FINAL

PROPOSED REMEDIAL ACTION PLAN
SITE 3 & SITE 6

New York Air National Guard
Schenectady Air National Guard Base
Scotia, New York
NYSDEC Site #447022

Prepared for:

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Appendix A Administrative Record

LIST OF ABBREVIATIONS AND ACRONYMS

AFCEE	Air Force Center for Engineering and the Environment
ANG	Air National Guard
ARARs	Applicable or Relevant and Appropriate Requirements
AWQS	Ambient Water Quality Standard
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Chemicals of Concern
COEC	Chemicals of Ecological Concern
COPC	Chemicals of Potential Concern
CVOC	Chlorinated Volatile Organic Compound
CY	cubic yard
DCE	Dichloroethene
DERP	Defense Environmental Restoration Program
DHC	Dehalococcoides Ethanogenes
DoD	Department of Defense
ECL	Environmental Conservation Law
EOS	Edible Oil Substrate
EPC	Exposure Point Concentrations
ERA	Ecological Risk Assessment
FFS	Focused Feasibility Study
GAC	Granular Activated Carbon
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
IRA	Interim Remedial Action
IRP	Installation Restoration Program
MDC	Maximum Detected Concentration
µg/L	Micrograms per Liter
mg/L	Milligrams per Liter
MGN	Methanogens
NYANG	New York Air National Guard
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	Operation and Maintenance
ORP	Oxidation/Reduction Potential
PCE	Perchloroethylene (Tetrachloroethene)
PFLA	Phospholipid Fatty Acids
PID	Photoionization Detector
ppm	parts per million
PRAP	Proposed Remedial Action Plan
PVC	Polyvinyl Chloride
RfDs	Reference Doses
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study

LIST OF ABBREVIATIONS AND ACRONYMS (CONTINUED)

SANGB	Schenectady Air National Guard Base
SARA	Superfund Amendments Reauthorization Act
SCA	Schenectady County Airport
SCGs	Standards, Criteria, and Guidance
SCO	Soil Cleanup Objectives
SDC	Supplemental Data Collection
SVOC	Semi-Volatile Organic Compound
TAGM	Technical Administrative Guidance Memorandum
TCE	Trichloroethene
TCRA	Time Critical Removal Action
TOC	Total Organic Carbon
TOGS	Technical and Operational Guidance Series
TP	Test Pit
UCL	Upper Confidence Limit
VC	Vinyl Chloride
VOC	Volatile Organic Compound

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1.0 INTRODUCTION

In 1984, the Defense Environmental Restoration Program (DERP) was established to promote and coordinate efforts for the evaluation and cleanup of contamination at U.S. Department of Defense (DoD) installations. In 1987, DERP became part of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The Installation Restoration Program (IRP) was established under DERP to identify, investigate, and clean up contamination at DoD installations. The IRP is focused on cleanup of contamination associated with past DoD activities to ensure that threats to public health are eliminated and to restore natural resources for future use following applicable, relevant, and appropriate federal, state, and local cleanup standards. Within the Air National Guard (ANG), the National Guard Bureau/Restoration Branch (NGB/A7OR) manages the IRP and related activities.

The ANG, in cooperation with the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH), is proposing a remedy to address potential impacts to human health and the environment created by the presence of environmental contaminants at the New York Air National Guard (NYANG) 109th Airlift Wing (AW), IRP Sites 3 (Drum Burial Area) and 6 (Suspected Spill Area), NYSDEC Site No. 447022, located at the Schenectady County Airport, Scotia, New York (Figure 1-1). Soil and groundwater has been impacted at these sites by past releases from aircraft fueling, maintenance, operation activities, and training exercises. This plan proposes remedial activities intended to address potential impacts to human health and the environment caused by these releases. Due to the close proximity of Sites 3 and 6, these sites are discussed together throughout this document.

This Proposed Remedial Action Plan (PRAP) identifies the proposed remedy, summarizes the remedial action alternatives considered, and discusses why the proposed remedy was selected. Historical information concerning these sites can be found in greater detail in the remedial investigation/feasibility (RI/FS) reports and other documents contained in the Administrative Record for this site (See Appendix A).

1.1 SUMMARY OF RISK ASSESSMENT RESULTS

The Human Health Risk Assessment (HHRA) showed that following the remediation as planned for Sites 3 and 6, the site will meet residential cleanup criteria and therefore be acceptable for residential use. Since the residential land uses have more conservative exposure assumptions than industrial or commercial exposure scenarios, use of Sites 3 and 6 for industrial or commercial purposes should not result in adverse effects to human receptors and remediation of soil is considered complete.

Four chlorinated volatile organic compounds (CVOCs) could not be eliminated as chemicals of concern (COC). Although the shallow groundwater is not considered a potable water source, tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC) are present in groundwater at concentrations in excess of Standards, Criteria, and Guidance (SCGs), or cleanup requirements, and could, conservatively, pose a risk to human health.

The Ecological Risk Assessment (ERA) showed the post remediation risk for soil is acceptable for *terrestrial ecological receptors* (ground level organisms and plants). Groundwater does not pose a risk to aquatic organisms if it discharges to the Site 3 drainage ditch. All sediment was removed from the drainage ditch, so there is no exposure medium for any remaining *benthic* (stream or ditch bottom) organisms. The risk of adverse effects to benthic organisms is considered acceptable. The drainage ditch weir is a functioning engineered control structure and is expected to trap future oily waste that may enter the storm water system.

1.2 SUMMARY OF FEASIBILITY STUDY

Four alternatives were evaluated as part of the focused feasibility study (FFS): No Action; Monitored Natural Attenuation; Hydraulic Containment through groundwater recovery and treatment; and *In Situ* (simulating the natural processes in the soil) Remediation through Enhanced Bioremediation. Hydraulic containment and in situ remediation are the two alternatives that are most protective of the human health and the environment, comply with SCGs, provide the greatest short-term and long-term effectiveness, and are acceptable by the community. In situ remediation could be more easily implemented due to the installation of a majority of the necessary infrastructure during the enhanced bioremediation pilot study. The anticipated time for in situ remediation to meet SCGs has been estimated to be less than 5 years while the time for hydraulic containment to meet SCGs has been estimated to be less than 10 years. The cost for in situ remediation was estimated to be $200,000, less than half the cost of the hydraulic containment option, which was estimated to be $410,000. The monitored natural attenuation alternative would require at least 30 years to meet SCGs and has a present worth cost of $240,000.

Based on this evaluation, the recommended remedy is Enhanced Bioremediation. The dechlorination process was initiated by the implementation of the enhanced bioremediation pilot study. The amount of contaminants in Site 6 has been reduced as a result of the initial injection of the substrate, and is expected to be further reduced by continued substrate treatment. An increase in CVOC concentrations was identified in two of the wells (MW-22 and MW-25) in the injection area during the August 2008 sampling event. This increase is attributable to CVOCs being flushed from the coarse aggregate which was separated by screening from the fine grained material, then reintroduced into the excavation. Despite this increase in CVOCs, the overall trend is that of reduction and breakdown through dechlorination (see below table).

CVOC Results in MW-23

Date	CVOC (ug/l)
June ‘02	3,776
Aug ‘02	878
May ‘07	517
EOS Infusion Aug ‘07	
Sep ‘07	143
Nov ‘07	46
Jan ‘08	32
Aug ‘08	80

No CVOCs have been identified in the three downgradient wells, 6MW-11 (opposite side of the drainage ditch), 6MW-27S, and 6MW-27D. This indicates that movement of contaminants from the Site 6 source areas has not occurred. Monitoring of well 6MW-27D has shown that contamination has not been identified in the underlying bedrock indicating that site remedial activities to date have controlled contaminant movement from the shallow groundwater to the bedrock groundwater.

Based on the results of the human health and ecological risk assessment, the following remedial action objectives were developed:

Site 3

- Prevent migration in groundwater of upgradient contaminants associated with the drainage ditch weir system from impacting soils.

Site 6

- Prevent current or future potential human exposure due to ingestion of groundwater with contaminant levels exceeding drinking water standards.
- To the extent practicable restore the aquifer to pre-disposal conditions.

1.3 PROPOSED REMEDY

The proposed remedies for Sites 3 and 6 have been based on previous investigations, interim removal actions, feasibility study, human health and ecological risk assessments, and remedial action objectives. The proposed remedies are summarized below.

Site 3

- No further action for soils associated with the five interim removal action (IRA) excavation areas: 3-1, 3-2, 3-3, 3-4, and 3-5 (see Figure 4-1).
- Delineation, removal and off-site disposal of soil contaminated with xylene associated with the "Creek Bank B" drainage ditch sample. Until these soils are removed, Site 3 will be limited to industrial/commercial use.
- Installation of a non-permeable geomembrane along the southern bank of the drainage ditch to isolate the Site 3 soils from any potential recontamination from upgradient sources.

Site 6

- Removal of a limited amount of soil, near sample location EX-6-1-SW-07.
- Injection of substrate or chemical oxidant into the horizontal well network to enhance bioremediation or chemical oxidation of the dissolved phase CVOCs. If groundwater cleanup criteria have not been met following the first round of injections, based on an evaluation of groundwater sampling performed following the injections, additional injections will be required.
- Groundwater sampling to monitor the performance of remedial measures for continued application of substrate and quantify the rates of groundwater contaminant reduction will be performed at three months and 12 months following the initial injections. Additional sampling will be required if additional rounds of injections are required.
- Conduct required NYSDEC closure monitoring once groundwater cleanup criteria have been achieved.
- A site management plan (SMP) will be developed and implemented.

- Effective institutional controls, such as an environmental easement, will be placed on the Site should the proposed remedy for groundwater not meet groundwater cleanup criteria for unrestricted use. These institutional controls will serve to (1) limit th e use and development of the property to commercial/industrial use, (2) comply with the approved SMP; (3) restrict the use of groundwater as a source of potable water, without necessary water quality treatment as determined by the NYSDOH; (4) the SMP will also provide for proper management of on-site soil to prevent exposures during ground intrusive activities; and (5) the property owner to complete and submit to the NYSDEC a periodic certification of institutional and engineering controls.
- An evaluation of indoor air quality will be required if site use changes or buildings are constructed on or near Site 6. Mitigation will be required should the evaluation indicate the presence of CVOC above NYSDOH guidelines.

1.4 PUBLIC PARTICIPATION

This PRAP has been issued as: 1) a component of the citizen participation plan developed pursuant to New York State Environmental Conservation Law and 6 New York Code of Rules and Regulations (NYCRR) Part 375, and 2) part of the public participation responsibilities under Section 300.430(f) (2) of the National Oil and Hazardous Substances Pollution Contingency Plan. The proposed remedy offered in this PRAP may be modified or an entirely new alternative may be chosen as a result of public comments. It is therefore in the best interest of both the public and the government that the public fully review all available information in order to provide meaningful input.

The public will be made aware of the document availability and comment process through a notice that will be published in the Daily Gazette (Schenectady, NY) newspaper. The Daily Gazette has a distribution covering an area in excess of the potentially affected communities. Written comments may be submitted to the NYSDEC and NYANG at the following address:

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Public comments received regarding this PRAP will be assimilated and/or summarized and responses to each will be prepared and included in the administrative record held by:

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A public meeting will be held to explain the PRAP and answer any questions pertaining to the proposed remedial action at Sites 3 and 6.

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2.0 SITE BACKGROUND

2.1 FACILITY DESCRIPTION AND HISTORY

The Schenectady Air National Guard Base (SANGB) is located in the southeast portion of Schenectady County Airport (SCA) in Scotia, New York. The Base covers an area of approximately 106 acres, located approximately 2 miles northeast of Scotia, NY. The locations of the IRP Sites on the Base are illustrated in Figure 1-1.

The land located to the north, east, and west of the Base is primarily residential and agricultural. South of the Base is the Mohawk River, a railway, and commercial and residential properties. Prior to the construction of the Base, the property was used for agricultural purposes.

In November 1949, the ANG authorized the formation of the 139th fighter squadron of the New York National Guard. This unit was previously located at the Scotia Naval Depot, which is approximately three miles west of the Base. By September 1950, the permanent facilities for the unit were completed at the SCA and consisted of the present administration building, hangar, vehicle maintenance, and various supply buildings.

Since 1950, the Base has operated an array of military aircraft under numerous assignments. These have included the B-6, C-47, the C-97A, and C-97G Stratocrusiers, various models of the C-130 Hercules, F-94 Starfire jets, P-47 Thunderbolt, P-51 Mustang, and the T-6. In 1991, the unit was redesignated to the 109th Airlift Wing and has since continued operations of the C-130H Aircraft.

2.2 SITE DESCRIPTIONS AND HISTORY

Site 3 (Drum Burial Area) is located near the former sewage treatment plant and sand filter. This area was identified when buried drums were discovered during construction activities. Site 6 (Suspected Spill Area) consists of an area of contaminated groundwater north of the former sewage treatment plant and sand filter. Site 3 covers an area of approximately 0.68 acres and is bounded to the north by the drainage ditch, to the south by the chain link fence, to the west by the chain link fence and extending approximately 250-ft to the east from the drainage ditch weir. Site 6 covers an area of approximately 0.96 acres and is bounded by the drainage ditch to the west, to the east by Building 22, to the north by monitoring well 6MW-21, and to the south by monitoring well 6-MW-20. The total area of these two sites is approximately 1.64 acres as shown in Figure 2.1

During the 1999 Remedial Investigation (RI), CVOCs were detected in groundwater samples collected from monitoring wells upgradient of Site 3. The contamination was determined to be unrelated to historical activity at Site 3. Therefore the area was designated as Site 6. The contamination associated with Site 6 consisted of a plume of dissolved phase CVOCs in the glacial soil aquifer as well as three areas with residual soil contamination in excess of the NYSDEC SCGs.

In April of 2002, a Time Critical Removal Action (TCRA) was performed consisting of the excavation and off-site disposal of 173 CY of soil from the three areas of residual soil contamination. Post-excavation soil sampling results reported no remaining contamination in two

areas while two post-excavation sidewall samples collected from the third area contained PCE at concentrations in excess of the SCGs.

A supplemental data collection (SDC) program for Site 6 was conducted in 2002 that consisted of monitoring well installation, collection and analysis of subsurface soil samples, and collection and analysis of groundwater samples. Results from the SDC indicated that CVOCs in excess of SCGs remained in the soils and that a dissolved-phase CVOC plume existed at Site 6. The SDC report recommended that further remedial measures be performed for Site 6's oils and groundwater.

Between May and September 2007, Earth Tech, completed IRAs at Site 3 and Site 6. The objectives of the IRAs were to remove and treat all unconsolidated material from both sites and to perform an in situ pilot test to evaluate the use of enhanced bioremediation to treat the chlorinated hydrocarbon plume at Site 6. The IRAs are summarized in Section 4.

2.3 GEOLOGY

2.3.1 Surficial Geology

The unconsolidated deposits in eastern Schenectady County are not uniform in character; rather they consist of interbedded layers of different materials. The majority of all soils are glacial deposits. The soils consist of glacial till (clays, silts and sands) that were deposited by temporary glacial lakes; and coarse sands and gravel deposited by glaciofluvial streams sourced in the receding glaciers.

As the glaciers advanced over the area, the topography was modified; parallel ridges and valleys were formed by the movement of ice. Glacial till was deposited directly from the sheet of moving ice. Till is one of the most widespread deposits in the region. The till in the Schenectady region contains cobble and boulder of igneous and metamorphic origin that were transported from the Adirondack Mountains. The till deposit underlying the Base typically consists of a gray to dark gray, silty to sandy clay containing varying amounts of cobbles and boulders. Thin sand and/or gravel deposits are scattered through the till. The thinnest deposits of till are present on the uplands surrounding the Base with thicker deposits found in bedrock depressions. During the retreat of the ice, Glacial Lake Albany was formed in the lowland regions confined by the upland boundaries of the Hudson Valley. Deposits in the lake included clays, silts and sands.

2.3.2 Bedrock Geology

Bedrock units underlying Schenectady County consist of the Schenectady Formation, Canajoharie Shale, as well as the Trenton and Black River Groups. Smaller portions of the Beekmantown Group are also found in the northwestern corner of the County.

The Schenectady Formation underlying the Base is composed of layers of black to gray shale with coarse-grained sandstone deposits, greywacke, and siltstones. In some localities the alternation of beds of shale and sandstone follow a coarsening upward sequence. The Schenectady Formation is estimated to have a thickness of 2,000 feet and a gentle south to southwest dip of up to 5 degrees. The Canajoharie Shale, which underlies the Schenectady Formation, is comprised of fine grained black shales estimated to be at least 1,000 feet thick in areas of the Mohawk Valley.

The rocks of the Schenectady Formation are dense and relatively impermeable. The bedrock may yield small amounts of water from fractures and bedding planes but low yield and poor water quality generally characterize the bedrock aquifer. The direction of groundwater flow in the bedrock aquifer is controlled by fracture orientation, size, density of joints and bedding planes, and by the interconnection with the glacial soil aquifer.

2.4 HYDROGEOLOGY

2.4.1 Regional Hydrogeology

The SANGB is situated near the eastern end of the Schenectady Aquifer, a highly permeable, unconfined glacial soil aquifer occupying a 25-square-mile portion of the Mohawk River Valley. The part of the Schenectady Aquifer that includes the site is in general finer grained, less productive, and less subject to recharge when compared to average conditions in the aquifer. The aquifer is not used for public water supply in this area. Groundwater impacts at the site are not expected to affect public or any known drinking water supplies.

