ether (MTBE)	3.21E-02	mg/L	3.52E-06	mg/kg-day	--	--	--	9.87E-06	mg/kg-day	8.6E-01	mg/kg-day	1.15E-05
				Tetrachloroethylene	2.74E-04	mg/L	3.01E-08	mg/kg-day	2.0E-03	1/(mg/kg-day)	6.1E-11	8.44E-08	mg/kg-day	1.7E-01	mg/kg-day	4.94E-07
				Trichloroethylene	3.57E-02	mg/L	3.93E-06	mg/kg-day	4.0E-01	1/(mg/kg-day)	1.6E-06	1.10E-05	mg/kg-day	1.1E-02	mg/kg-day	9.65E-04
				Vinyl Chloride	8.80E-02	mg/L	9.67E-06	mg/kg-day	3.1E-02	1/(mg/kg-day)	3.0E-07	2.71E-05	mg/kg-day	2.9E-02	mg/kg-day	9.47E-04
			Exp. Route Total								1.9E-06					1.9E-03
		Exposure Point Total									1.9E-06					1.9E-03
	Exposure Medium Total										1.9E-06					1.9E-03
Groundwater Total											5.9E-04					3.4E+00

Footnote Instructions:

TABLE 6-12
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
NOSEDOCKS/APRON 2 CHLORINATED PLUME

Scenario Timeframe:	Future
Receptor Population:	Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer - Tap Water	Arsenic, inorganic	5.20E-05	NA	7.79E-07	NA	5.28E-05	NA	3.24E-01	NA	4.85E-03	3.29E-01
			Benzene	5.57E-08	NA	6.62E-09	NA	6.23E-08	NA	7.08E-04	NA	8.43E-05	7.93E-04
			Dichloroethylene,1,2-cis	--	NA	--	NA	0.00E+00	Blood	5.97E-02	NA	7.29E-03	6.70E-02
			Ethylbenzene	--	NA	--	NA	0.00E+00	Liver/Kidney	8.91E-05	NA	3.67E-05	1.26E-04
			Manganese (Water)	--	NA	--	NA	0.00E+00	NA	5.45E-01	NA	8.37E-02	6.29E-01
			Methyl tert-Butyl Ether (MTBE)	--	NA	--	NA	0.00E+00	NA	--	NA	--	0.00E+00
			Tetrachloroethylene	4.98E-08	NA	1.86E-08	NA	6.85E-08	NA	2.68E-04	NA	1.00E-04	3.69E-04
			Trichloroethylene	5.00E-05	NA	3.81E-05	NA	8.80E-05	NA	1.17E+00	NA	8.88E-01	2.05E+00
			Vinyl Chloride	4.31E-04	NA	1.81E-05	NA	4.49E-04	Liver	2.87E-01	NA	1.21E-02	2.99E-01
			Chemical Total	5.33E-04	NA	5.70E-05	NA	5.90E-04		2.38E+00	NA	9.96E-01	3.38E+00
		Exposure Point Total						5.90E-04					3.38E+00
	Exposure Medium Total							5.90E-04					3.38E+00
	Air		Benzene	NA	8.7E-10	NA	NA	8.69E-10	NA	NA	1.04E-05	NA	1.04E-05
			Dichloroethylene,1,2-cis	NA	--	NA	NA	--	Blood	NA	--	NA	--
			Ethylbenzene	NA	3.85E-10	NA	NA	3.85E-10	Liver/Kidney	NA	9.79E-07	NA	9.79E-07
			Methyl tert-Butyl Ether (MTBE)	NA	--	NA	NA	--	NA	NA	1.15E-05	NA	1.15E-05
			Tetrachloroethylene	NA	6.12E-11	NA	NA	6.12E-11	NA	NA	4.94E-07	NA	4.94E-07
			Trichloroethylene	NA	1.571E-06	NA	NA	1.57E-06	NA	NA	9.65E-04	NA	9.65E-04
			Vinyl Chloride	NA	2.9792E-07	NA	NA	2.98E-07	Liver	NA	9.47E-04	NA	9.47E-04
			Chemical Total	NA	1.87E-06	NA	NA	1.87E-06		NA	1.93E-03	NA	1.93E-03
		Exposure Point Total						1.87E-06					1.93E-03
	Exposure Medium Total							1.87E-06					1.93E-03
Medium Total								5.92E-04					3.38E+00
Receptor Total							Receptor Risk Total	5.92E-04				Receptor HI Total	3.38E+00

Total Blood HI Across All Media	6.70E-02
Total Liver HI Across All Media	3.00E-01

potential non-carcinogenic risk to industrial workers. Because industrial use of the groundwater is highly unlikely, no removal action is warranted. However, land use restrictions should be placed in the deed prior to property transfer, ensuring that: (a) the property will be maintained for industrial/commercial use only, unless permission is obtained from the EPA and NYSDEC; and (b) the owner or occupant of the property shall not extract, utilize, consume, or permit to be extracted any water from the aquifer below the ground surface within the boundary of the property unless prior written approval has been obtained from the New York State Department of Health (NYSDOH).