The Schenectady Aquifer (also referred to as the Great Flats Aquifer, the Schenectady Sole Source Aquifer, and other names) is the sole source of potable water to five municipalities and approximately 90 percent of Schenectady County residents. Municipal well fields utilizing this groundwater resource include the City of Schenectady, Town of Rotterdam (including a separate well field at Rotterdam Junction), Town of Glenville, Village of Scotia and part of the Town of Niskayuna.

Regionally, groundwater flow tends to follow topographic controls flowing to the south and southeast towards the Mohawk River. Most of the water supplies are from groundwater encountered in the highly permeable unconsolidated glacial deposits which overlie somewhat impermeable bedrock.

Groundwater recharge occurs almost wholly from precipitation. Under natural conditions, the water table fluctuates on a seasonal basis depending on precipitation and discharge. Both consolidated and unconsolidated deposits in Schenectady County are aquifers, even though their saturation and production characteristics vary greatly.

Regional bedrock formations are relatively poor sources of groundwater and normally only yield enough water for domestic use. The rocks are relatively impermeable, and groundwater occurs principally in open fractures along joints in the rock. The most common water-bearing zone lies within the top few feet of the bedrock surface.

The regional soil consists of glacial deposits containing irregularly spaced deposits of sand and gravel from glaciofluvial streams. These relatively coarse grained deposits are the most productive sources of water in the area. These productive zones range greatly in aerial extent and thickness due to changing depositional conditions. At many locations, a thin permeable zone of gravel is present between the till and the underlying bedrock that is capable of producing water at a rate measured in thousands of gallons per minute (ANEPTEK, 2000).

2.4.2 Local Hydrogeology

Glacial deposits at the Base consist predominately of clay and silt overlying a shallow fractured bedrock zone. Groundwater depths reported in monitoring wells screened at the soil/bedrock interface ranged between 6 and 11 feet below ground surface (bgs). Hydraulic conductivity tests conducted in these monitoring wells reported groundwater flow velocities estimated between 2 and 25 feet per year (ANEPTEK, 2002) consistent with typical groundwater flow velocities found in fractured bedrock (ANEPTEK, 2000) or a silt/clayey fine sand.

As part of the site investigations, four bedrock borings were advanced to a depth of 100 feet or deeper. Groundwater was not encountered and the borings were abandoned. A bedrock monitoring well (MW-27D) was installed as part of the 2007 IRA with an open interval extending from 5-ft into the competent rock (15-ft bgs) to 40-ft bgs. Bedrock well MW-27D does yield limited quantities of water, though no pumping test has been performed.

The Schenectady Aquifer (which is also referred to as the Great Flats Aquifer, the Schenectady Sole Source Aquifer, and by other names) is the sole source of potable water to five municipalities and approximately 90 percent of Schenectady County residents. Municipal well fields tapping this groundwater resource include the City of Schenectady, Town of Rotterdam (including a separate well field at Rotterdam Junction), Town of Glenville, Village of Scotia and part of the Town of Niskayuna. Pumping wells are approximately 50 feet deep and located over four miles west of the Base. The Base and surrounding residents are all connected to the Town of Glenville public water system; no residents adjacent to the Base use private wells as a potable water supply. No residents are downgradient from the Base.

Local groundwater flow is south to southeasterly towards the Mohawk River. The latest glacial aquifer water table elevation contours, developed from measurements taken in August 2008, are shown in Figure 2-2. The groundwater flow direction is consistent with what has been previously documented.

3.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section presents information used to establish media-specific applicable or relevant and appropriate regulations (ARARs) criteria for chemicals released from Sites 3 and 6 that may have adverse impacts to human health, the environment, or water quality. Applicable requirements are cleanup standards, standards of control, or other substantive environmental protection requirements, criteria or limitation promulgated under Federal or State law which specifically addresses a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site. Relevant and appropriate requirements are those Federal and/or State requirements that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERLCA site that their use is well suited to the particular site. ARARs are used to create a framework for determining health and risk based limits for remedial action and developing remedial action alternatives, as outlined in the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988).

In New York State, a remedial program is governed by the Environmental Conservation Law (ECL-27) and the rules and regulations in 6 NYCRR. These regulations are analogous to the Federal National Contingency Plan which requires that the selection of remedial actions meet ARARs of state and federal environmental laws and regulations.

Remedial actions at Sites 3 and 6 must, at a minimum, achieve overall protection of human health and the environment and comply with New York State SCGs as specified in Technical Administrative Guidance Memorandum #4030 (TAGM 4030) *"Selection of Remedial Actions At Inactive Hazardous Waste Sites"* (May 1990).

As specified in 6 NYCRR Part 375: "A site's program must be designed so as to conform to standards and criteria that are generally applicable, consistently applied, and officially promulgated, that are either directly applicable, or that are not directly applicable but are relevant and appropriate, unless good cause exists why conformity should be dispensed with. Such good cause exists if any of the following are present:

a) "The proposed action is only part of a complete program that will conform to such standard or criterion [of guidance] upon completion; or

b) Conformity to such standard or criterion will result in greater risk to the public health or to the environment than alternatives; or

c) Conformity to such standard or criterion is technically impracticable from an engineering perspective; or

d) The program will attain a level of performance that is equivalent to that required by the standard or criterion through the use of another method or approach."

SCGs are used to assist in determining the appropriate extent of site cleanup, to scope and

formulate remedial action alternatives, and to govern the implementation of a selected response action. In accordance with TAGM 4030, an alternative which does not meet the SCGs should not be considered unless a waiver to the SCG(s) is appropriate or justifiable.

Based on the results of the FFS and RA, the contaminants of concern (COCs) for Sites 3 and 6 soils are volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). The regulations providing the cleanup criteria for these COC, based on media, can be found in:

- ***Groundwater***: Ambient Water Quality Standards (AWQS) and Guidance Values and Groundwater Effluent Limitations, Division of Water Technical and Operational Guidance Series 1.1.1 (TOGS 1.1.1).

- ***Soils***: 6 NYCRR Subpart 375, Unrestricted Use.

4.0 NATURE AND EXTENT OF IMPACTED MEDIA

Between May and September 2007, Earth Tech, Inc completed IRAs at Sites 3 and 6. The objectives of the IRAs were to remove and treat all contaminated soils from both sites and to perform an pilot test to evaluate the use of enhanced bioremediation to treat the CVOC groundwater contamination at Site 6. The results of the IRAs are presented below.

4.1 SOILS

4.1.1 Site 3 Soil Excavations

As part of the soil removal effort at Site 3, five areas were excavated. Two of the excavation areas (EX3-1 and EX3-2) were combined into a single excavation when elevated photo ionization detector (PID) readings were collected from soils that had separated the two areas. The excavation areas were as follows:

- EX3-1: The northern portion of former test pit (TP) TP-7 was excavated due to SVOC contamination. As the planned limits of the excavation were reached, field screening exhibited elevated PID measurement on the side walls, including the small area to the east between EX3-1 and EX3-2. The excavation was extended and approximately 10-ft of additional soil was removed from both the northern and southern limits. This resulted in the two excavation areas (EX3-1 and EX3-2) combining into a single area. The excavation was completed to competent rock at approximately 7-ft bgs. Approximately 250 cubic yards (CY) were removed from the combined EX3-1/EX3-2 area.

- EX3-2: The surface soil sample location SS-5 was excavated down to a depth of 5-ft. Due to relative high PID measurements along the northern and western portion of this excavation, the excavation was widened and combined with EX3-1. The excavation was advanced to competent rock or approximately 7-ft bgs.

- EX3-3: A geophysical anomaly was investigated. The excavation exposed metallic debris, including crushed drums and automobile parts. The excavation was advanced to a depth of 5-ft. The metallic debris was removed for recycling. Approximately 30 CY were removed from this excavation.

- EX3-4: The southern portion of former TP-1 was excavated. In addition to the VOC contamination, a buried drum and several paint cans were found. The excavation was advanced to competent rock, or approximately 7-ft bgs. The buried drum and paint cans were placed into an over-pack drum and shipped to Cycle Chem, Inc, Elizabeth, New Jersey for disposal. Approximately 70 CY were removed from this excavation.

- EX3-5: A geophysical anomaly was investigated. The utilities search identified an underground conduit of communications lines within the planned excavation area aligned parallel to the road. The conduit was carefully unearthed and found in the center of the excavation. The excavation also exposed some metallic debris, including fence posts, that was removed off-site for recycling. The excavation was advanced to a depth of approximately 5-ft. Approximately 40 CY were removed from this excavation.

A total of 390 CY of soil were removed from the five planned excavation areas. Soils were loaded directly from the excavation onto a dump truck and relocated to a pre-prepared temporary soil staging area before final disposition. No groundwater was encountered in any of the Site 3 excavations.

Excavated soils from the two geophysical anomaly areas (EX3-3 and EX3-5) were segregated from soils removed from the other areas since no contamination had been previously identified at these locations. Since no soil contamination was identified in the two geophysical anomaly areas (EX3-3 and EX-3-5); these soils (approximately 70 CY) were ultimately used as backfill.

At the completion of excavation, post-excavation confirmatory samples were collected to confirm removal of all contaminated soils. A summary of the soil removal activities at Site 3 is presented in Figure 4-1.

The Site 3 excavations were backfilled with excess soil from EX3-3, EX3-5, and excess soil from the Site 6 excavations. The excavations were backfilled with soil placed in approximately 2-ft lifts. Once placed in the excavation, the soil was compacted by tamping with the excavator bucket. For final restoration hydroseeding was completed in the disturbed areas on September 8, 2007.

4.1.2 Site 6 Soil Excavation

Site 6 soils inside the CVOC groundwater plume 50 ppb plumes, as delineated by previous investigations, were excavated. All of the soil in the area was removed from the ground surface to the top of competent bedrock or between 5-ft to 7-ft bgs; approximately 0.5-ft to 1-ft of groundwater was encountered above competent bedrock.

Due to spacial constraints, only portions of the overall area could be excavated and temporarily staged at a single time. Consequently, a total of six sections of Site 6 were excavated sequentially, tested, and backfilled beginning with the furthest upgradient area and advancing downgradient towards the creek. Excavation of each section of Site 6 followed the same general procedure.

Excavations were typically advanced in 2-ft benches. As the excavation proceeded, the soil in the excavator bucket was screened with a PID. Soils were segregated into three stockpiles based on results of the PID screening measurements; less than 5 parts per million (ppm), between 5 and 50 ppm and greater than 50 ppm. As the excavation deepened, large rocks and fractured shale were encountered. A mechanical screener was then brought onto the site to physically separate the larger material (2-inch plus) from the smaller material. The larger material was used as the backfill for the horizontal infusion well network. The smaller than 2-inch fraction was then segregated into stockpiles based on PID screening measurements as designated above.

The total volume of soil excavated in Site 6 was 4,790 CY, based on measured *in-situ* volume (the measured size of the final hole).

The breakdown of this volume by section is presented in Table 3-3. The approximate volumes of soil based on the field screening results with the PID are also presented in Table 4-1.

The total estimated volume of soil with PID readings less than 5 ppm was approximately 2,870 CY. The amount of soil removed with PID measurements greater than 5 ppm but less than 50 ppm was approximately 1,920 yards. No stockpiled soil had PID readings greater than 50 ppm. All stockpiled soils were screened, sampled and used as backfill based on the analytical results for the Sites 3 and 6 excavations.

Table 4-1: Site 6 Excavation Volumes

Stockpile Segment	Excavated Volume (CY *in situ*)		
	Total	PID < 5 ppm	50 > PID > 5 ppm
1	440	260	180
2	720	430	290
3	430	260	170
4	1280	770	510
5	910	550	360
6	1010	610	400
Total	4790	2870	1920

A buried electrical line and communication line was identified along the northern portion of the excavation. To prevent disruption of service to the base, these lines were not removed and the excavation proceeded on either side, leaving a section of soil approximately 10-ft wide that was not removed. A sidewall confirmation sample was collected on the southern side of this section of soil.

Several concrete blocks were also encountered during the excavation activities. The largest one was identified as an old septic tank located in the northeastern section of the planned Site 6 excavation. All soil was removed from around the tank and a sidewall confirmatory sample was collected from the soil adjacent to the tank.

A concrete slab, at least 12-inches thick, was located along the southern portion of the plume. Rather than break apart the slab, all soil was removed up to its edges and confirmation samples collected from two sides.

Due to the construction of the permeable layer around the horizontal injection well network, a small strip of drainage ditch bank, approximately four feet wide, was not removed. This was done to isolate, as best as possible, the water from the drainage ditch and the groundwater involved in the bioremediation pilot test. This strip of soil will be excavated concurrent with the Site 3 removal effort, thereby eliminating any contaminated soil at Site 6.

Confirmation samples were collected along the excavation sidewall at approximately 50-ft spacing. These samples were collected at the water table.

During the soil removal activities at Site 6, a horizontal infusion gallery was constructed (Figure 4-2). The infusion gallery consists of four horizontal laterals of slotted polyvinyl chloride (PVC) pipe aligned somewhat perpendicular to the assumed groundwater flow direction.

Based on the sequencing and final limits of the excavation and apparent local groundwater flow direction the final length of the laterals varied from 45-ft to 120-ft, with the longer laterals located near the center of Site 6.

The laterals were constructed of 4-inch diameter, Schedule 40 PVC.010-slot screen placed along the top of competent bedrock at the base of the excavation with solid vertical risers to grade at each end and in the middle of the horizontal well (Figure 4-3). The lateral well screens were covered with approximately a one-foot-thick layer of the highly permeable material (2-in plus aggregate) that had been screened from the excavation materials. A permeable woven geotextile liner was placed over the aggregate and the remaining excavation(s) backfilled to grade with stockpiled soils.

The excavation was backfilled in roughly 2-ft lifts from the geotextile to final grade. Once placed in the excavation, the soil was compacted by tamping with the excavator bucket. The risers for the gallery were completed with protective steel flush mounted road box at the ground surface and finished with a concrete pad.

A summary of the soil removal activities at Site 6 are presented in Figure 4-4.

4.2 SITE 6 GROUNDWATER – ENHANCED BIOREMEDIATION PILOT STUDY

The enhanced bioremediation pilot study consisted of the infusion of an edible oil substrate into the infusion gallery constructed as part of the Site 6 IRA. The infusion was prepared by mixing one drum of Edible Oil Substrate (EOS) Concentrated 598B 42 and one quart of EOS Vitamin B12 Supplement with 10,000 gallons of treated groundwater stored in the baffle tank. Analytical results for the groundwater in the batch tank indicated that the treated water was non-detect for all contaminants and suitable for use as infusion water. Using the treated groundwater for the infusion avoided the residual chlorine problems associated with using potable drinking water when mixing the EOS and offered the additional benefit of possibly containing acclimated microbes. Once the substrate had been sufficiently mixed, the solution was gravity fed sequentially into each of the 12 vertical riser pipes beginning at the furthest upgradient riser and advancing progressively downgradient. The substrate infusion was performed on August 8, 2007.

In order to evaluate the effects of the Site 6 excavation activities and the substrate pilot test infusion on CVOC concentrations on the groundwater, five rounds of samples were collected for analysis. One round of samples was collected in May 2007 from five existing groundwater monitoring wells (MW-11, MW-12, MW-13, MW-19, and MW20) prior to excavation. Four rounds of post-infusion groundwater samples were collected from the eight newly installed monitoring wells (MW-21, MW-22, MW-23, MW24, MW-25, MW-26, MW-27S, and MW27D) and three previously existing wells (MW-11, MW-12, and MW-19). Sampling events were conducted in September and November of 2007, and January and August of 2008 at approximately 30 days, 60 days, 120 days and 360 days following the substrate infusion in August 2007. The fourth round collected in August 2008, was requested by the NYSDEC as part of the acceptance of the FFS report.

4.3 PILOT STUDY RESULTS

The following section presents the results of the Enhanced Bioremediation Pilot Study through the collected groundwater samples. Multiple lines of evidence were evaluated (e.g., total organic carbon (TOC), VOC, indicator parameters and biological counts) to determine the efficacy of enhanced microbial dechlorination of the dissolved phase contaminants.

4.3.1 Chlorinated Compounds

Groundwater samples were analyzed for the target compound list of volatile organic compounds. The analytical results for CVOCs are presented in Table 4-2 and Figure 4-5. Recent studies have shown that under certain groundwater conditions, aquifer microorganisms can break down PCE and TCE into its daughter products 1,2-DCE and VC and eventually into harmless chloride ions and ethane. This process is termed reductive dechlorination (i.e., sequential removal of the choride ions). By measuring the concentrations of the breakdown byproducts, the effectiveness of the biodegradation process can be estimated.

Comparison of the May 2007 baseline sample results for total CVOCs for MW-23 (519 µg/L) to the site wide average results (171 µg/L) reported in the 30-day post-infusion sampling event indicates that total concentration of CVOCs declined significantly in the monitoring wells located within the substrate infusion zone in the footprint of the Site 6 excavation.

The results also indicate a significant shift in the species reported with PCE decreasing from 310 µg/L, in May 2007, to ND (not detected) in September 2007. An increase in the total concentration of the daughter products TCE, DCE, and VC was also reported. Concentrations of the PCE breakdown products are expected to increase over time as the dechlorination process progresses which appeared to be happening within the zone of infusion for the 30-day and 60 day sampling events.

Subsequent sampling events indicated a rebound in the concentration of PCE with a maximum reported value of 21 µg/L in the sample collected from MW-23 in January 2008. However, the total average concentration of PCE at the end of the pilot test remained significantly less than the initially reported concentration.