6.2.5 Uncertainties Evaluation

Uncertainty exists in many areas of the human health assessment. However, use of conservative variables in intake calculations and conservative assumptions throughout the risk assessment results in an assessment that is protective of human health. The site-specific uncertainties for the baseline risk assessment for the site are as follows:

- In quantifying exposure, it was assumed that chemicals are uniformly distributed over a defined area, i.e., the chlorinated plume extent. At this site, samples were collected from the areas suspected to be contaminated, with a focus on the source area. Areas on the plume fringes, characterized by lower levels of contamination, were not as frequently investigated. Data collected in this manner, rather than through random sampling, result in a biased data set which may overestimate risk.
- In the calculation of the EPC term for each compound, non-detect results were replaced with half the method detection limit. However, in some cases, particularly trichloroethylene, non-detect results characterized more than 25% of the total results (68% for trichloroethylene). With such a high fraction of nondetects, goodness-of-fit tests fail (i.e., data are neither normally or lognormally distributed), resulting in the use of conservative nonparametric UCLs which are biased high and may overestimate risk.
- Inhalation RfDs and cancer slope factors were unavailable for many chemicals detected in the groundwater (including cis-DCE, MTBE, and ethylbenzene). The risks of potential exposure to compounds of unknown toxicity could not be quantified. This may result in underestimation of the overall risk.

While some of the uncertainties identified above may underestimate the potential risks from exposure to groundwater associated with the southern chlorinated solvent plume, overall the use of conservative assumptions throughout the risk assessment results in an assessment that is protective of human health.

6.3 ENVIRONMENTAL EVALUATION

There are no plant and animal species at the base or in the immediate vicinity of the base that are considered to be threatened or endangered by the U.S. Department of the Interior. Though some plant species present at the base are protected in the state of New York, these species have not been found in this portion of the base. Therefore, threatened and endangered species are not considered to be a concern at this site. Also, the site is located in a highly developed portion of the base.

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7.0 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the site background, scope of the field investigation, site characteristics, nature and extent of contamination, and baseline risk assessment, and provides recommendations for future work at the site.

7.1 SITE SUMMARY

7.1.1 Site Background

The Nosedocks (Buildings 782 through 786) are located in the southeast portion of Griffiss AFB between Aprons 1 and 2. The site is topographically flat, with surface drainage directed into the stormwater drainage system (via OWS 6389-3), and a drainage swale located between the northern edge of the paved parking area and the southern edge of Apron 1.

The Site consists of one main area of contamination, consisting of two chlorinated solvent plumes. The main plume consists of dissolved concentrations in permanent monitoring wells of TCE up to 50 µg/L, and daughter product concentrations of cis-DCE and VC up to 66 µg/L and 100 µg/L, respectively. The plume appears to be degrading to ethene before discharging to Six Mile Creek. The reductive dechlorination/biotransformation observed in the southern portion of this main plume appears to be driven by the presence of MTBE, which is commingling with the southern portion of the main plume. MTBE (or other fuel/petroleum-related components associated with MTBE that have since been degraded in the subsurface) may serve as either a carbon source or a cosubstrate, whose fermentation may provide the hydrogen donor necessary to fuel the reductive dechlorination pathway.

A second (northern) plume appears to start in the vicinity of Building 782 near Manhole 19, just upstream (with respect to the former Nosedocks Wash Waste System) of the OWS 5730. This plume has shown evidence of reductive dechlorination through cis-DCE only (i.e., it has not progressed to vinyl chloride or ethene). However, based on the observation that downgradient wells (i.e., 782VMW-86 and -89) do not report chlorinated solvent concentrations above their respective detection limits, the plume may undergo further degradation either by anaerobic cometabolism of petroleum-related VOCs from the OWS, or from aerobic oxidation of cis-DCE. MTBE, however, was identified at wells located downgradient of the northern chlorinated plume, forming a narrow plume extending approximately 900 ft from just north of Building 782 to 782MW-9.

A possible source area for the main, southern chlorinated plume is the former Nosedocks Wash Waste System, that runs the length of the distance between the front (north) side of Building 786 through 782. Although some low levels of TCE were found north of the former Nosedocks Wash Waste System (i.e., in the soil at 782VMW-107 at 16 ft bgs [36 ppb], and in the shallow groundwater at 782VMW-107 and -109 [approximately 9 µg/L]), these levels are not deemed high enough to suspect an additional source area. The source area for the northern chlorinated plume may be associated with the former Nosedocks Wash Waste System at Manhole 18.

7.1.2 Scope of Field Investigation

- Collected Hydropunch® groundwater samples from 39 soil borings for off-site analysis of VOCs;
- Collected soil samples from eight borings for VOC analysis;
- Installed 28 wells screened across the zone with the highest concentration of chlorinated hydrocarbons reported during the vertical profiling;
- Installed two bedrock wells and submitted groundwater samples for VOC analysis to evaluate potential bedrock aquifer contamination;
- Collected groundwater samples from the 28 new wells and six existing wells for analysis of VOCs and geochemical parameters to evaluate the extent of ongoing biodegradation across the plume. Most wells were sampled during two monitoring rounds, conducted in February 2002 and February 2003;
- Collected surface water and groundwater seepage samples downgradient of the main, southern chlorinated plum to evaluate the plume transport off-site.