Since the entire area above the 50 µg/L total chlorinated hydrocarbon plume has been excavated and the entire hydrogeologic system has been altered, including the removal of all monitoring wells within the excavation area, no continuous monitoring well data is available. The closest data available would be at location MW-13 which was replaced with MW-23 following the excavation. Figure 4-6 shows the concentrations of PCE, TCE, DCE, VC and total CVOC for thee sampling events prior to the excavation/infusion (June 2002, August 2002 and May 2007) and post-infusion (September 2007, November 2007, January 2008 and August 2008). There was a significant drop (77 percent) between the June and August 2002 sampling events and then a 41 percent drop between August 2002 and May 2007. One month following the substrate infusion, the concentration decreased 72 percent and following the 120 day sampling event, the pre-infusion total CVOC concentration had decreased 94 percent. The August 2008 total CVOC showed a slight increase, however the overall decrease from 517 µg/L (May 2007) to 78.5 µg/L (August 2008) supports the use of enhanced biodegradation to support the remediation of the residual dissolved CVOCs remaining at Site 6. The upgradient monitoring well MW-21 had non detected levels of CVOCs up

Table 4-2: Site 6 Analytical Groundwater Summary Table

Well ID	Sample Date	Selected Chlorinated VOCs (µg/L)						Wet Chemistry (mg/L)					
		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	Total CVOCs	TOC	Alkalinity	Nitrate	Ferrous Iron	Sulfate	Chloride
	AGWQS	5	5	5	5	2				20		500	500
MW-11	May 07	ND	ND	ND	ND	ND	0	3.9	320	ND	ND	52	0.907
	Sept. 07	ND	ND	ND	ND	ND	0	0.77	420	ND	ND	210	1.55
	Nov. 07	ND	ND	ND	ND	ND	0	2.4	410	0.19	ND	220	1.15
	Jan. 08	ND	ND	ND	ND	ND	0	2.6	330	ND	ND	170	1.18
	Aug. 08	ND	ND	ND	ND	ND	0	2.8	410	0.20	ND	200	NA
MW-19	May 07	ND	ND	ND	ND	ND	0	0.58	370	ND	ND	110	12
	Sept. 07	ND	ND	ND	ND	ND	0	1.5	400	0.19	ND	100	31
	Nov. 07	ND	ND	ND	ND	ND	0	1.8	400	ND	ND	110	39
	Jan. 08	ND	ND	ND	ND	ND	0	1.1	420	ND	ND	85	31
	Aug. 08	ND	ND	1.3	ND	ND	1.3	2.6	390	0.22	ND	110	42
MW-20	May 07	1.2 J	1.3 J	25	ND	4 J	31.5	0.92	350	0.3	ND	120	14.5
	Sept. 07	ND	7.3	140 D	ND	6.1	153	1.6	390	0.20	ND	90	30
	Nov. 07	11	7.2	93 D	ND	10	121	3.2	350	0.23	ND	190	33
	Jan. 08	19	6	60	ND	ND	85.0	2.1	230	0.34	ND	160	23
	Aug. 08	10	8.5	330 D	0.96 J	8.2	358	4.8	330	0.20	0.11	250	39
MW-21	May 07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sept. 07	ND	ND	ND	ND	ND	0	1.4	290	0.44	ND	310	28
	Nov. 07	ND	ND	ND	ND	ND	0	6.1	190	0.23	ND	34	4.7
	Jan. 08	ND	ND	ND	ND	ND	0	2.1	280	0.55	ND	110	11
	Aug. 08	ND	2.6	6	ND	ND	9	6.3	260	0.2	0.5	110	7.3
MW-22	May 07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sept. 07	ND	ND	24	ND	ND	24.0	19	360	ND	ND	440	54
	Nov. 07	2.2 J	ND	13	ND	ND	15.2	4.7	360	0.22	ND	470	47
	Jan. 08	14	5.5	22	ND	15	56.5	5.3	300	0.22	ND	340	58
	Aug. 08	2.5	6.8	390 D	4.2 JD	35	439	6.7	380	0.20	0.03	330	61
MW-23/ MW 13	May 07	310 D	15 JD	190 D	ND	ND	515	1.4	290	0.31	ND	130	11
	Sept. 07	ND	ND	140	ND	3.1 J	143	27	620	ND	0.12	2.4	56
	Nov. 07	9.8 J	3.7 J	29	ND	3.0 J	45.5	3.7	280	ND	ND	200	36
	Jan. 08	21	ND	11	ND	ND	32.0	3.1	180	0.54	ND	150	14
	Aug. 08	3.5	3	45 D	1.6	27	80.1	7.2	380	0.20	0.68	250	32
MW-24	May 07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sept. 07	ND	11	28	ND	ND	39.0	17	370	0.22	ND	320	65
	Nov. 07	ND	11	28	ND	ND	39.0	13	260	3.1	ND	370	58
	Jan. 08	ND	5.8	16	ND	ND	21.8	9.9	180	4.7	ND	420	79
	Aug. 08	ND	14	42	0.68 J	ND	56.7	14	200	2.1	0.01	280	27
MW-25	May 07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sept. 07	ND	ND	590 D	ND	7.8	598	22	600	ND	ND	3.4	56
	Nov. 07	4.3	ND	34	ND	15	53.3	5.8	340	0.48	ND	450	39
	Jan. 08	3.1 J	1.8 J	82	ND	60	147	4.0	280	1.13	ND	500	42
	Aug. 08	2	1.8	370 D	ND	580 D	954	6.4	330	ND	0.67	430	31
MW-26	May 07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sept. 07	ND	ND	55	ND	ND	55.0	8.3	410	ND	ND	110	36
	Nov. 07	ND	ND	120	ND	87	207	5.8	360	ND	ND	370	50
	Jan. 08	5.1	1.6 J	22	ND	5.6	34.3	4.2	270	0.56	ND	370	22
	Aug. 08	6	3.5	37	0.64 J	8.6	55.7	7.2	370	0.24	0.8	340	27
MW-27S	May 07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sept. 07	ND	ND	ND	ND	ND	0	15	650	0.20	ND	6.28	15
	Nov. 07	ND	ND	ND	ND	ND	0	14	610	0.19	ND	54	14
	Jan. 08	ND	ND	ND	ND	ND	0	7.5	360	ND	ND	180	10
	Aug. 08	ND	ND	ND	ND	ND	0	0.86	400	0.21	0.77	240	9.37
MW-27D	May 07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sept. 07	ND	ND	ND	ND	ND	0	2.0	370	ND	ND	18	29
	Nov. 07	ND	ND	ND	ND	ND	0	1.5	330	ND	ND	18	32
	Jan. 08	ND	ND	ND	ND	ND	0	1.1	260	ND	ND	27	25
	Aug. 08	ND	ND	ND	ND	ND	0	2.0	320	ND	ND	18	33

NOTES:

AGWQS = NYS Ambient Water Quality Standards (TOGS 1.1.1, June 1998 with June 2004 Addendum).
ND = Analyte not detected above the listed Detection Limit
NA = not analyzed
D = Result of diluted sample
TOC = total organic carbon
Bold = indicates results exceeding listed Detection Limit
Highlighted cells indicate values exceeding AWQS

until the September 2008 sampling round, when total CVOCs of 8.5 µg/L were detected. The downgradient well pair MW-27S and MW-27D have consistently had non-detected levels of VOCs. The Site 6 groundwater CVOC plume is confined in the area between MW-21 and MW-27S.

Rebound effects are commonly observed in the sampling results for in-situ pilot tests. This is due partially to the redistribution of the residual contaminant load after the effects of the infusion have diminished, and partially through physical removal of contaminants that were attached to the aquifer material. At Site 6 all unconsolidated materials within the assumed limits of the 50 µg/L CVOC groundwater plumes were excavated (as documented in the SRI) and rock, primarily 2-inch diameter or larger shale, was used as backfill for the infusion gallery, some residual contamination would be expected to remain on the shale. However, since the aggregate is coarse and does not have the ability to hold as much contaminants as a fine grained material (e.g., silt or clay), the rebound effect will diminish with each successive application of substrate.

Rebound has been seen in the wells, primarily within the centerline of the plume. Figure 4-7 shows total CVOC results for the four post-infusion sampling events. For most of the wells, the reported concentrations of individual and total CVOCs were analogous to previous sampling events. However, in the case of MW-20, MW-22, and MW-25, the concentrations of CVOCs were significantly higher than previously measured. These results indicate a rebound effect since the addition of the substrate in August 2007.

The concentration of cis-1, 2-DCE in each for these wells was nearly the same, ranging from 390 µg/L in upgradient most well (MW-23) to 330 µg/L in downgradient most well (MW-22). Additionally, these three wells fall on or close to the apparent axis of groundwater flow suggesting that the observed concentrations in each of these wells may be related to advective transport of CVOCs released by rebound after reaching the effective life of the substrate infusion. The high concentration of VC in MW-25 reported at 580 µg/L indicates the effectiveness of the substrate at reducing the DCE.

4.3.2 Total Organic Carbon (TOC)

Total organic carbon provides a measure of the amount of substrate being provided to the microbial community which in turn cometabolizes the CVOCs. Based on past experience, case studies provided from numerous DoD facilities, and site-specific contaminant concentrations, a TOC concentration of between 500 and 1000 mg/L in a reductive environment would be required to affect total dechlorination of the estimated mass of dissolved contaminant.

Based on the manufacturer's published literature, undiluted EOS has a specific gravity of approximately 1.0 with a total organic load of 74% ± 2 by weight. The mix is comprised of 60% soybean oil, 4% sodium lactate, and 10% organic surfactants (similar to the soy in chemical composition). Based on the chemical composition of soy bean oil, lactate, and surfactants, the total carbon content of the mix is approximately 75% of the organic load. Consequently, the total maximum carbon load delivered by EOS 598B42 is approximately 0.57 g/l. A 55-gallon drum of pure EOS therefore contains approximately 115 kg (251 lbs) of available carbon. The 55-gallon drum was mixed with 10,000 gallons of water prior to infusion. The combined emulsion would therefore contain a calculated initial TOC load of 3,000 mg/L. Assuming that

the volume of groundwater within the infusion 'bathtub' is 100,000 gallons, the resulting TOC concentration in the groundwater would be 280 mg/L.

In September 2007, the maximum observed TOC concentration achieved was reported at 27 mg/L with the average TOC concentration within the infusion area was 19 mg/L. The average TOC concentration then dropped to 6.6 mg/L in November 2007 and 5.3 mg/L in January 2008 and then rose slightly to 8.3 mg/L, primarily due to the continued elevated TOC levels in MW-24. The results of the baseline sampling and post-infusion monitoring events for TOC are shown in Figure 4-7.

Background concentrations of TOC were measured in samples collected during the May 2007 sampling event. The maximum background TOC concentration was 3.94 mg/L (MW-11). Comparison of this background value to the results of the post-infusion monitoring indicates that a single substrate injection created a significant increase in groundwater TOC concentrations.

The steep decline in the concentration of TOC over the relatively short timeframe of the study suggests that the microbes present in the study area were able to utilize substrate. Assuming the initial concentration of TOC was approximately 280 mg/L, the TOC reduction over the first 30 days to 19 mg/L was greater than 90 percent. The TOC concentrations were further reduced in the 90 day sampling event to approximately 6 mg/L, slightly above the pre-infusion concentration of 3 mg/L. The TOC results would indicate that significant biological activity occurred during the first 30 to 60 days following the infusion.

4.3.3 Inorganic Indicators

Groundwater sample results were collected for select inorganic parameters including, ferrous iron, chloride, sulfates, alkalinity, and nitrates.

Ferrous iron, sulfates, alkalinity, and nitrates are indicator parameters of the competition for free hydrogen in a reductive environment. Microbial degradation of the injected carbon consumes available electron acceptors such as oxygen and nitrates and forces the aquifer microbial communities into utilization of alternative electron acceptors such as ferric iron and sulfates.

In general Air Force Center for Engineering and the Environment (AFCEE) case studies of reductive dechlorination demonstrate that, during biodegradation of CVOCs the concentrations of nitrate and sulfate decrease while concentrations of ferrous iron, alkalinity, and chloride increase. This assumes that a reductive environment sufficient for sulfate-nitrate reduction is maintained throughout the process.

The results of the analyses of the indicator parameters are summarized in the Table 4-3. Only those wells within the footprint of the substrate infusion zone are summarized (MW-22 through MW-26, inclusive). For the post-infusion events, the average concentrations for the Site 6 excavation monitoring wells are utilized (except for the May 2007 sampling event when only MW-13 results are available).

Increasing chloride concentrations provide an indication of reductive dechlorination as chloride ions are released by the process. The results of the May 2007 sampling event reported 11 mg/L of chlorides in MW-13. The post infusion sampling results reported average chloride

concentrations of 53 mg/L in September 2007, 46 mg/L in November 2007, 44 mg/L in January 2008 and 36 mg/L in August 2008.

The concentrations of nitrate behaved as was expected, reducing significantly immediately after the infusion event then increasing as the effects of the infusion dispersed and the system reequilibrated.

Table 4-3: Average Indicator Parameter Results Summary Table

Indicator	May '07	Sep '07	Nov '07	Jan '08	Aug '08
Nitrate	0.31	< 0.1	NA	1.8	0.59
Sulfate	130	170	370	350	326
Alkalinity	290	470	320	240	332
Chloride	11	53	46	44	36
Ferrous Iron	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

NA = Not available
May 2007 results for MW-13 only
September 2007, November 2007, January 2008 and August 2008 average of MW-22, MW-23, MW-24, MW-25 and MW-26 only
All results reported in mg/L

The concentration of sulfate behaved counter intuitively to the anticipated results. Instead of decreasing, as would be expected, sulfate increased (compared to the baseline) during the test with the highest reported average values reported in the 90 and 120-day post-infusion sampling events and remained high at the completion of the test.

Conversely, alkalinity levels increased from the baseline concentration of 290 mg/L to 470 mg/L during the first post-infusion sampling events and then dropped to baseline concentrations reported in the last two sampling rounds. These trends suggest that the groundwater quality was significantly altered immediately following the substrate infusion and once TOC concentrations decreased to background levels (within 90 days) groundwater quality stabilized with elevated sulfate, chloride, and nitrate concentrations remaining.

4.3.4 Biological Indicators

Groundwater samples were collected during the May 2007 baseline sampling event and the three post-infusion sampling events for analysis of biological indicators. The samples were analyzed for Phospholipid Fatty Acids (PFLA), dehalococcoides ethanogenes (DHC), and methanogens (MGN). Analysis of the groundwater samples for these biological indicators was performed to verify that a microbial population capable of initiating reductive dechlorination existed in Site 6 groundwater and to monitor the effects of the substrate infusion on the biological population.

Note that the overall sample results may not be entirely reflective of the microbial population in the subsurface. The results indicate only those bacteria suspended in the groundwater samples. Bacteria typically colonize while adhering to the solid grains of the matrix. Healthy colonies with plentiful matrix sites would likely display relatively low concentrations in groundwater samples. Unhealthy colonies or growth exceeding the available substrate results in a large increase in the measured biomass suspended in the groundwater. A distressed colony could have large numbers of deceased cells detached from the substrate and suspended in the groundwater.

PFLA analysis is used to calculate viable (living) microbial biomass (by measuring the amount of lipid extracted). The results of the PFLA tests indicate that a viable biomass was present throughout the test. The PFLA analyses results indicates that the total biomass increased by more than one order of magnitude by September 2007 then decreased slightly in November 2007 and January 2008. These results indicate that the infusion caused an initial bloom of the microbial population but was insufficient to sustain it for the duration of the test. However, at the conclusion of the test, the total biomass was still elevated by half an order of magnitude above the baseline concentrations.

Dehalococcoides ethanogenes is the only bacterium known to complete the reductive dechlorination process through all of the breakdown products to ethane. The result of the DHC analysis for the baseline sampling event indicates that a relatively small population existed prior to the substrate infusion. The population varied erratically within the individual well samples with no discernible trend in subsequent sampling events.

Methanogens contribute to the reductive dechlorination process but are generally ineffective at metabolizing DCE. Similar to DHC, the genetic marker test for MGN is indifferent to the viability of the bacteria measuring both living and dead cells. It is intended to demonstrate the presence of this microbe. In the baseline sampling event, MGN represented over 25 percent of the total viable biomass. In subsequent events, the MGN population declined sharply representing only 3 percent of the total biomass at the completion of the test.

4.4 PILOT STUDY CONCLUSIONS

Based on multiple lines of evidence the infusion of substrate had a beneficial effect on the concentration of CVOCs in the groundwater at Site 6. The CVOC concentrations decreased as a result of the pilot study, both overall (as measured by the total CVOC concentration in the study area) and at well MW-23 (the only well where pre- and post-infusion data were available). The combined CVOC results for the wells within the test area (MW-22 through MW-26) showed levels decrease from 1012 µg/L in September 2007 (30 days following injection) to 370 µg/L in January 2008 (120 days following injection) for a reduction of 63 percent, but have subsequently rebounded during the August 2008 sampling event.