7.1.3 Site Characteristics

- Surface water runoff is to Six Mile Creek via the base storm drain system.
- Surface soils (from 0 ft bgs to approximately 20 ft bgs) consist of a uniform brown, silty fine sand, with variable quantities of gravel and occasional clay. The soil appears to be fill material.
- The native material beneath the fill underneath the Apron area consists of brown, silty fine to coarse sand with variable quantities of gravel.
- Beneath a thin (up to 3 ft) clay layer which supports perched groundwater conditions at some locations, subsurface soils at or near the top of the groundwater table (mainly from 25 ft bgs to 35 ft bgs) consist of gray/brown gravelly sands with trace silt, generally followed by gray medium to fine sand with varying amounts of silt.
- Finally, the till layer (generally from 40 to 60 ft bgs) consists of a gray silt with some sand and subrounded gravel, varying in density from soft to very stiff. Occasional shale fragments were also encountered, and the top of bedrock was inferred from auger/split spoon refusal.
- Depth to saturated conditions ranged from 7 (782VMW-101) to approximately 23.3 ft bgs (782VMW-79).
- Groundwater flow direction is the northeast-east toward Six Mile Creek.

7.1.4 Nature and Extent of Contamination

7.1.4.1 Main (Southern) Chlorinated Plume

- Plume Extent (main plume): Based on 2002 results, chlorinated VOCs were detected in the groundwater at concentrations up to 87.3 µg/L (vinyl chloride only) at 782VMW-96 (in a Hydropunch® sample collected at 39'). The main chlorinated solvent plume was observed to extend from the source area, associated with the former Nosedocks Wash Waste System near Manhole 15, to just upgradient of Six Mile Creek. Although two groundwater seep samples (782SW-114 and -116) indicated levels of VC above the detection limit but below NYS Groundwater Effluent Limitations, the results of surface water samples (collected during two sampling rounds) confirmed that the VC is either biodegraded or volatilized prior to discharging to Six Mile Creek. The vertical profile wells (Hydropunch® samples) exhibiting the highest total chlorinated ethenes concentrations (including all sampling intervals) were those closest downgradient of the source area consisting of mostly cis-DCE — 782VMW-80 (131 µg/L) and -81 (217 µg/L) — and those further downgradient and consisting of mostly VC — 782VMW-93 (173 µg/L), -96 (133 µg/L), and -84 (135 µg/L). The contamination has traveled both laterally, up to approximately 2,800 feet to the northeast/east towards Six Mile Creek, and vertically, approximately 33 feet downward from the approximate depth of the wash waste system at 16 ft bgs to approximately 55 ft bgs. The width of the plume is approximately 200 feet near Manhole 15/the Nosedocks Wash Waste System and 400 to 500 feet at the leading edge (where it appears to discharge to Six Mile Creek). The plume extends to the overburden immediately above bedrock at several locations, including 782VMW-76, -81, -84, -87, -88, -93, -96, and -101.
- Source Area (main plume): Chlorinated VOCs were detected in the groundwater at concentrations up to 173 µg/L (total chlorinated solvents) at 782VMW-105b (in a Hydropunch® sample collected at 39'). The vertical profile well exhibiting the highest total chlorinated solvents concentration (including all Hydropunch® sampling intervals) was 782VMW-105b (246 µg/L). TCE was measured at levels up to 66 µg/L (as indicated in the Hydropunch® sample collected at 30').
- Source Area soils (main plume): Chlorinated VOCs were detected in the subsurface soil (from approximately 14 ft bgs to 16 ft bgs) at concentrations up to 36 µg/kg.
- Bedrock Aquifer Evaluation: Results from bedrock well sampling indicated that the chlorinated VOCs have not migrated to the bedrock aquifer.

7.1.4.2 Northern Chlorinated Plume

- Plume Extent (northern plume): Chlorinated VOCs were detected in the groundwater at concentrations up to 61.5 µg/L (cis-DCE only) at 782VMW-90 (in a Hydropunch® sample collected at 26'). The vertical profile well exhibiting the highest total chlorinated solvents concentration (including all Hydropunch® sampling intervals) was 782VMW-90 (68.4 µg/L). The northern chlorinated solvent plume was observed to extend from the source area, associated with the former Nosedocks Wash Waste System near Manhole 18, to just upgradient of the wells 782VMW-86, -89, and -85. No degradation to vinyl chloride was observed in conjunction with this plume. The northern chlorinated plume has traveled laterally approximately 480 feet from the potential source area at Manhole 18 to the drainage swale area northeast of Building 782. The plume does not appear to have traveled vertically, since it was detected in two samples only at well locations 782VMW-90 and -95, at depths of 26 and 29 ft bgs, respectively. The width of the plume is approximated at 200 ft.

- Source Area (northern plume): Chlorinated VOCs were detected in the groundwater at concentrations up to 9 µg/L TCE, near 782VMW-95 (in a Hydropunch® sample collected at 29'). Precise delineation of the upgradient and/or source area for the northern plume was not performed due to the low chlorinated compound concentrations measured relative to the southern, main plume.

7.1.4.3 MTBE Plumes

- MTBE concentrations of up to 251 µg/L (at 782VMW-102) were reported in the groundwater, and two separate MTBE plume areas were delineated, one located just north and downgradient of the northern chlorinated plume, and one commingling with the main chlorinated plume. MTBE was found at levels above NYS Surface Water Standards in samples collected from Six Mile Creek. MTBE levels above NYS Groundwater Standards were recorded at depths up to 57 ft bgs at 782VMW-80. Based on groundwater contours and sampling results, the source area for the larger MTBE plume (to the south) is presumed to be related to former Building 7001. The data were not sufficient to identify the potential source area for the shorter, northern MTBE plume. The source area for the smaller MTBE plume may be the former trench fire area associated with the Nosedocks 1 and 2 AOC, or the former jet fuel pipeline associated with Apron 1. These plumes are being investigated separately under the Petroleum Spill Sites LTM Program (FPM, 2002) (Building 7001 and Aprons 1 and 2).

7.1.5 Baseline Risk Assessment

- Based on an industrial land-use scenario, groundwater at the site may be used in the future by workers in the vicinity for industrial purposes. Consequently, risks associated with exposure of industrial workers to groundwater at the site (as defined by the main southern chlorinated plume only) were evaluated using the dermal exposure, inhalation of VOCs, and ingestion pathways.
- The incremental hazard index for exposure to groundwater was 3.38, above the EPA benchmark value, and the cancer risk for groundwater exposure was estimated at 5.92×10^{-4}, also exceeding the EPA's target risk range.

- While industrial use of the groundwater is unlikely, restrictions will be placed in the deed prior to property transfer.

7.2 DATA LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORK

Given the following observations for the main chlorinated plume:

- The concentrations of chlorinated compounds appear to be decreasing along the length of the plume via biodegradation processes;
- The source area does not indicate the presence of DNAPL and appears to consist of dissolved concentrations of TCE only (at levels up to 66 µg/L);
- Industrial use of the groundwater is unlikely, and deed restrictions/institutional controls would be implemented prior to transfer to limit use and/or exposure to the groundwater; and
- The chlorinated compound contamination is not traveling off-site (i.e., chlorinated compounds were not detected in downgradient Six Mile Creek samples);

Based on the results of the environmental sampling in the vicinity of the Nosedocks/Apron 2 Chlorinated Plume and the baseline risk assessment, the following is recommended:

- LTM of groundwater to confirm that concentrations across the site are not increasing and to verify that the COC concentrations are decreasing within the plume area.
- Surface water and/or sediment sampling in the vicinity of Six Mile Creek downgradient of the plume to confirm that contaminant concentrations are not migrating off-site.
- Petroleum-related contamination (including MTBE) identified in this investigation shall be further characterized under the Petroleum Spill Sites LTM work plan for Apron 2 (NYSDEC Petroleum Spill #9713631), Apron 1 (NYSDEC Petroleum Spill #9707954), and Nosedocks 1 and 2 (NYSDEC Spill #9109658 and #9413416) (FPM, 2002).
- Conduct a feasibility study of this site in conjunction with the Apron 2 Petroleum Spill Sites to recommend an alternative that can achieve site closure.

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8.0 REFERENCES

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Technical Review - Draft Remedial Investigation Report for the Nosedocks/Apron 2 Chlorinated Plume
USAF Former Griffiss Air Force Base
Rome, New York

GENERAL COMMENTS

1. Contaminant distribution in the bedrock aquifer was not investigated. However, according to Figure 4-5b, chlorinated hydrocarbons are present at the overburden/bedrock interface. Wells should be installed in the bedrock aquifer. At a minimum, one well should be placed in the vicinity of the source area near well 782VMW-81 and downgradient near the highest concentrations of vinyl chloride (VC) in the vicinity of well 782VMW-84.

Response

Per the email sent 4/16/03, one bedrock well shall be installed at each of the two locations suggested, corresponding to new wells 782MW-181 and 782MW-184. Results shall be provided under separate cover.

2. Applicable or Relevant and Appropriate Requirements (ARARs) were not discussed in the text. A discussion of Federal and State ARARs including, but not limited to, a table of chemical-specific ARARs, should be added to the text.

Response

The text shall be revised as requested.

3. The recommendations indicate or imply long-term monitoring of the plume, essentially monitored natural attenuation (MNA), without the preparation of a feasibility study (FS) and consideration of other remedial alternatives. However, considering the concerns associated with the risk assessment and the limitations of the plume modeling, the proposed alternative seems premature. To use MNA as a remedy, a demonstration is necessary that it will remediate the plume below ARARs in a reasonable amount of time compared to other treatment technologies. Plume modeling suggests that long-term monitoring would be required for more than 20 years. More active remedies should be examined to determine whether a shorter clean-up time might be achieved. Contrary to the text, enhanced bioremediation, for example would not "interfere" with the biodegradation processes. In addition, the cost of long-term monitoring should be evaluated.