Based on the amount of organic carbon available within a 55-gallon drum of EOS (approximately 250 pounds), the theoretical concentration of TOC within the treatment area should have been approximately 280 mg/L, within the targeted range of 100 to 500 mg/L. No groundwater samples were collected within a short time following infusion, so these TOC concentrations could not be confirmed. The samples collected 30 days following the infusion did show a maximum TOC concentration of 27 mg/L, up from a baseline of approximately 1 mg/L. The average TOC concentrations for the 30 day, 90 day and 120 day sampling events were 19, 6.6 and 5.3 mg/L, respectively, indicating that TOC did decrease, most likely due to the EOS being utilized as a substrate for indigenous bacteria.

Chloride in the groundwater also increased during the pilot study. The baseline results (May 2007) reported a concentration of 11 mg/L in MW-13, while the concentration at this location increased to 56 mg/L 30 days following infusion (September 2007). The average chloride concentrations, as measured in the wells within the treatment area, in the post infusion sampling

results decreased from 53 mg/L in September 2007 to 44 mg/L in January 2008 and to 36 mg/L in August 2008.

Biological testing showed that the viable biomass as indicated by the PFLA analyses and the population of both DHC and MGN fluctuated by as much as two orders of magnitude during the test. In general the total biomass blossomed early in the test, with the highest reported results in PFLA observed in the 30-day post-infusion samples collected from the wells inside the footprint of the infusion zone, then decreased as the TOC concentrations decreased. The result of the DHC analysis for the baseline sampling event indicates that a relatively small population existed prior to the substrate infusion. The population varied erratically within the individual well samples with no discernible trend in subsequent sampling events.

4.5 SOIL GAS SAMPLING

Two soil gas samples were collected to characterize the potential for soil vapor migration from the dissolved CVOC plume at Site 6 to the closest indoor air receptor. The nearest receptor is Building 18, located 475-ft cross-gradient to the Site 6 groundwater plume. The locations of the two soil gas sampling points are shown in Figure 4-8. The soil gas samples were analyzed using Modified Method TO-15 (chlorinated hydrocarbons only). No CVOCs were detected in either soil gas sample.

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5.0 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

A HHRA was performed for the combined excavation areas using soil and groundwater data from confirmation samples collected during the IRAs. An ERA was performed for excavation areas using surface soil data from confirmation sampling collected during the IRAs. All sediment in the oil-water separator was removed down to bedrock, so no confirmation sediment samples are available, thereby removing the exposure pathway to sediment. The purpose of the post-remediation risk assessments was to assess whether chemicals detected in exposure media after remediation represents an acceptable residual risk to human health and/or ecological receptors. The HHRA also provides a basis for the evaluation of the success of the implemented remedial alternatives (USEPA, 1989a).

The HHRA consists of two Tiers: 1) the screening of confirmation sample results against project human health-based residential cleanup goals, and 2) quantitative risk estimates for chemicals that exceed HHRA screening criteria. The ERA also consists of two Tiers: 1) the screening of confirmation sample results against project ecological health-based cleanup goals, and 2) quantitative risk estimates for chemicals that exceed ERA screening criteria.

5.1 IDENTIFICATION OF CHEMICALS OF CONCERN (COCS)

All chemicals detected in surface soil, subsurface soil, groundwater, surface water, and sediment during previous investigations for the RI/FS were considered preliminary chemicals of potential concern (COPCs) for human health and ecological receptors. Chemicals detected in soil, sediment and groundwater confirmation samples are considered COPCs for assessment of post remediation residual risk. The maximum detected concentrations (MDC) were compared to media specific cleanup goals based on 6 NYCRR 375-6.8 (a): residential human exposure to identify human health COCs. The soil MDCs were compared to SCGs based on 6 NYCRR 375-6.8 (a): Protection of Ecological Resources to identify ecological COCs. The sediment MDCs were compared to sediment-specific cleanup goals based on protection of benthic organisms to identify sediment COECs. Because groundwater could discharge to surface water downgradient of Site 6, groundwater MDCs were compared to surface water-specific cleanup goals based on protection of aquatic life to identify water COECs. All analytical data results and data packages were presented in the Site 3 and Site 6 IRA Completion Report (Earth Tech, 2007).

5.2 SUMMARY OF HUMAN EXPOSURE PATHWAYS

Based on a review of the physical setting, historical site operations, and previous environmental investigations, potentially contaminated exposure media at Sites 3 and 6 include surface and subsurface soil, ambient air, sediment and groundwater.

Table 3-1 presents a summary of the number of chemicals detected in site media during the RI. Site soils were remediated in the removal action based on 6 NYCRR 375-6.8 (a): Unrestricted Use Soil Cleanup Objectives (SCOs). These objectives are based on the lowest of all land use categories considered in 6 NYCRR 375-6. Although the land use for the area is, and will continue to be, considered industrial the human health risk assessment uses a comparison of maximum and mean confirmatory soil sample results to more conservative residential SCOs (6 NYCRR 375-6.8 (b): Restricted Use Soil Cleanup Objectives – Residential).

The remediation of the groundwater plume located in the glacial soil aquifer at SANGB consisted of excavation of the overlying source soil and emplacement of a groundwater injection system across Site 6 at the surface of bedrock. To enhance naturally occurring biodegradation of VOCs in the remaining plume, edible oil was injected into the plume. Monitoring of the groundwater plume over time showed a decrease of CVOCs in the plume. To assess the current risk to hypothetical current and future human users of the plume as a source of residential water, the analytical results from the final monitoring round (January 2008) are compared to New York State drinking water criteria (TOGS 1.1.1).

Table 5-1: Number of COPCs Detected During the RI Investigation

COPC	Number Detected in Ground Water	Number Detected in Sediment	Number Detected in Surface Soil
VOCs	6	3	1
SVOCs	12	16	15
Pesticides	2	0	1
Herbicides	3	0	1
Total Metals	21	18	20
Dissolved Metals	14	--	--

Notes:
-- = not analyzed
COPC = chemical of potential ecological concern
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds
This table lists analytes detected in soil from various depths in the side walls and bottom of the remedial excavation.

5.3 POTENTIALLY EXPOSED RECEPTORS AND EXPOSURE PATHWAYS

There are no current on-site residents at Sites 3 and 6. In addition, the Base currently eliminates access by trespassers via Base fencing and administrative controls. The following current human receptors may be potentially exposed to site-related contaminants remaining in Sites 3 and 6 based on current land use:

Current Land Use

- Current on-site industrial workers at Sites 3 and 6.

Based on site characteristics and historical site data, several hypothetical future human receptors may be exposed to site-related contaminants based on potential future land use:

Future Land Use

- Hypothetical future on-site industrial workers who are assumed to work on site.
- Hypothetical future on-site construction workers who are assumed to perform excavation activities that disturb site subsurface soil.
- Hypothetical future off-Base residents located at the boundaries of the Base who may be exposed (via potable uses) to contaminants in the upper water-bearing unit if it has migrated from Sites 3 and 6 to the Base boundary.

Groundwater in the upper water-bearing unit was characterized and is evaluated for the risk assessment as a single plume. Sites 3 and 6 were investigated as a potential source area for this groundwater plume.

New York State has developed SCOs and these values are published in NYCRR Chapter IV, Subchapter B: Solid Wastes NYCRR Subpart 375-1. The basis of the SCOs is:

1. Human-health-based levels that correspond to excess lifetime cancer risks of one in a million for Class A and B carcinogens, or 1 in 100,000 for Class C carcinogens.

2. Human-health-based levels for systemic toxicants, calculated from reference doses (RfDs). RfDs are an estimate of the daily exposure an individual (including sensitive individuals) can experience without appreciable risk of health effects during a lifetime. An average scenario of exposure in which children ages 1 to 6 is assumed. An intake rate of 200 mg per day for a five-year exposure period for a 16-kg child is assumed.

3. Environmental concentrations which are protective of groundwater/drinking water quality; based on promulgated or proposed New York State standards;

Thus the Subpart 375-1 SCOs are protective of unrestricted residential exposure scenarios. As such, they may be overprotective of identified current and future land uses for Sites 3 and 6 (see above).

5.4 DETAILS OF THE POST-REMEDIATION HHRA FOR SITES 3 AND 6

This section provides the specific methodology that was used for the post-remediation HHRA conducted for Sites 3 and 6. All chemicals having toxicity data that were detected in one or more environmental samples were evaluated. 6 NYCRR 375-6.8 (b): Restricted Use Soil Cleanup Objectives – Residential values were used to screen confirmation surface soil, and subsurface soil samples.

Chemicals that are considered essential human nutrients that have no available toxicity values (i.e., sodium, potassium, magnesium, calcium) were eliminated as COECs.

If a chemical did not exceed its screening criterion for any medium, the chemical was eliminated from further evaluation in the HHRA and remediation for that chemical was considered complete with respect to human health risk. If no chemical detected in a specific medium exceeded its screening criteria, the medium was eliminated from further evaluation in the HHRA and remediation of that medium was considered complete with respect to human health risk. All chemicals with a detection that exceeded a screening criterion were retained for further evaluation in Tier 2.

5.4.1 Post-Remediation Human Health Risk Screening

The residual risk to human receptors from exposure to Sites 3 and 6 soils is estimated based on the analytical results from the confirmation samples taken from the sides and/or bottom of the remedial excavations. The residual risk to human receptors from exposure to Site 6 groundwater is estimated based on the analytical results from the groundwater samples taken from monitoring wells in August 2008, after the infusion of edible oil to stimulate breakdown of chlorinated solvents in the groundwater by the resident soil microbial community.

5.4.2 Soils

The COCs in soils that failed the Tier 1 screening process and were carried to Tier 2 included:

Site 3: None
Site 6: Benzo(a)anthracene, Chrysene and Benzo(b)fluoranthene

In the Tier 1 evaluation, maximum concentrations were used to represent soil exposure point concentrations (EPCs). Because people may be exposed as they move around the entire site, the average soil concentration at the site better represents the actual exposure. The average EPC can be estimated as the mean concentration or, more conservatively, as the 95 percent upper confidence limit (UCL) on the mean (95 UCL). The confirmation sampling collected sufficient samples to confirm the success of the removal action down to the cleanup goals, but in some cases did not collect sufficient samples to perform more sophisticated statistical tests. For this Tier 2 risk assessment, the mean of the confirmation samples is used to represent the EPC and is compared to 6 NYCRR 375-6.8 (b): Restricted Use Soil Cleanup Objectives – Residential). The mean concentration of each Tier 2 COC is divided by the criterion. The resulting quotient is called the hazard quotient (HQ). An HQ greater than 1 means that the EPC exceeded the criterion and that the risk of adverse health effects may result.

All three of these COCs have only a single detection; therefore, a mean could not be computed. The detected value of each of the three COCs is compared to the NYSDEC None of the rounded HQs exceeds one. Therefore, the risk to human health from exposure to Sites 3 and 6 soils is considered acceptable.

5.4.2 Groundwater

The groundwater COCs that failed the Tier 1 screening process and were carried to Tier 2 included:

- Tetrachloroethene
- Trichloroethene
- Cis-1,2-dichloroethene
- Vinyl chloride

In Tier 1 maximum concentrations were used to represent soil EPCs. Due to the small number of groundwater samples available from the post remediation monitoring well samples, accurate representation of the exposure point concentration as the 95 percent UCL of the mean could not be calculated. Therefore, the EPC is represented as both the maximum and mean detected concentration. Although the EOS feasibility study showed a substantial reduction in VOCs during the demonstration period, however, the groundwater concentrations of PCE, TCE, cis-1, 2-DCE, and VC were not reduced below residential drinking water standards and could not be eliminated as COCs. Although the upper water bearing unit is not considered a potable aquifer, these four chlorinated VOCs are conservatively considered present in groundwater at concentrations that pose a risk to human health.

5.5 DETAILS OF THE POST-REMEDIATION ECOLOGICAL RISK ASSESSMENT

The ERA estimates the potential exposure and adverse effects to benthic organisms, and terrestrial wildlife after the remediation is complete. As with the HHRA, confirmation sample results were used to estimate post remediation exposure of ecological receptors and the resulting risk of adverse effects.

5.5.1 Exposure Pathways for Ecological Receptors

Surface water and sediment are found in an unnamed drainage ditch to the Mohawk River that is located along the western boundary of Sites 3 and 6. The unnamed tributary originates from the culvert outfall of part of the Base storm water system, base-flow can be observed at times not associated with precipitation events. This suggests that there is some groundwater discharges to the unnamed tributary. Chemicals in soils from the site may have washed into the unnamed tributary and deposited as sediment in the stream or the ponded area behind the oil/water separator weir. Benthic organisms may contact chemicals in sediment or chemicals may partition from the sediment into the water column where aquatic life, such as fish, may be contacted. Surface water from the remediated area ultimately discharges to the Mohawk River after flowing overland approximately 1 m ile. The unnamed tributary traverses several residential and industrial properties after it leaves the SANGB.

Site-related contaminants in groundwater from the upper water-bearing unit are not known to have migrated beyond Base boundaries; however, site-related contaminants in the upper water-bearing unit may discharge to the unnamed tributary where they could contact aquatic life and migrate beyond the boundaries of the Base to the Mohawk River.

Terrestrial animals may be exposed to site chemicals through:

- Incidental ingestion of soil or sediment with food or while grooming,
- Ingestion of chemicals in plants that have taken up the chemical from the soil,
- Ingestion of chemicals in soil invertebrates that have taken up the chemical from the soil, and
- Terrestrial animals may drink water from the contaminated surface water body.

5.5.2 Post-Remediation Ecological Risk Screening

The residual risk to ecological receptors from exposure to Sites 3 and 6 soils after remediation is estimated based on the analytical results from the confirmation samples taken from the sides and/or bottom of the remedial excavations. The residual risk to ecological receptors from exposure to Site 6 groundwater is estimated based on the analytical results from the confirmation samples taken from monitoring wells after the feasibility study using edible oil to stimulate breakdown of chlorinated solvents in the groundwater by the resident soil microbial community. The confirmation samples are located in the subsoil and are used as a surrogate for surface soil in the post-remediation ERA. The groundwater samples are used to represent groundwater that may seep from the ground into the unnamed tributary to the Mohawk River located downgradient from the drainage ditch weir.

Soils

The chemicals that failed the Tier 1 screening process and were carried to Tier 2 included:

Site 3:

- Silver
- Xylenes
- Naphthalene
- 2-methylnaphthalene

Site 6:

- Tetrachloroethene
- Pyrene
- Nickel

In Tier 1, maximum concentrations were used to represent soil EPCs. Because ecological receptors may be exposed as they move around the entire site, the average soil concentration at the site better represents the actual exposure. The average EPC can be estimated as the mean concentration or, more conservatively, as the 95 percent upper confidence limit on the mean (95 UCL). The confirmation sampling collected sufficient samples to confirm the success of the removal action down to the cleanup goals, but in some cases did not collect sufficient samples to perform more sophisticated statistical tests. For this Tier 2 ERA the mean of the confirmation samples is used to represent the EPC and it is compared to 6 NYCRR 375-6.8 (b): Soil Cleanup Objectives – Protection of Ecological Resources.

EPA's ProUCL program was used to calculate the mean soil concentrations when more than 1 detected concentration was present in the data set. For chemicals with only one detected concentration, the non-detected concentrations were used in the calculation at ½ the reporting limit. The mean concentration of each Tier 2 COEC was divided by the criterion. The resulting quotient is called the HQ. A HQ greater than 1 means that the EPC exceeded the criterion and that the risk of adverse effects to wildlife may result. The results of the HQ calculations are presented in Table 5-25. Xylenes were the only COEC that had a HQ greater than 1 (HQ = 2). Because of the low HQ and the low frequency of detection, xylenes in the soil adjacent to the oil/water separator are not expected to cause unacceptable risk to wildlife at IRP Site 3.

Groundwater

Groundwater could migrate to the unnamed tributary downgradient from the drainage ditch weir and seep into the surface water. Groundwater analytical results were therefore compared to surface water criteria to protect aquatic life from chronic exposure. If the groundwater concentration of a chemical exceeds its screening value, the exposure concentration could exceed a potential threshold for adverse effects to aquatic organisms.

Groundwater was sampled five times between August 2007 and August 2008. The final groundwater sampling results were collected in August 2008 and screened against chronic surface water criteria for the protection of aquatic life. No COECs were detected at a concentration exceeding surface water chronic standards to protect aquatic life. Therefore, COECs in groundwater are not considered a threat to aquatic life downstream from the site and the remediation of groundwater is considered complete with respect to ecological health. No further action to groundwater is necessary to protect aquatic organisms.

5.6 SUMMARY OF RISK ASSESSMENTS

The HHRA showed the post remediation risk for Site 3 and Site 6 soil is acceptable for residential exposure scenarios. Since the residential land uses have more conservative exposure assumptions than industrial or commercial exposure scenarios, use of Site 3 and Site 6 for industrial or commercial purposes should not result in adverse effects to human receptors and remediation of soil is considered complete.

Regarding groundwater, four chlorinated VOCs could not be eliminated as COCs. Although the upper water bearing unit is not considered a potable aquifer, PCE, TCE, cis-1, 2-DCE, and VC are present in groundwater at concentrations that pose a risk to human health.

The ERA showed the post remediation risk for Site 3 and Site 6 soil is acceptable for terrestrial ecological receptors with the exception of xylene, which was detected along the drainage ditch bank. The ERA showed that groundwater does not pose a risk to aquatic organisms if discharged to the Site 3 drainage ditch. All sediment was removed from the drainage ditch eliminating the exposure medium for any remaining benthic organisms. The risk of adverse effects to benthic organisms is considered acceptable. The drainage ditch weir is a functioning engineered control structure and is expected to trap future oily waste that may enter the storm water system.