Response

A focused feasibility study (FFS) is being prepared to discuss and consider the remedial alternatives for the plume.

4. The BIOCHLOR model should be used to determine the approximate amount of time

required to achieve ARARs throughout the entire plume and for all VOCs, not just VC at the receptor. This information should be included in the text.

Response

BIOCHLOR makes use of biodegradation rate constants to identify trends in the behavior of plumes using a mathematical model. The model is not capable of estimating the duration of the plume, or the time required to achieve ARARs throughout the plume, which would require several rounds of data at each monitoring point, so that a concentration vs. time rate constant could be derived. The text has been revised to reflect the capability and limitations of the model, which was used to determine the approximate extent of the cis-DCE and VC plumes upon reaching an apparent steady state.

5. Overwhelming evidence suggests that VC will be geochemically reduced in the subsurface (e.g., the presence of methane, concentrations of ferrous iron above 1 milligram per liter [mg/L], highly negative redox potential, and anaerobic conditions). The rate constant for VC biotransformation, however, is low and the amount of organic carbon in the subsurface is below optimal levels. Therefore, VC will accumulate in the subsurface, as was discovered during the site characterization. It is unclear whether the BIOCHLOR prediction simulation accounts for on-going accumulation of VC in the subsurface because cis-DCE and the remaining trichloroethene (TCE) was not included in the prediction. A discussion of this issue should be added to the text.

   In addition, it is unclear why the parameters for the prediction model were changed significantly from the calibration simulations. Essentially, different model conditions were used to predict VC fate and transport than the one that was calibrated to site conditions. It is unclear why the calibration simulation was not run for a longer period of time to simulate future conditions throughout the plume. This information should be added to the text.

Response

The observation that VC will accumulate in the subsurface was substantiated by the results of the model calibration. The model calibration was run until steady state was achieved, to the plume length where no remaining TCE and/or cis-DCE was observed. The model prediction was changed from the calibration simulation due to the change in hydraulic conductivity and hydraulic gradient that occurs at a point from the easternmost edge of Apron 2, approximately 1900 ft downgradient of the Manhole 15 source area, to Six Mile Creek. The biodegradation rate constants, or decay coefficients, however, were assumed to be uniform across the site for simplification.

6. The text should indicate whether the electron donor supply is adequate to allow microbial reduction of VC. The total organic carbon content of the aquifer material, however, is not optimal (below 20 mg/L). In addition, the rate constant for VC that was calibrated to observed site conditions is also low (0.001/day). As stated in the text, the BIOCHLOR model assumes a constant supply of electron donors; therefore, an independent review of

the future electron donor supply should be performed.

Response

An independent review of the future electron donor supply shall be assessed in the FFS document, to be issued under separate cover. The FFS may consider the option of enhanced bioremediation whereby electron donor is added to the subsurface to supplement existing in situ concentrations.

7. One round of sampling data was used to delineate the plume. One round, however, is not sufficient to determine whether the plume is expanding, either downgradient, laterally, or vertically; multiple rounds of groundwater samples are needed. Additional rounds of sampling should be conducted, or the historical trends in analytical data from existing long-term monitoring wells within the plume should be evaluated to determine whether the assumption that the plume is at steady state is reasonable.

Response

According to the EPA Groundwater Issue, "Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies" (EPA/540/S-02/500), November 2002, time-based estimates of attenuation rates (i.e., those based on concentration vs. time, from multiple rounds of data at individual wells) can be used to predict the time required for natural attenuation to achieve remediation objectives, while distance-based estimates (i.e., those based on concentration vs. distance, from several wells within a plume) provide an evaluation of whether a plume will expand, remain stable, or shrink. A second round of data was collected in January/February 2003 and shall be included in the revised RI report. Preliminary evaluation suggests that the plume is at a steady state; however, further rounds of data are necessary to confirm this trend. Quarterly monitoring shall be considered in the FFS; if conducted, the results shall be used to assess whether the assumption that the plume is at steady state is reasonable.

8. Rate constant estimates can be affected by uncertainty from a number of sources, such as design of the monitoring network, seasonal variations, uncertainty in sampling methods and lab analyses, and the heterogeneity within the aquifer. A discussion of uncertainty inherent within the rate constant should be added to the text.

Response

Uncertainty in the rate constant and the limitations of the model were discussed in Section 5.1.1.5. The discussion will be expanded to include uncertainty in seasonal variations, design of the monitoring network, and other factors.

GENERAL COMMENTS–RISK ASSESSMENT

9. The conclusion that no remediation is necessary for groundwater at this site cannot be supported using the risk assessment methodologies presented in this Remedial

Investigation. Outdated toxicity data and exposure parameters may have been used in risk calculations. To support the recommendation for land use restrictions relating to the use of this groundwater, the risk assessment must be revised.

Response

The risk assessment shall be revised based on RAGS guidance as suggested below. Exposure parameters used for the risk assessment were based on the assumptions made during the RI (Law, 1996), but shall be reviewed in the context of RAGS updates and revised as necessary.