Table 5-2: Contaminants of Concern and Cleanup Criteria

Contaminant of Concern	Cleanup Critieria	Maximum Detected (Sample Location)
Soil (mg/kg)		
Xylenes	0.26	5.8 (Creek Bank B)
Groundwater (µg/L)		
Tetrachlorethene	5	10 (MW-20)
Trichloroethene	5	14 (MW-24)
Cis-1,2-Dichloroethene	5	390 (MW-22)
Vinyl Chloride	2	580 (MW-25)

Maximum detected concentration for groundwater based on August 2008 sample results

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6.0 COMPARISON OF ALTERNATIVES

6.1 ALTERNATIVE DESCRIPTIONS

The following alternatives were developed and retained for detailed evaluation:

Alternative 1 – No Action
Alternative 2 – Monitored Natural Attenuation
Alternative 3 – Hydraulic Containment (Groundwater recovery and treatment)
Alternative 4 – In Situ Remediation (Enhanced bioremediation)

6.1.1 Alternative 1 – No Action

The No Action Alternative was retained in a Feasibility Study for comparison of the relative advantages of active remediation versus the risks associated with leaving the site "as is". No Action was not being considered as a possible remedy for the site but is included for comparison only.

6.1.2 Alternative 2 – Monitored Natural Attenuation

Monitored natural attenuation was based on the principle that, in the absence of a sustaining source area (or a controlled source), a dissolved phase contaminant plume will expand until it achieves equilibrium between the rate of expansion and the rate of decay at the leading edge of the plume through physical, chemical, and biological reduction in the concentration of the contaminants. Over time, these natural processes will mitigate the contamination, collapse the plume back on the original source area, and reduce concentrations to the SCGs. This alternative uses monitoring only to track the progress of the remediation of the residual groundwater contamination resulting from these natural processes.

Utilizing existing available data, a hydrodynamic predictive model would be developed to identify the current and assumed maximum extent at equilibrium of the advective and dispersive migration of the plume. A number of existing monitoring wells and new wells, if needed, located at the predictive equilibrium points would be periodically monitored for site related compounds of concern and for natural attenuation parameters. The sampling results would be used to periodically verify and refine the predictive model as needed.

Chemical indicators that PCE is naturally breaking down to its inert components include an increase in chemical breakdown products (TCE, DCE, VC, Ethane and Chlorides), the reduction of nitrates and sulfates, and an increase in oxygen-reduction potential (ORP). Advanced bio-assessment tools (microbial genetic testing) are also becoming a viable means of determining if PCE metabolizing microbes are present and increasing or decreasing in population. The enhanced bioremediation pilot study relies on similar data, therefore the background information required to determine if attenuation has been proceeding was collected.

For the purposes of the evaluation, this alternative would initially involve a first-year round of sampling at eleven (11) wells including five wells currently containing COCs in excess of groundwater standards, four cross-gradient wells (two well pairs) and two upgradient wells (one well pair). The samples would be analyzed for VOCs, nitrates, sulfates and ORP.

Microbiological DNA testing would be conducted at two wells with varying levels of COCs. This level of sampling would be conducted every five years.

Annually, between successive five year sampling events, the number of wells sampled and analyses performed would be reduced to five of the eleven wells. Samples would be collected from three wells containing exceedances of SCGs and VOC (based on previous sampling) in the center of the plume, one downgradient well at or near the leading edge of the plume, and one bedrock well. These samples would be analyzed for VOCs only. Evaluation of the analytical results would be conducted each year with modeling, and detailed analysis would be completed every five years to determine the rate of attenuation and the recommended sampling frequency.

6.1.3 Alternative 3 – Hydraulic Containment

Under Alternative 3, a hydraulic containment and treatment system would be installed and operated until groundwater contaminant concentrations have been reduced to below SCGs. The removal of groundwater from the area of contamination would cause an alteration of the groundwater flow paths from their natural state to a flow toward the area of contamination, or an inward gradient toward the pumping wells.

For the purposes of this feasibility study, on-site treatment of extracted groundwater is assumed to be through the use of activated carbon. Should Alternative 3 have been the selected remedy, a value engineering analysis would be warranted to determine if an air stripper based treatment would be more cost effective. The system to treat groundwater extracted from Site 6 would consist of two bag filters and two granular activated carbon (GAC) units, all in series, capable of handling a maximum flow rate of 25 gallons per minute. Assuming that the treatment system would use between 0.5 and 5 pounds per day of carbon, the system would consist of at a minimum, two 1,000 pound vessels which would then require change out no more than once a year. Extraction pumps capable of removing the groundwater at high saturation levels and providing operating pressure at the system would be required to be installed into the existing well network to provide the inward gradient.

Alternative 3 would require operation, maintenance and monitoring for the duration of the remedial action. The time frame for achieving site remedial goals under this alternative was anticipated to extend to 10 years. Though the system would prove to be effective, the amount of monitoring and maintenance is considerable and was taken into account for the purpose of choosing a remedial alternative to be implemented.

6.1.4 Alternative 4 – In Situ Remediation

The in-situ remediation alternative consisted of either enhanced bioremediation or chemical oxidation. Enhanced bioremediation would occur through the infusion of food-grade additives designed to enhance the growth of reductive organisms and promote the metabolic dechlorination process in order to permanently reduce the toxicity of site contaminants to environmentally benign compounds. The breakdown process was similar to that identified in Alternative 2, however in this alternative the process occurs more rapidly due to the active alteration of the subsurface environment to conditions more favorable for the breakdown of the contaminants. The subsurface environment may also be enhanced through the addition of microbes preferentially chosen for their ability to effectively dechlorinate contaminants, and organic material that allows for the rapid expansion of the microbial population. The

environment created sustains and fosters the microbes that provide the desired breakdown of TCE through the entire dechlorination series to ethane. Injection of a mixture of a food substrate (e.g., EOS), Vitamin B12 supplement and water will be utilized to provide a long term carbon source to enhance the bioremediation of contaminants. Chemical oxidation would occur through the infusion of a chemical to react with the COCs to produce innocuous substances including carbon dioxide, water, and inorganic chloride. Chemical oxidants may include the infusion of one of the following: potassium or sodium permanganate, activated persulfate, ozone, and peroxide.

Alternative 4 will require operation, maintenance and monitoring for the duration of the systems operation. The time frame for achieving site remedial goals under this alternative is anticipated to extend to 5 years. The system will prove to be effective in a relatively short period of time when compared to other applicable alternatives. The amount of monitoring and maintenance is limited due to the shortened remediation timeframe and minimal operation. These factors were taken into account for the purpose of choosing a remedial alternative to be implemented.

6.2 DETAILED EVALUATION OF ALTERNATIVES

A comparison of the four alternatives developed for the SANGB site has been conducted using the seven TAGM 4030 evaluation criteria and community acceptance and is summarized in the following sections.

6.3 COMPLIANCE WITH SCGS

All of the proposed alternatives will comply with applicable SCGs given the fact that PCE and its breakdown products will naturally attenuate to meet groundwater standards given enough time to complete the process. Alternative 3 will comply with SCGs provided that the waste stream discharged from the facility meets the permit requirements established with the receiving facility. If a structure were to be constructed over or adjacent to the Site 6 groundwater plume, SCGs associated with vapor intrusion would need to be followed. The time required for Alternatives 1 and 2 to obtain SCGs will likely be greater than 30 years. The time required for Alternatives 3 and 4 to meet SCGs have been estimated to be 10 years and 5 years, respectively.

6.4 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternatives 3 and 4 provide for greater protection of human health and the environment by providing active remedial measures which act to accelerate the removal of the contaminants of concern. Alternative 3 provides an active system to contain, remove and treat contaminated groundwater, providing the most immediate removal of contaminants from the current location and thus providing the greatest protection to the area currently affected by the contamination. Alternative 4 provides for managed accelerated breakdown of contaminants to environmentally benign constituents. Monitoring and alteration of the contaminated media provides accelerated restoration beyond natural processes to reduce the risk to human health and the environment. Alternatives 1 and 2 rely on the natural breakdown of contaminants in the environment over time; as such they provide the least protection of human health and the environment. Alternative 1 does not provide for monitoring to confirm that natural attenuation is occurring, and therefore provides the least protection of human health and the environment. Effective institutional controls, such as an environmental easement, to prevent exposure to contaminated media is required for all alternatives and site usage restrictions must be addressed if any alteration to the

Site 6 vicinity is being considered until SCGs have been met. This will include an evaluation of indoor air quality if site use changes or buildings are constructed on or near Site 6.

6.5 SHORT- TERM EFFECTIVENESS

Alternative 4 provides for significant reduction in contaminant concentration associated with implementation since the results of the pilot study showed that degradation occurred within the first month and most TOC was consumed within three months; the use of chemical oxidation would result in COC breakdown in a shorter time period than bioremediation. Alternatives 3 and 4 provide for greater effectiveness over a more limited amount of time due to the active approach to managing the contamination. Alternative 3 provides for containment of the contaminant plume via groundwater flow alteration which in the short term will reduce the continued downgradient distribution of contaminants. Alternatives 1 and 2 rely on natural processes which are not effective over limited lengths of time.

6.6 LONG- TERM EFFECTIVENESS

Alternatives 3 and 4 have the greatest long term effectiveness since Alternative 3 physically removes the contaminants while Alternative 4 allows for the reduction of contaminated groundwater via enhanced bioremediation or chemical oxidation. Alternatives 1 and 2 rely on breakdown of contaminants without enhancement to environmentally benign compounds without removal of contaminated groundwater. Allowing the contaminated media to remain in place during the breakdown process will require a longer period of time for the contaminants to be rendered benign; however the effectiveness of the alternatives may be equal as far as the eventual contaminant reduction. Alternative 1 does not provide for monitoring of the effectiveness of the breakdown process, and therefore no conclusions about the reduction of contaminants would be available.

6.7 REDUCTION OF TOXICITY, MOBILITY OR VOLUME

Alternatives 1, 2 and 4 provide for reduction in toxicity and volume through the dechlorination process which alters the contaminants leaving environmentally benign compounds. The mobility is not reduced through these alternatives, however as the toxicity and volume are reduced mobility becomes a less significant concern. Alternative 1 does not provide for monitoring of the dechlorination process which makes determination of the mobility and risks associated with contaminant migration impossible to determine. The removal of contaminated groundwater from the site in Alternative 3 provides for the greatest reduction of mobility from the source area. The reduction in mobility is effected through the use of groundwater flow alteration via pumping wells. Volume is reduced at the site by adsorbing the contaminants to granular activated carbon particles which are containerized aboveground, once the adsorptive properties of the carbon has diminished it is replaced and the contamination is removed from the site for appropriate disposal adsorbed to the spent carbon. In that way the contamination at the site is reduced, while the contaminant volume and toxicity has been transferred to an offsite disposal facility.

6.8 IMPLEMENTABILITY

Alternative 1 requires little effort to implement, it is not being considered as a viable alternative. Alternative 1 is carried through to provide a basis for comparing other alternatives. Alternative 2 is readily implementable requiring mainly oversight and management of contracted services providing additional sampling and evaluation in order to establish conclusions regarding natural

attenuation. Alternative 3 will require capital expenditure for construction, though a portion of the system installed for the enhanced bioremediation pilot study could be utilized as a portion of a groundwater capture system. Alternative 4 would be readily implemented using the horizontal well network installed during the IRA.

6.9 COSTS

Table 6-1 summarizes the estimated costs for each of the alternatives. Alternative 1 is obviously the least costly alternative since it has no associated costs. Alternatives 2 through 4 have capital costs associated with their implementation, including monitoring, construction, operating and maintenance. A present worth cost based a 5 percent discount rate was calculated to normalize long term costs. Alternative 4, assuming enhanced bioremediation, is the least costly of the alternatives to be considered at $200,000. The use of a chemical oxidant would result in either the same or slightly reduced cost. This alternative is the least costly due to the shortened remedial time frame (less than 5 years) and the fact that the majority of the capital expenditure for Alternative 4 has already been realized as a part of the treatability pilot test. Alternative 2 is the next least costly at $240,000, since the alternative requires monitoring only. Alternative 3 is the most expensive at $410,000 due to the high annual operation and maintenance (O&M) costs expended over a 10 year period.

6.10 COMMUNITY ACCEPTANCE

The ANG and the NYSDEC rely on public input to ensure that the concerns of the community are considered in selecting an effective remedy for each Superfund site. To this end, this PRAP, along with the supporting reports, have been made available for public comment.

A public meeting will be held during the public comment period to elaborate on the reasons for the proposed remedy and to receive public comments. Comments received at the public meeting, as well as written comments, will be documented in the Responsiveness Summary Section of the ROD, the document which formalizes the selection of the remedy.

Table 6-1: Remedial Action Alternatives Cost Estimates Summary

Item Description	Alt 1 No Action	Alt 2 Monitored Natural Attenuation	Alt 3 Hydraulic Containment	Alt 4 In Situ Remediation
CAPITAL COSTS				
Site Preparation	$ -	$ -	$ 2,000	$ -
Year 1 Groundwater Removal and Treatment	$ -	$ -	$ 40,000	$ -
Year 1 EOS Injection	$ -	$ -	$ -	$ 104,000
Year 1 Quarterly Discharge Monitoring	$ -	$ -	$ 5,000	$ -
Year 1 Annual Groundwater Monitoring	$ -	$ 20,000	$ 9,000	$ 20,000
Subtotal Capital Costs	$ -	$ 20,000	$ 56,000	$ 124,000
Engineering (20% capital costs)	$ -	$ 4,000	$ 11,200	$ 24,800
Contingency (20% capital costs)	$ -	$ 4,000	$ 11,200	$ 24,800
TOTAL CAPITAL COSTS	$ -	$ 24,000	$ 78,400	$ 173,600
ANNUAL O&M COSTS				
Operation and Maintenance	$ -	$ -	$ 25,000	$ -
Discharge Monitoring	$ -	$ -	$ 13,000	$ -
Long-Term Groundwater Monitoring	$ -	$ 11,000	$ 4,800	$ 13,000
Five-Year Groundwater Monitoring	$ -	$ 3,300	$ 3,300	$ 4,000
Subtotal Annual O&M Costs	$ -	$ 14,300	$ 46,100	$ 17,000
Present Worth O&M Costs	$ -	$ 220,000	$ 356,000	$ 74,000
TOTAL PRESENT WORTH OF COST TO IMPLEMENT ALTERNATIVE				
Total Capital Costs	$ -	$ 24,000	$ 78,400	$ 173,600
Total Present Worth O&M Costs	$ -	$ 220,000	$ 356,000	$ 74,000
TOTAL COST	$ -	$ 250,000	$ 440,000	$ 250,000

All total costs rounded up to the nearest $10,000.
A Pre-Design investigation required to refine estimated quantities and costs.
Present worth rate of 5% for O&M assumed from NYSDEC guidance range of 3%-10%.

7.0 RECOMMENDED REMEDIAL ALTERNATIVE

Alternative 4 was selected as the most appropriate remedial alternative for the treatment of CVOCs in the Site 6 groundwater.

7.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 4 provide for greater protection of human health and the environment by providing active remedial measures which act to accelerate the removal of the contaminants of concern. Alternative 4 provides for managed accelerated breakdown of contaminants to environmentally benign constituents. Monitoring and alteration of the contaminated media provides accelerated restoration beyond natural processes to reduce the risk to human health and the environment.

7.2 COMPLIANCE WITH STANDARDS, CRITERIA, AND GUIDANCE

All of the proposed alternatives will comply with applicable SCGs given the fact that PCE and its breakdown products will naturally attenuate to meet groundwater standards given enough time to complete the process. Alternative 4 will likely meet the SCGs in the shortest time frame.

7.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 4 allows for the reduction of contaminated groundwater via enhanced bioremediation or chemical oxidation.

7.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

Alternative 4 provide for reduction in toxicity and volume through the dechlorination process which alters the contaminants leaving environmentally benign compounds. The mobility is not reduced through this alternative, however as the toxicity and volume are reduced mobility becomes a less significant concern.

7.5 SHORT-TERM EFFECTIVENESS

Alternative 4 provides for significant reduction in contaminant concentration associated with implementation since the results of the pilot study showed that degradation occurred within the first month and most TOC was consumed within three months. Chemical oxidation would occur within a shorter time period than bioremediation.

7.6 IMPLEMENTABILITY

Alternative 4 would be readily implemented using the horizontal well network installed during the IRA.

7.7 COST

Alternative 4 is the least costly of the alternatives to be considered at $200,000. This alternative is the least costly due to the shortened remedial time frame (less than 5 years) and the fact that the majority of the capital expenditure for Alternative 4 has already been realized as a part of the treatability pilot test.