10. No exposure parameters for the industrial worker receptor have been provided with the risk assessment. Section 6.2.2 states that the values of the exposure parameters used in this risk evaluation were also used in the 1996 Remedial Investigation. These values may be outdated and potentially under- or overestimate risk to this receptor. Regardless, exposure parameters must be presented with this human health risk assessment. Because of the lack of supporting information, a complete verification of risk calculations could not be conducted.

Response

All supporting information for the development of exposure parameters shall be presented with the risk assessment and revised from the 1996 RI where required.

11. All dermal risk calculations should be conducted in accordance with the current guidance "EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), September 2001." Dermal assessments conducted in this risk assessment could not be verified because of the lack of available exposure parameters, but a review of Table J.2 reveals that the assessments were not conducted in accordance with Appendix B of the above referenced document. Permeability constants are also not correct in accordance with RAGS E. All dermal exposures should be corrected in accordance with RAGS E.

Response

The dermal risk calculations shall be revised as requested.

12. The human health risk assessment tables are not presented in RAGS D format. Verification of calculations was not possible because of the lack of applicable supporting information. The risk assessment should be resubmitted in RAGS D format.

Response

The risk assessment shall be revised as requested in RAGS D format.

SPECIFIC COMMENTS

13. **Section 3.4, page 3-5**. This section states that groundwater may be influenced by several drainage culverts located on the northeast side of Apron 2. It is unclear whether these drainage culverts are located within the chlorinated hydrocarbon plume. The location of these culverts should be provided on a figure. If the culverts are within the plume, additional investigation to determine the magnitude of their influence on groundwater and the plume may be required.

Response

There is a 48" storm drain culvert located on the northeast side of Apron 2, and shall be added to the site figures. The culvert is located within the limits of the VC plume, but based on the sampling results of existing locations in the vicinity of the culvert, the groundwater contours/plume shape already account for the existence of the culvert.

14. **Figure 3-3, page 3-11**. This figure provides the potentiometric surface and groundwater contours for the site. Several wells do not appear to correspond to the adjacent groundwater contour. For example, if wells 782VMW-77 and 782VMW-91 were properly mapped, it would indicate a southerly flow component. The potentiometric surface should be remapped surrounding the following wells:

    - 782VMW-98;
    - 782VMW-77;
    - 782VMW-82;
    - 782VMW-91;
    - 782VMW-90;
    - 782VMW-84; and
    - 782VMW-100.

Response

The figure shall be revised as requested.

15. **Figures 4-5a and 4-5b, pages 4-29 and 4-30**. These figures provide hydropunch sampling locations for vertical plume delineation. Several of the sampling locations appear to be above the top of the groundwater table. For example, the shallow sampling zones in wells 782MW-84, 782MW-82, and 782MW-88 are above the groundwater elevation provided on the figure. Either the figures should be corrected or an explanation should be added to the text.

Response

Several layers of perched water were observed at these locations, and it is likely that the shallowest sampling zones for these locations were sampled from the perched water layer(s). It was not possible to confirm that the perched water layers were continuous across several locations, so not all perched water layers are shown in the figures. The groundwater elevation provided on the figures is based on the groundwater elevation measurements from permanent *wells. An explanation shall be added to the text to clarify the successive perched water layers observed at these and other locations.*

16. **Section 5.1.1.4, page 5-20**. The BIOCHLOR prediction model uses a residual VC concentration of 20 micrograms per liter (µg/L) at 1,900 feet downgradient of the source area. However, the highest concentration of VC observed at the site was 87 µg/L at well 782MW-96, approximately 1,000 feet downgradient of the source area. It is unclear why the model was not set up with these more conservative parameters or run as an extension of the calibration simulations.

Response

The BIOCHLOR prediction model was based on the difference in hydraulic gradient observed at the easternmost edge of Apron 2, approximately 1,900 ft downgradient of the Manhole 15 source area, to Six Mile Creek. The hydraulic gradient and hydraulic conductivities of the presumed conductive zone were uniform across Apron 2. The model calibration was conducted to derive a biodegradation rate constant, which was assumed to be uniform across the site, but could not be extended beyond a point 1,900 ft downgradient of Manhole 15, since the hydraulic properties of the aquifer were not uniform across the site.

SPECIFIC COMMENTS–RISK ASSESSMENT

17. **Section 2.1.1, page 2-3**. This section states that potable water was used during drilling at six wells. Analytical results of sampling of these wells indicated that analytes detected in City of Rome drinking water were present. Therefore, well development did not entirely remove all of the drilling water from the aquifer, and the analytical results for the chlorinated solvents is suspect. Analytical results from these wells should be removed from the risk assessment. Wells 782VMW-94, 782VMW-93, 782VMW-76, 782VMW-80, 782VMW-83 and 782VMW-97 should be resampled and the new data added into the risk assessment.