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8.0 REFERENCES

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FIGURES

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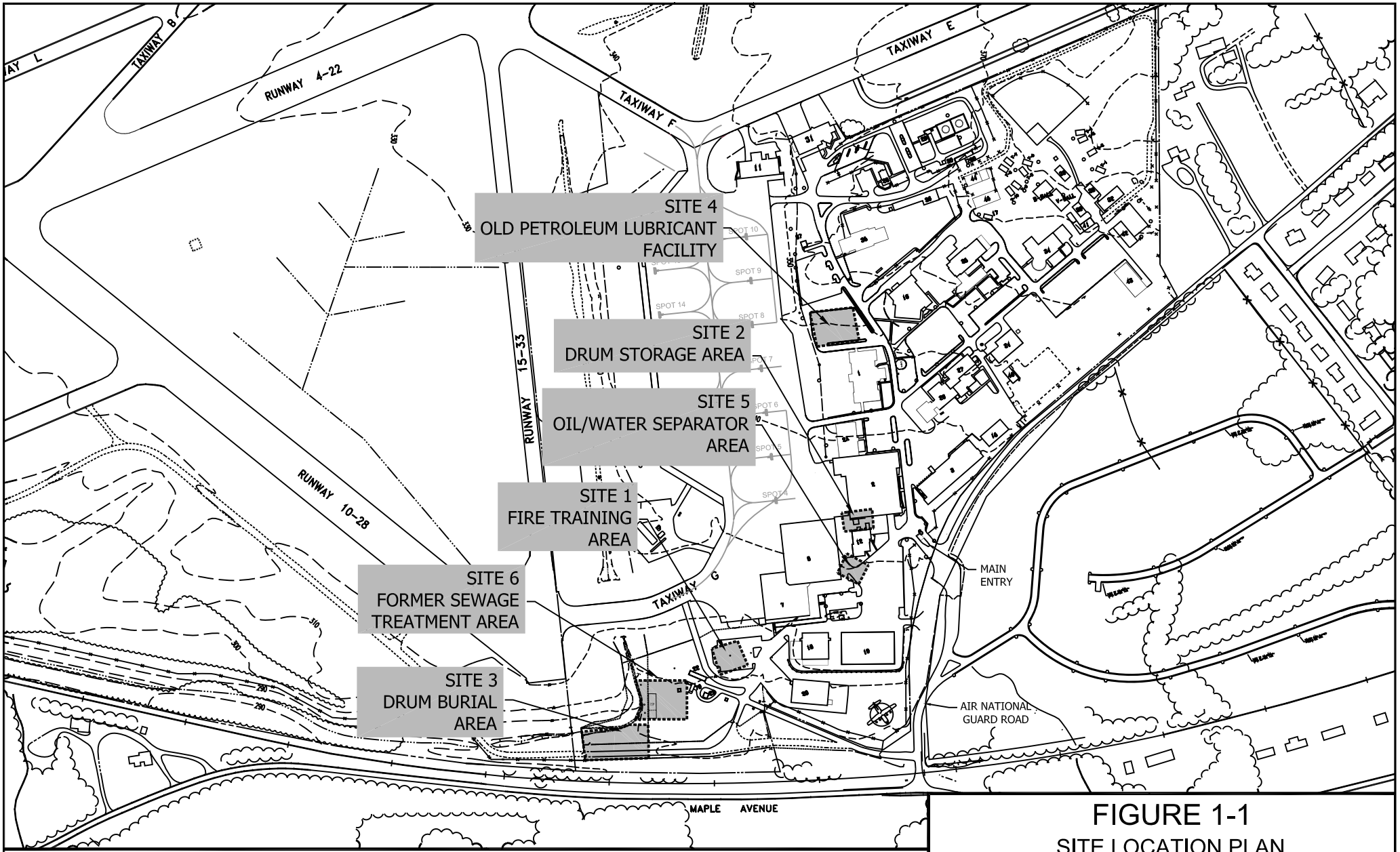


MAP REFERENCE:

1. BASE MAPPING SHOWN SUPPLIED BY AIR NATIONAL GUARD.
2. PROPERTY LINES WHERE SHOWN ARE APPROXIMATE.
3. VERTICAL DATUM: ASSUMED
4. HORIZONTAL COORDINATE SYSTEM: APPROX.. NY STATE PLANE - EAST
5. SITES SHOWN TAKEN FROM FIGURE 3-5 "INSTALLATION RESTORATION PROGRAM SITE LOCATIONS", DATED JULY 2006.

PLAN

NORTH

Scale in Feet

0 250' 500'

FIGURE 1-1

SITE LOCATION PLAN

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

AECOM

DATE: FEBRUARY 2011

PROJECT NO.: 96029

MAP REFERENCE:

1. BASE MAPPING SHOWN SUPPLIED BY AIR NATIONAL GAURD.
2. PROPERTY LINES WHERE SHOWN ARE APPROXIMATE.
3. VERTIVCAL DATUM: ASSUMED
4. HORIZONTAL COORDINATE SYSTEM: APPROX. NY STATE PLANE - EAST

PLAN

NORTH

Scale in Feet

0 30' 60'

FIGURE 2-1

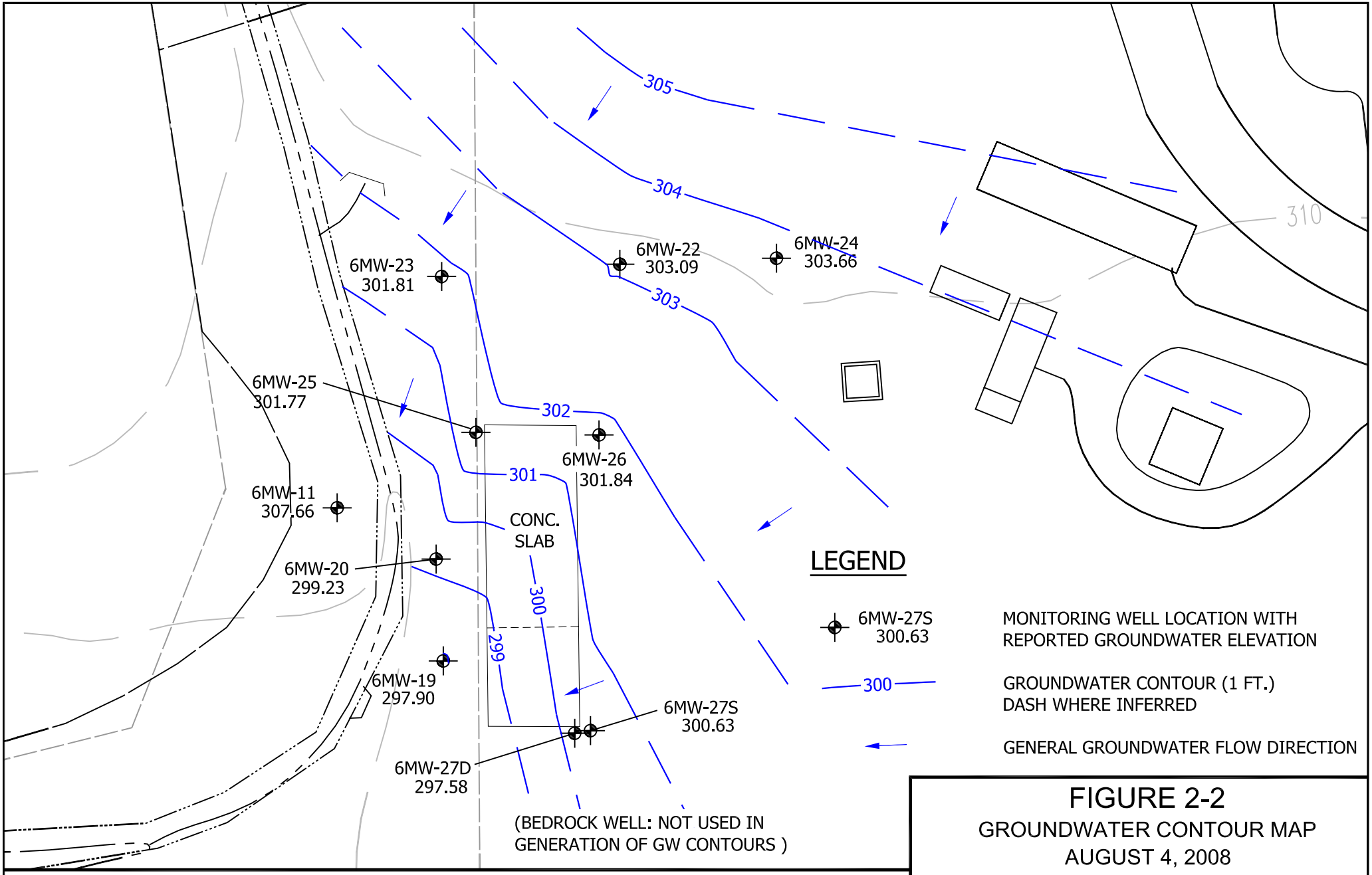
LIMITS OF SITE 3 AND SITE 6

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

AECOM

DATE: FEBRUARY 2011

PROJECT NO.: 96029



MAP REFERENCE:

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2. PROPERTY LINES WHERE SHOWN ARE APPROXIMATE.
3. VERTIVCAL DATUM: ASSUMED
4. HORIZONTAL COORDINATE SYSTEM: APPROX. NY STATE PLANE - EAST

PLAN

NORTH

Scale in Feet

0 20' 40'

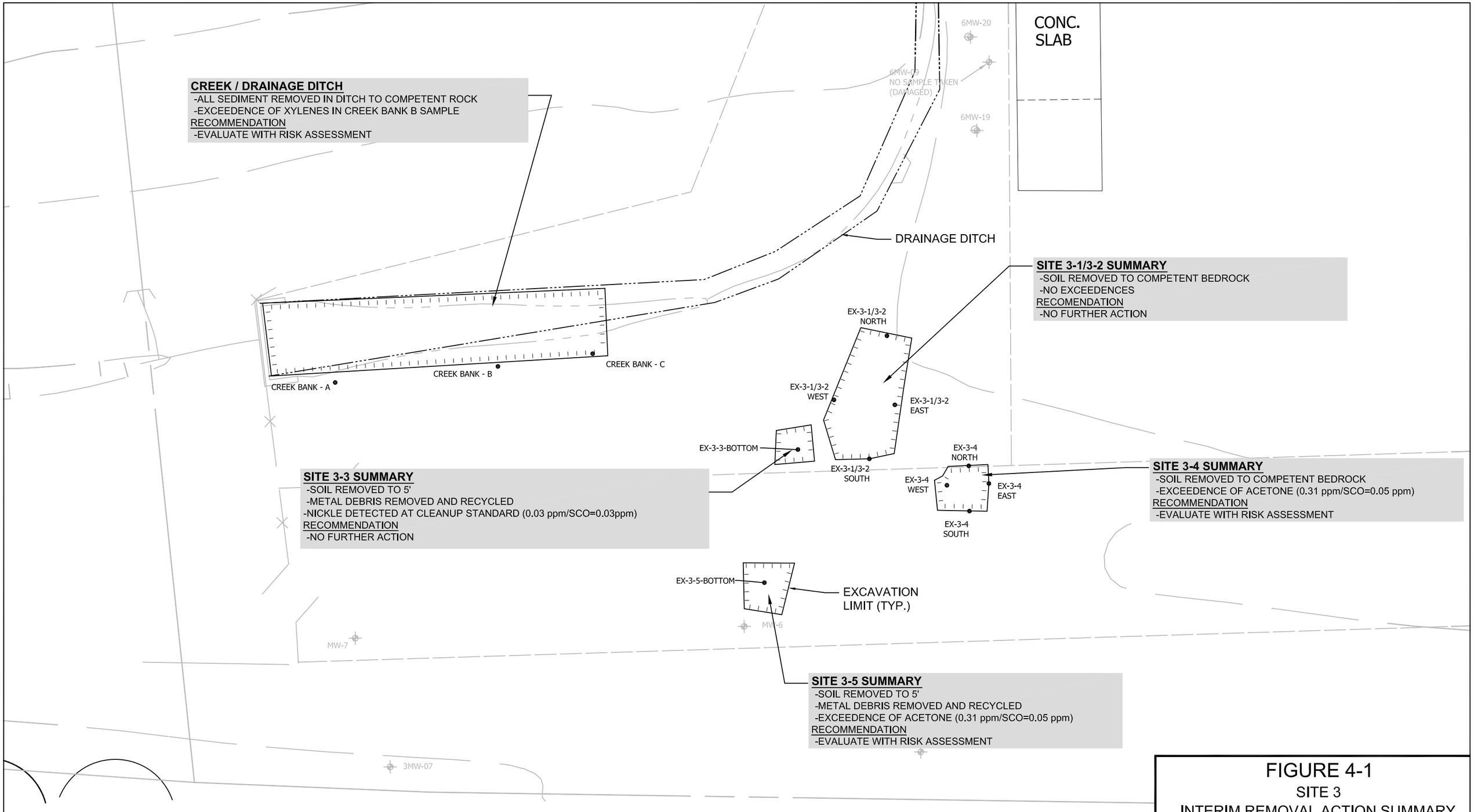
FIGURE 2-2

GROUNDWATER CONTOUR MAP
AUGUST 4, 2008
NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

AECOM

DATE: FEBRUARY 2011

PROJECT NO.: 96029



CREEK / DRAINAGE DITCH
-ALL SEDIMENT REMOVED IN DITCH TO COMPETENT ROCK
-EXCEEDENCE OF XYLENES IN CREEK BANK B SAMPLE
RECOMMENDATION
-EVALUATE WITH RISK ASSESSMENT

SITE 3-1/3-2 SUMMARY
-SOIL REMOVED TO COMPETENT BEDROCK
-NO EXCEEDENCES
RECOMENDATION
-NO FURTHER ACTION

SITE 3-3 SUMMARY
-SOIL REMOVED TO 5'
-METAL DEBRIS REMOVED AND RECYCLED
-NICKLE DETECTED AT CLEANUP STANDARD (0.03 ppm/SCO=0.03ppm)
RECOMMENDATION
-NO FURTHER ACTION

SITE 3-4 SUMMARY
-SOIL REMOVED TO COMPETENT BEDROCK
-EXCEEDENCE OF ACETONE (0.31 ppm/SCO=0.05 ppm)
RECOMMENDATION
-EVALUATE WITH RISK ASSESSMENT

SITE 3-5 SUMMARY
-SOIL REMOVED TO 5'
-METAL DEBRIS REMOVED AND RECYCLED
-EXCEEDENCE OF ACETONE (0.31 ppm/SCO=0.05 ppm)
RECOMMENDATION
-EVALUATE WITH RISK ASSESSMENT

MAP REFERENCE:

1. BASE MAPPING SHOWN SUPPLIED BY AIR NATIONAL GAURD.
2. PROPERTY LINES WHERE SHOWN ARE APPROXIMATE.
3. VERTIVCAL DATUM: ASSUMED
4. HORIZONTAL COORDINATE SYSTEM: APPROX. NY STATE PLANE - EAST

NORTH

Scale in Feet
0 15' 30'

PLAN

LEGEND

- Confirmation Soil Sample Location

FIGURE 4-1
SITE 3
INTERIM REMOVAL ACTION SUMMARY

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
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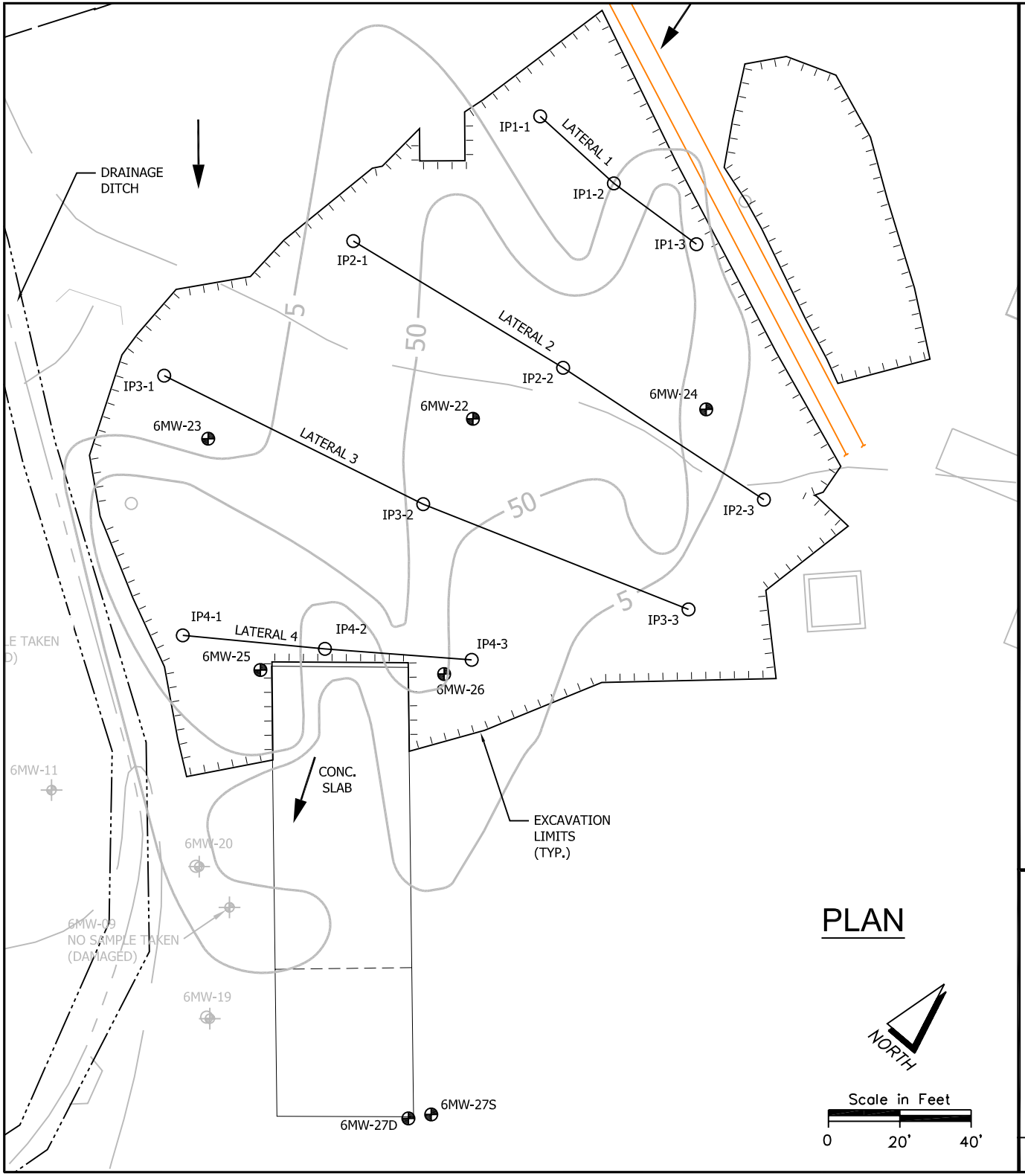

LEGEND

- 3MW-05 — Existing Monitoring Well Location
- 6MW-27D — New Monitoring Well Location
- Approximate groundwater flow direction
- IP1-2 — Infusion Well Riser Pipe (IP)
- LATERAL 1 — Horizontal Infusion Well
- 5 — Total VOC Isopleth (ppb)

PLAN

NORTH

Scale in Feet

0 20' 40'

FIGURE 4-2

SITE 6 HORIZONTAL INFUSION WELL LAYOUT AND NEW MONITORING WELL LOCATIONS

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

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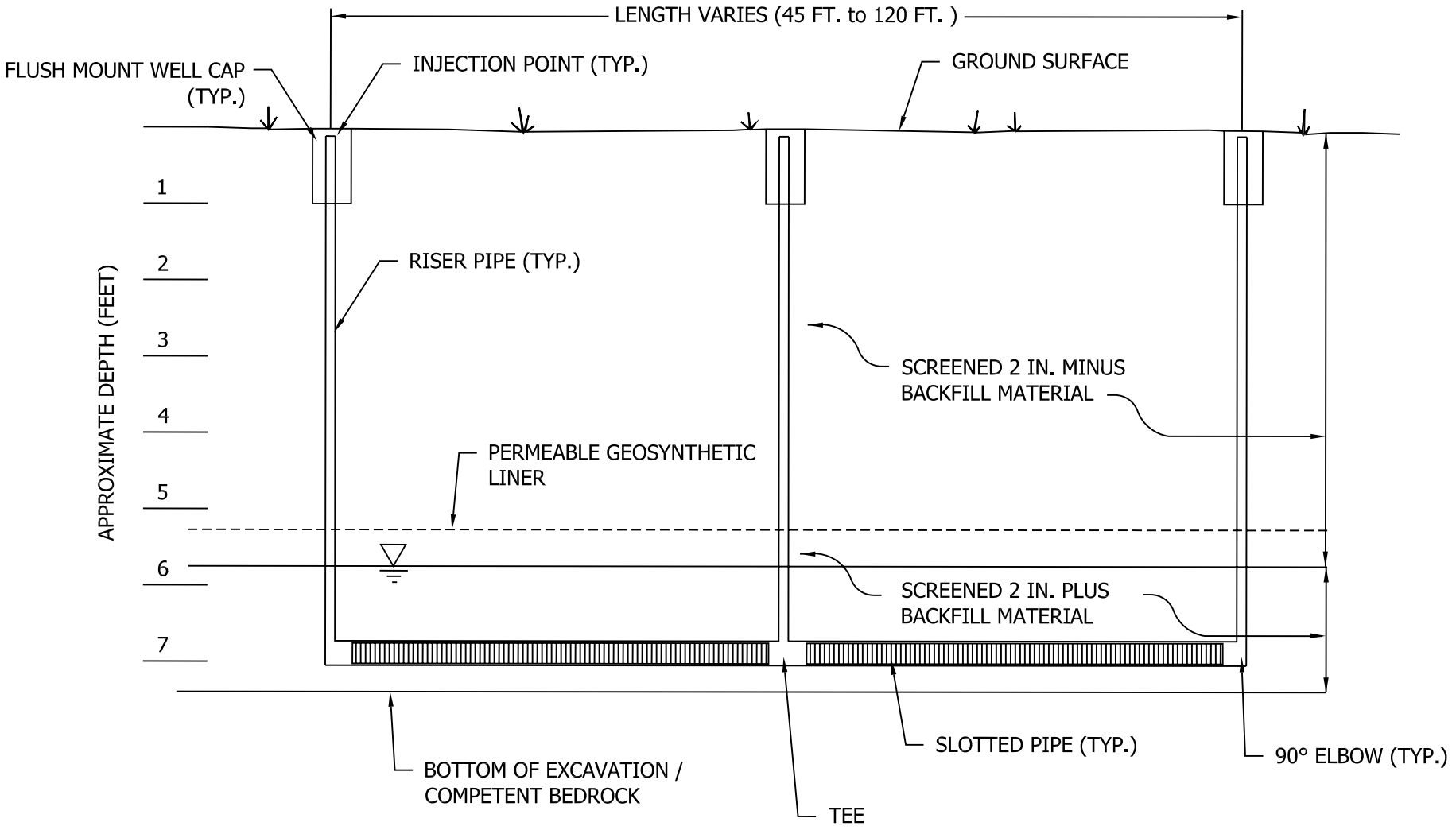

NOTE:

DEPTHS SHOWN ARE APPROXIMATE. WELL DEPTH BASED ON ELEVATION OF COMPETENT BEDROCK.

SECTION
NO SCALE

FIGURE 4-3

TYPICAL HORIZONTAL INFUSION WELL SECTION

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109TH AIRLIFT WING
SCOTIA, NEW YORK

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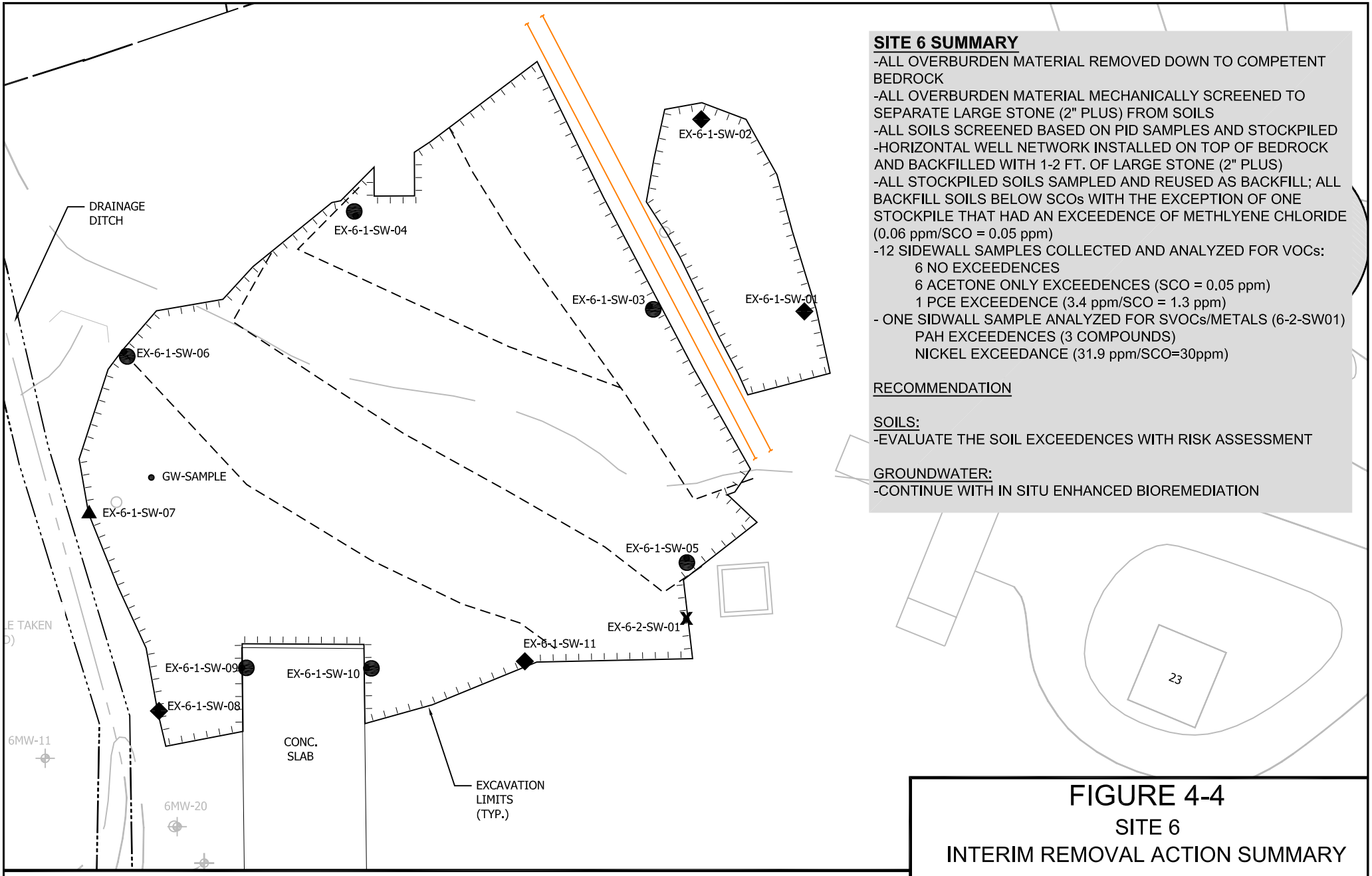


SITE 6 SUMMARY

-ALL OVERBURDEN MATERIAL REMOVED DOWN TO COMPETENT BEDROCK
-ALL OVERBURDEN MATERIAL MECHANICALLY SCREENED TO SEPARATE LARGE STONE (2" PLUS) FROM SOILS
-ALL SOILS SCREENED BASED ON PID SAMPLES AND STOCKPILED
-HORIZONTAL WELL NETWORK INSTALLED ON TOP OF BEDROCK AND BACKFILLED WITH 1-2 FT. OF LARGE STONE (2" PLUS)
-ALL STOCKPILED SOILS SAMPLED AND REUSED AS BACKFILL; ALL BACKFILL SOILS BELOW SCOs WITH THE EXCEPTION OF ONE STOCKPILE THAT HAD AN EXCEEDENCE OF METHLYENE CHLORIDE (0.06 ppm/SCO = 0.05 ppm)
-12 SIDEWALL SAMPLES COLLECTED AND ANALYZED FOR VOCs:
- 6 NO EXCEEDENCES
- 6 ACETONE ONLY EXCEEDENCES (SCO = 0.05 ppm)
- 1 PCE EXCEEDENCE (3.4 ppm/SCO = 1.3 ppm)

- ONE SIDWALL SAMPLE ANALYZED FOR SVOCs/METALS (6-2-SW01)
- PAH EXCEEDENCES (3 COMPOUNDS)
- NICKEL EXCEEDANCE (31.9 ppm/SCO=30ppm)

RECOMMENDATION

SOILS:
-EVALUATE THE SOIL EXCEEDENCES WITH RISK ASSESSMENT

GROUNDWATER:
-CONTINUE WITH IN SITU ENHANCED BIOREMEDIATION

LEGEND

- EX-6-1-SW-10 — Soil Sample Location
- ● — No Soil Cleanup Objective (SCO)Exceedence
- ◆ — Acetone SCO Exceedence Only
- ▲ — TCE / Acetone SCO Exceedences
- X — Acetone / PAH / SCO Exceedences

PLAN

NORTH

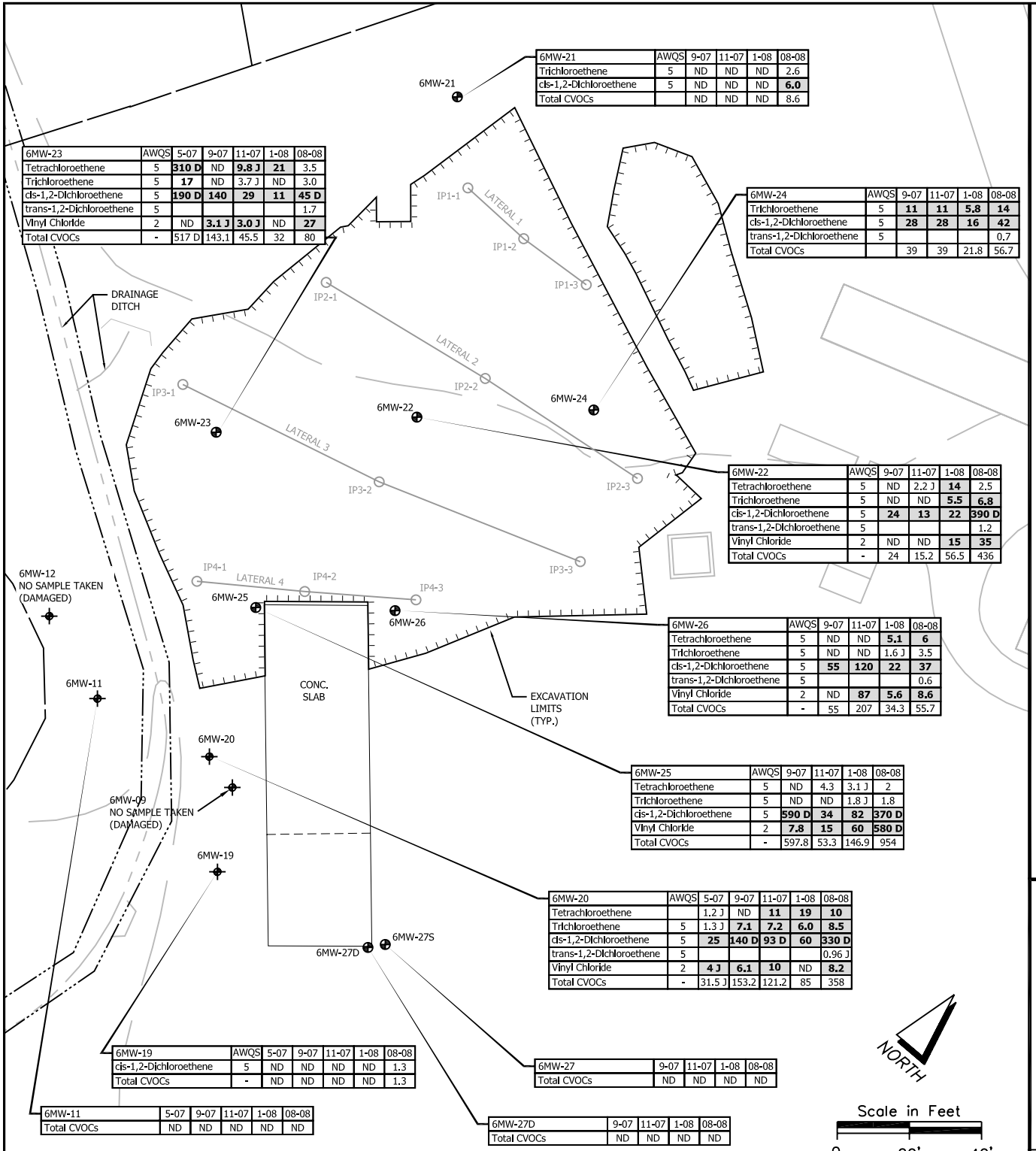
Scale in Feet
0 15' 30'

FIGURE 4-4
SITE 6
INTERIM REMOVAL ACTION SUMMARY

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

AECOM

DATE: FEBRUARY 2011 | PROJECT NO.: 96029



6MW-21	AWQS	9-07	11-07	1-08	08-08
Trichloroethene	5	ND	ND	ND	2.6
cis-1,2-Dichloroethene	5	ND	ND	ND	**6.0**
Total CVOCs		ND	ND	ND	8.6

6MW-23	AWQS	5-07	9-07	11-07	1-08	08-08
Tetrachloroethene	5	**310 D**	ND	**9.8 J**	**21**	3.5
Trichloroethene	5	**17**	ND	3.7 J	ND	3.0
cis-1,2-Dichloroethene	5	**190 D**	**140**	**29**	**11**	**45 D**
trans-1,2-Dichloroethene	5					1.7
Vinyl Chloride	2	ND	**3.1 J**	**3.0 J**	ND	**27**
Total CVOCs	-	517 D	143.1	45.5	32	80

6MW-24	AWQS	9-07	11-07	1-08	08-08
Trichloroethene	5	**11**	**11**	**5.8**	**14**
cis-1,2-Dichloroethene	5	**28**	**28**	**16**	**42**
trans-1,2-Dichloroethene	5				0.7
Total CVOCs		39	39	21.8	56.7

6MW-22	AWQS	9-07	11-07	1-08	08-08
Tetrachloroethene	5	ND	2.2 J	**14**	2.5
Trichloroethene	5	ND	ND	**5.5**	**6.8**
cis-1,2-Dichloroethene	5	**24**	**13**	**22**	**390 D**
trans-1,2-Dichloroethene	5				1.2
Vinyl Chloride	2	ND	ND	**15**	**35**
Total CVOCs	-	24	15.2	56.5	436

6MW-26	AWQS	9-07	11-07	1-08	08-08
Tetrachloroethene	5	ND	ND	**5.1**	**6**
Trichloroethene	5	ND	ND	1.6 J	3.5
cis-1,2-Dichloroethene	5	**55**	**120**	**22**	**37**
trans-1,2-Dichloroethene	5				0.6
Vinyl Chloride	2	ND	**87**	**5.6**	**8.6**
Total CVOCs	-	55	207	34.3	55.7