Response

Please note that well development was performed after Hydropunch sampling was conducted, after permanent wells were installed. None of the components in the City of Rome drinking water were present in the monitoring well samples, except for chloroform at 782VMW-97 at a concentration of 0.15 F µg/L (below the reporting limit, and well below the NYS Groundwater Standard). Some components of the City of Rome drinking water were present, however, in Hydropunch samples collected at these wells, because no development was or could be conducted prior to sampling, given that the samples are grab groundwater samples collected from the Hydropunch apparatus. However, the grab groundwater results were used in the calculation of a conservative exposure point concentration, apart from the monitoring well samples, as explained in Section 6.2.1. None of the constituents of concern detected in the City of Rome drinking water samples were identified as constituents of concern (COCs) for the risk assessment, based on the criteria as listed in Section 6.2.1 for COC identification.

18. **Tables 6-2 and 6-3, pages 6-11-12.** Please provide an explanation for the different groundwater screening concentrations presented for vinyl chloride in these two tables. Additionally, 2-butanone is presented twice in Table 6-3 with different screening concentrations and with different frequencies of detections. If these samples were collected in different areas of the plume or site, they should be presented in another manner, or presented in separate tables. The screening concentrations for the following contaminants could not be verified: 2-butanone, acetone and vinyl chloride. The "U" presented in Table 6-3 as the screening concentration for arsenic should be defined in the footnotes in that table.

Response

The difference in the groundwater screening concentrations presented in Tables 6-2 and 6-3 is those in Table 6-2 were derived from permanent monitoring well sampling, and those in Table 6-3 were derived from grab Hydropunch groundwater samples. 2-Butanone is presented twice in Table 6-3 in error; the table shall be revised accordingly. The screening concentrations for all contaminants in Tables 6-2 and 6-3 can be verified by checking the concentrations listed in Table 4-1, which includes both Hydropunch and permanent monitoring well sampling data. The "U" for arsenic is presented in Table 6-2, and shall be defined as requested.

19. **Section 6.2.5, page 6-17.** The text indicates that the apparent lack of available toxicity data (inhalation RfDs and cancer slope factors) may cause underestimation of potential risk. Inhalation reference concentrations for xylene, ethylbenzene and MTBE and provisional toxicity data for trimethylbenzene isomers, however, are available and should have been used in this risk assessment. Additional sources for toxicity information should be researched and used to complete the risk assessment.

Response

The risk assessment shall be revised accordingly.

20. **Section 6.3, page 6-17.** Please include text to support the conclusion that "no plant and animal species at the base or in the immediate vicinity of the base that are considered to be threatened or endangered by the U.S. Department of the Interior." Does this include the area of Six Mile Creek where the furthest extent of the plume appears to reach?

Response

As stated in the RI (Law, 1996) and in each proposed plan that has been issued for the former Griffiss AFB, there are no federally listed threatened or endangered plant or animal species at the former Base. The EIS and FEIS for Six Mile Creek also evaluated this and confirmed this statement to be true. The text shall be revised to include these references.

21. **Table J.1.** The oral reference dose for xylenes has been changed from 2.0 mg/kg-day to 0.2 mg/kg-day. The oral reference dose presented for trichloroethylene is not correct. Please use the NCEA provisional reference dose in risk calculations for trichloroethylene.

The oral reference dose listed for manganese in this table could not be verified. Please review the table and verify the oral reference dose for manganese. Please recalculate all applicable hazard indices for these chemicals.

Response

The table shall be revised as requested.

22. **Table J.3.** There are several errors in the toxicity values presented in this table. Please review the toxicity data presented for xylenes and trichloroethylene. Please review all appropriate toxicity references and revise the applicable tables.

Response

The tables shall be reviewed and revised as requested.

TECHNICAL REVIEW of the RESPONSE TO COMMENTS
NOSEDOCKS/APRON 2 - CHLORINATE PLUME
GRIFFISS AFB - ROME, NEW YORK

GENERAL COMMENTS

Comment 4. The BIOCHLOR model should be used to determine the approximate amount of time required to achieve ARARs throughout the entire plume and for all VOCs, not just VC at the receptor. This information should be included in the text.

Response

BIOCHLOR makes use of biodegradation rate constants to identify trends in the behavior of plumes using a mathematical model. The model is not capable of estimating the duration of the plume, or the time required to achieve ARARs throughout the plume, which would require several rounds of data at each monitoring point, so that a concentration vs. time rate constant could be derived. The text has been revised to reflect the capability and limitations of the model, which was used to determine the approximate extent of the cis-DCE and VC plumes upon reaching an apparent steady state.

Additional Comment

The original comment indicated that the approximate amount of time to achieve ARARs throughout the plume should be quantified. The response indicated that the BIOCHLOR model was not capable of this analysis. In addition, only one round of groundwater sampling was conducted; therefore, a concentration vs. time rate constant cannot be developed. The time to reach ARARs should be addressed in the feasibility study (FS) that will be conducted. Please note, the purpose of the original comment was to make sure that if monitored natural attenuation (MNA) was selected as the remedy for this site, the time to reach ARARs was comparable to other remediation technologies.

GENERAL COMMENTS - RISK ASSESSMENT

Comment 10. The conclusion that no remediation is necessary for groundwater at this site cannot be supported using the risk assessment methodologies presented in this Remedial Investigation. Outdated toxicity data and exposure parameters may have been used in risk calculations. To support the recommendation for land use restrictions relating to the use of this groundwater, the risk assessment must be revised.

Response

> *The risk assessment shall be revised based on RAGS guidance as suggested below. Exposure parameters used for the risk assessment were based on the assumptions made during the RI (Law, 1996), but shall be reviewed in the context of RAGS updates and revised as necessary.*

Additional Comment

In addition to the changes agreed to in the response to comments, please remember the following items in the revised risk assessment:

1. Any new data (for example, the January/February 2003) should be incorporated into the risk assessment as appropriate.

2. Screening for the selection of chemicals of potential concern (COPCs) should be done using a risk-based screening process. EPA Region 2 prefers the use of EPA Region 9 PRG values for use in the selection of COPCs.

3. EPA Region 2 does not permit the elimination of chemicals as COPCs based on a comparison to background values. Background comparisons can be evaluated in the risk characterization stage after the risks have been calculated. If a comparison to background is considered in the risk characterization, background values should be presented and justified.

4. Use of the 95%UCL for the Exposure Point Concentration may not be a conservative approach because data from non-impacted wells, in effect may dilute the potential impact from exposure to groundwater within the actual plume. Suggested alternatives include calculating the 95% UCL from groundwater data from wells within the plume; using the maximum concentration detected within the plume; or use of a temporal average from within the plume.

5. Because the COPCs are volatile organics, risks from vapor intrusion into buildings should be considered as a potentially complete exposure pathway.

SPECIFIC COMMENTS

Comment 16. **Section 5.1.1.4, page 5-20**. The BIOCHLOR prediction model uses a residual VC concentration of 20 micrograms per liter (:g/L) at 1,900 feet downgradient of the source area. However, the highest concentration of VC observed at the site was 87 :g/L at well 782MW- 96, approximately 1,000 feet downgradient of the source area. It is unclear why the model was not set up with these more conservative parameters or run as an extension of the calibration simulations.

Response

The BIOCHLOR prediction model was based on the difference in hydraulic gradient observed at the easternmost edge of Apron 2, approximately 1,900 ft downgradient of the Manhole 15 source area, to Six Mile Creek. The hydraulic gradient and hydraulic conductivities of the presumed conductive zone were uniform across Apron 2. The model calibration was conducted to derive a biodegradation rate constant, which was assumed to be uniform across the site, but could not be extended beyond a point 1,900 ft downgradient of Manhole 15, since the hydraulic properties of the aquifer were not uniform across the site.

Additional Comment

The original comment questioned the use of a residual vinyl chloride (VC) concentration of 20 :g/L 1,900 feet downgradient of the source area. The use of the 20 :g/L VC concentration requires further substantiation.

SPECIFIC COMMENTS - RISK ASSESSMENT

Comment 17. Section 2.1.1, page 2-3. This section states that potable water was used during drilling at six wells. Analytical results of sampling of these wells indicated that analytes detected in City of Rome drinking water were present. Therefore, well development did not entirely remove all of the drilling water from the aquifer, and the analytical results for the chlorinated solvents is suspect. Analytical results from these wells should be removed from the risk assessment. Wells 782VMW-94, 782VMW-93, 782VMW-76, 782VMW-80, 782VMW-83 and 782VMW- 97 should be resampled and the new data added into the risk assessment.

Response

Please note that well development was performed after Hydropunch sampling was conducted, after permanent wells were installed. None of the components in the City of Rome drinking water were present in the monitoring well samples, except for chloroform at 782VMW-97 at a concentration of 0.15 F ug/L (below the reporting limit, and well below the NYS Groundwater Standard). Some components of the City of Rome drinking water were present, however, in Hydropunch samples collected at these wells, because no development was or could be conducted prior to sampling, given that the samples are grab groundwater samples collected from the Hydropunch apparatus. However, the grab groundwater results were used in the calculation of a conservative exposure point concentration, apart from the monitoring well samples, as explained in Section 6.2.1. None of the constituents of concern detected in the City of Rome drinking water samples were identified as constituents of concern (COCs) for the risk assessment, based on the criteria as listed in Section 6.2.1 for COC identification.

Additional Comment

Please see Evaluation of General Comment 9 regarding COPC screening and the use of background comparisons.

Comment 21. **Table J.1.** The oral reference dose for xylenes has been changed from 2.0 mg/kg-day to 0.2 mg/kg-day. The oral reference dose presented for trichloroethylene is not correct. Please use the NCEA provisional reference dose in risk calculations for trichloroethylene. The oral reference dose listed for manganese in this table could not be verified. Please review the table and verify the oral reference dose for manganese. Please recalculate all applicable hazard indices for these chemicals.

Response

The table shall be revised as requested.

Additional Comment

In addition to revising the table, please revise the risk calculations as appropriate.

Comment 22. **Table J.3.** There are several errors in the toxicity values presented in this table. Please review the toxicity data presented for xylenes and trichloroethylene. Please review all appropriate toxicity references and revise the applicable tables.

Response

The tables shall be reviewed and revised as requested.

Additional Comment

In addition to revising the table, please revise the risk calculations as appropriate.