6MW-25	AWQS	9-07	11-07	1-08	08-08
Tetrachloroethene	5	ND	4.3	3.1 J	2
Trichloroethene	5	ND	ND	1.8 J	1.8
cis-1,2-Dichloroethene	5	**590 D**	**34**	**82**	**370 D**
Vinyl Chloride	2	**7.8**	**15**	**60**	**580 D**
Total CVOCs	-	597.8	53.3	146.9	954

6MW-20	AWQS	5-07	9-07	11-07	1-08	08-08
Tetrachloroethene		1.2 J	ND	**11**	**19**	**10**
Trichloroethene	5	1.3 J	**7.1**	**7.2**	**6.0**	**8.5**
cis-1,2-Dichloroethene	5	**25**	**140 D**	**93 D**	**60**	**330 D**
trans-1,2-Dichloroethene	5					0.96 J
Vinyl Chloride	2	**4 J**	**6.1**	**10**	ND	**8.2**
Total CVOCs	-	31.5 J	153.2	121.2	85	358

6MW-19	AWQS	5-07	9-07	11-07	1-08	08-08
cis-1,2-Dichloroethene	5	ND	ND	ND	ND	1.3
Total CVOCs	-	ND	ND	ND	ND	1.3

6MW-27	9-07	11-07	1-08	08-08
Total CVOCs	ND	ND	ND	ND

6MW-11	5-07	9-07	11-07	1-08	08-08
Total CVOCs	ND	ND	ND	ND	ND

6MW-27D	9-07	11-07	1-08	08-08
Total CVOCs	ND	ND	ND	ND

LEGEND

- 3MW-05 — Existing Monitoring Well Location
- 6MW-27D — New Monitoring Well Location
- IP1-2 — Infusion Well Riser Pipe (IP)
- LATERAL 1 — Horizontal Infusion Well

Sampling Event

Sampling Location

6MW-25	AWQS	9-07	11-07	1-08	08-08
Tetrachloroethene	5	ND	4.3	3.1 J	2
Trichloroethene	5	ND	ND	1.8 J	1.8
cis-1,2-Dichloroethene	5	**590 D**	**34**	**82**	**370 D**
Vinyl Chloride	2	**7.8**	**15**	**60**	**580 D**
Total CVOCs	-	597.8	53.3	146.9	954

Chemical Constituent

Analytical Result (ppb)
Shaded where concentration exceeds NYS Ambient Water Quality Standards (AWQS)
(ND = Not Detected)

FIGURE 4-5

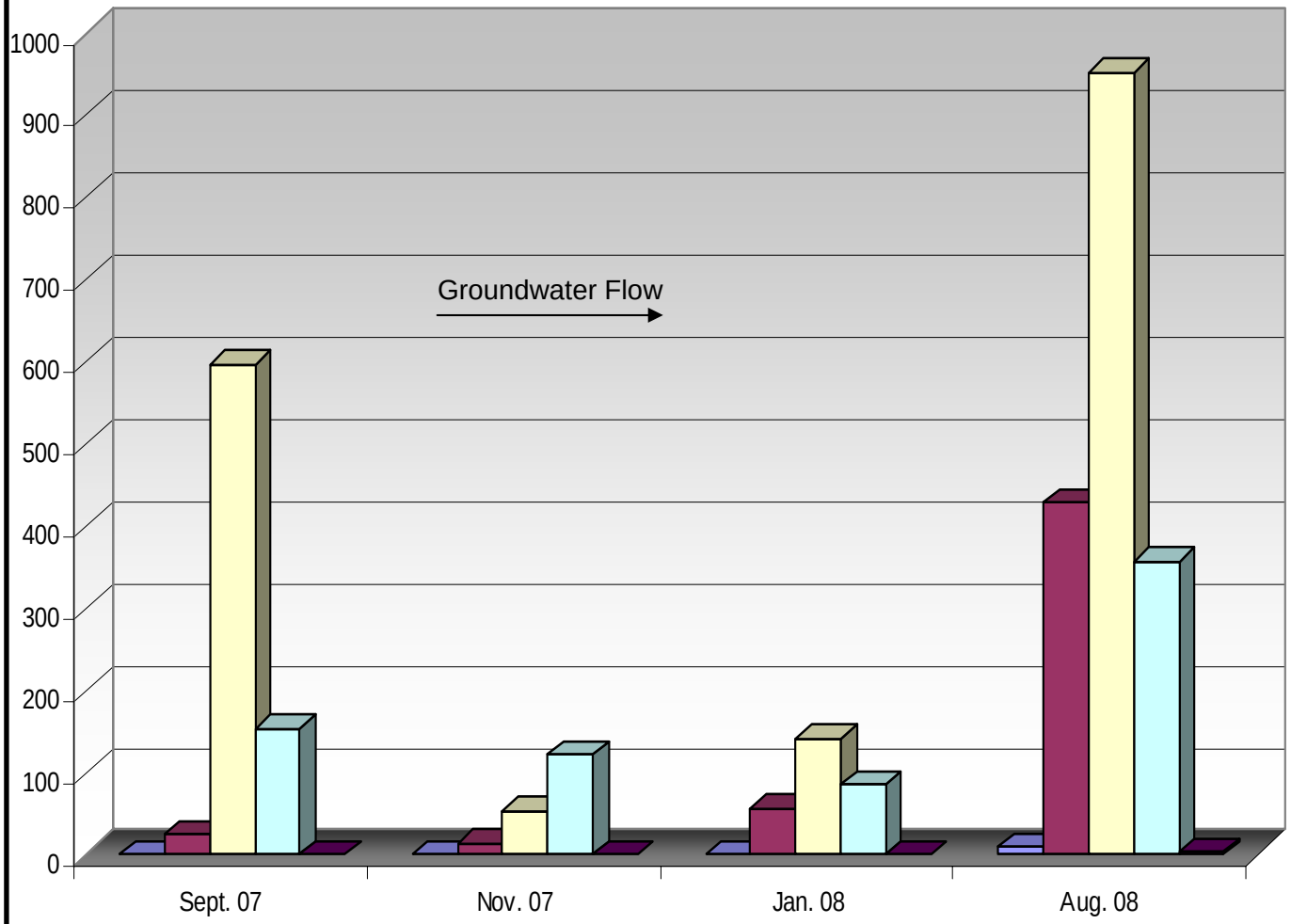
SITE 6 VOC GROUNDWATER SAMPLING RESULTS (2007-2008)

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

AECOM

DATE: FEBRUARY 2011

PROJECT NO.: 96029



LEGEND

Cross section of the plume
Groundwater flow is from the left to the right (north to south)

Total CVOC Results in μg/L

- MW-21
- MW-22
- MW-25
- MW-20
- MW-19

Figure 4-6

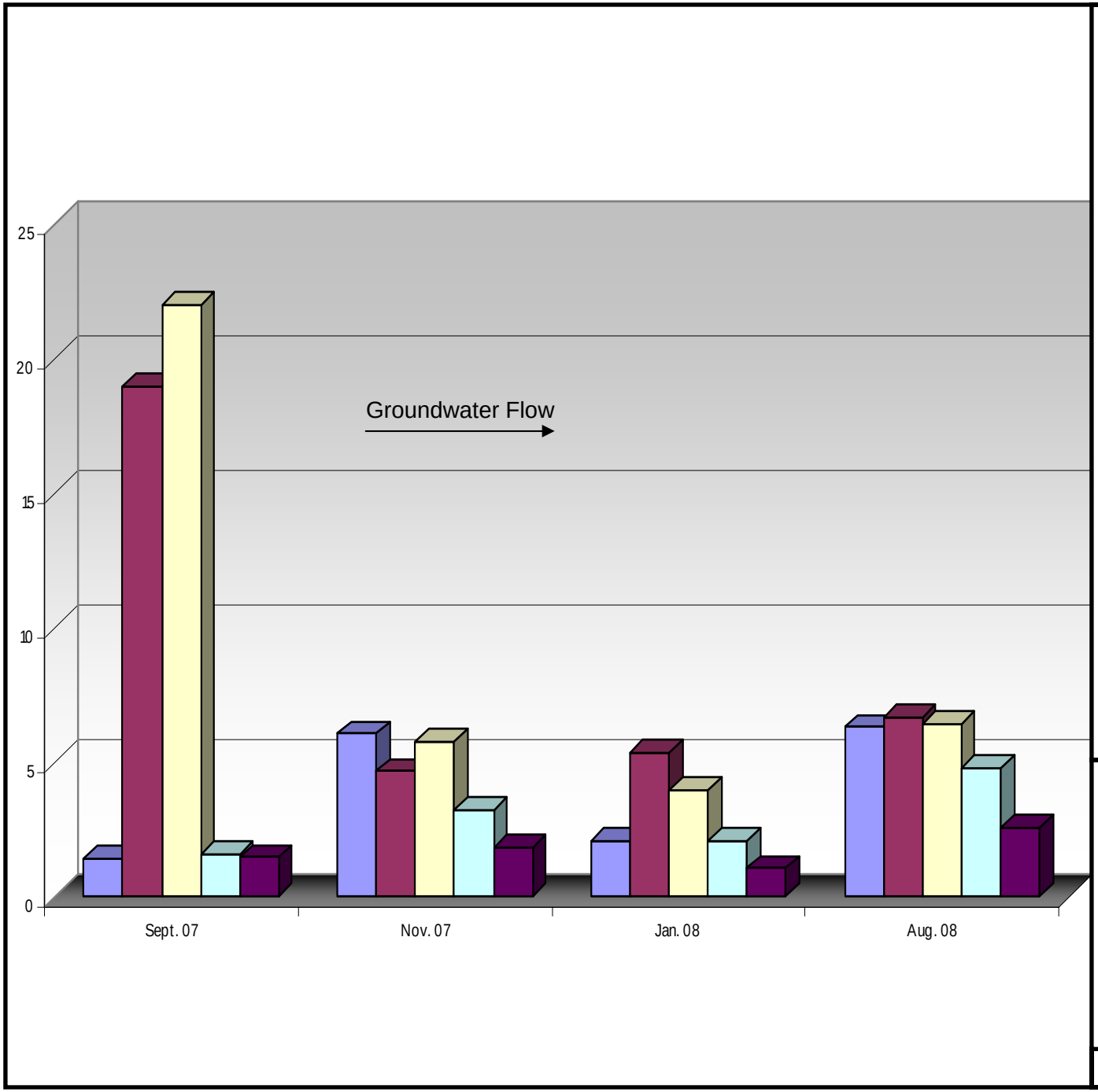
TOTAL CVOC

ANALYTICAL RESULTS BY WELL

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

EARTH TECH | AECOM

DECEMBER 2008 | PROJECT NO.: 96029



LEGEND

Cross section of the plume
Groundwater flow is from the left to the right (north to south)

Total organic carbon results in mg/L

Figure 4-7

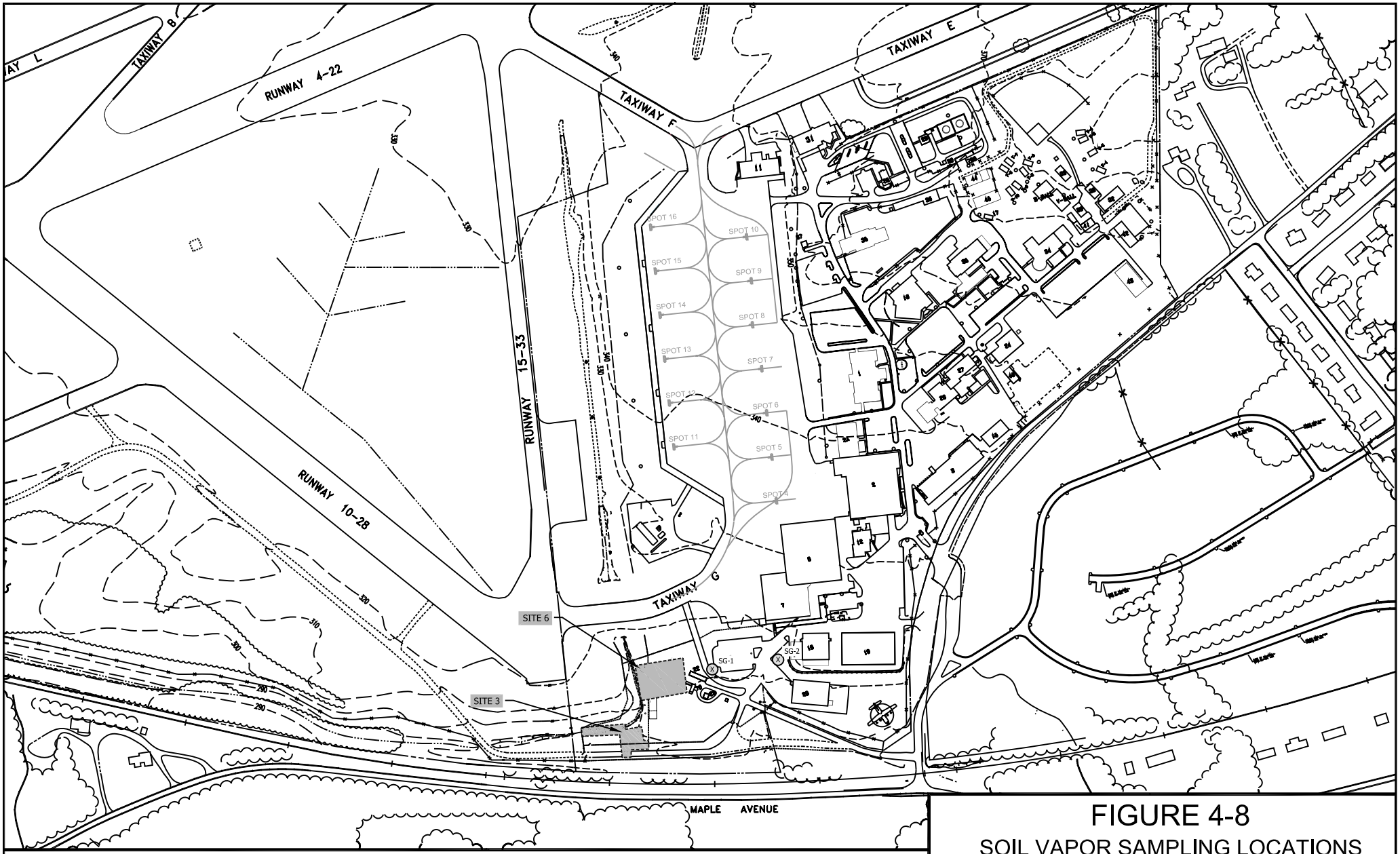
TOTAL ORGANIC CARBON

ANALYTICAL RESULTS BY WELL

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

EARTH TECH | AECOM

DECEMBER 2008 | PROJECT NO.: 96029



LEGEND

SG-1 (X) Soil Vapor Sample Location

PLAN

NORTH

Scale in Feet

0 250' 500'

FIGURE 4-8

SOIL VAPOR SAMPLING LOCATIONS

NEW YORK AIR NATIONAL GUARD
109TH AIRLIFT WING
SCOTIA, NEW YORK

AECOM

DATE: FEBRUARY 2011

PROJECT NO.: 96029

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APPENDIX A
Administrative Record

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The following documents are included in the Administrative Record for IRP Sites 3 and 6:

1) Preliminary Assessment, 109th Tactical Airlift Group, Schenectady County Airport, Scotia, New York, Hazardous Materials Technical Center, June 1989.

2) Management Action Program, 109th Airlift Group, Schenectady County Airport, Scotia, New York, Radian Corporation, July 1994.

3) Site Investigation Report, Volume 1, 109th Airlift Wing, Schenectady County Airport, Scotia, New York, BB Environmental Services, 1996.

4) Final Remedial Investigation/Feasbility Study Work Plan, 109th Airlift Wing, Stratton Air National Guard Base, Scotia, New York, Aneptek Corporation, April 1998.

5) Final Remedial Investigation Report Site 2 – Site 3 – Site 6 Stratton Air National Guard Base, Aneptek Corporation, September 2000.

6) Draft Final Feasibility Study, 109th Airlift Wing, Stratton Air National Guard Base, Scotia, New York, Aneptek Corporation, March 2001.

7) Final Action Memorandum IRP Site 6, 109th Airlift Wing, Schenectady Air National Guard Base, Scotia, New York, Aneptek Corporation, August 2002.

8) Final Time Critical Removal Action Completion Report – Site 6 Stratton Air National Guard Base, Aneptek Corporation, January 2003.

9) Final Supplemental Data Collection Technical Memorandum Site 6 Stratton Air National Guard Base, Aneptek Corporation, August 2003.

10) Draft Final Feasibility Study Report Site 6 Stratton Air National Guard Base, Aneptek Corporation, November 2003.

11) Letter dated May 13, 2005 from Jeffery W. LaRock of AMEC Earth & Environmental, Inc. to Mr. George Gribar, ANG/CEVR providing results of the 2004 geophysical subsurface investigation at IRP Sites 3 and 6.

12) *Final Interim Remedial Action (IRA) / Focused Feasibility Study (FFS) Work Plan. Schenectady Air National Guard Base, Earth Tech, April 2007.

13) *Final Interim Removal Action Completion Report, Site 3 & Site 6, Schenectady Air National Guard Base, Earth Tech, December 2007.

14) *Final Risk Assessment and Focused Feasibility Study Report Site Site 3 & Site 6, Schenectady Air National Guard Base, Earth Tech, July 2008.

Note: All documents available for review at the Schenectady Air National Guard Base. Documents denoted with (*) available at the Schenectady County Public Library (Glenville Branch) for review.

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