DRAFT FINAL

PROPOSED REMEDIAL ACTION PLAN FOR THE INSTALLATION RESTORATION PROGRAM SITES 4, 7, AND 9

NEW YORK AIR NATIONAL GUARD
(106TH RESCUE WING)
FRANCIS GABRESKI INTERNATIONAL AIRPORT

WESTHAMPTON BEACH, NEW YORK

OCTOBER 2006

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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OCTOBER 2006

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Prepared by
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ACRONYMS

ANG	Air National Guard
ARAR	Applicable or Relevant and Appropriate Requirements
BEHP	bis(2-ethylhexyl)phthalate
BGS	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COPC	contaminant of potential concern
CV	coefficient of variance
DCA	dichloroethane
DERP	Defense Environmental Restoration Program
DoD	U.S. Department of Defense
DPT	direct-push technology
EPA	U. S. Environmental Protection Agency
FTA	Fire Training Area
FS	feasibility study
gpm	gallons per minute
HHRA	Human Health Risk Assessment
IRP	Installation Restoration Program
JP	jet propellant
MCL	maximum contaminant level
MNA	monitored natural attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NGB/A7CVR	National Guard Bureau Environmental Restoration Branch
NYANG	New York Air National Guard
NYSDEC	New York State Department of Environmental Conservation
ORC	oxygen release compound
PAH	polycyclic aromatic hydrocarbon
PCE	tetrachloroethene
PID	photoionization detector
POC	principle organic contaminant
ppb	parts per billion
PRAP	Proposed Remedial Action Plan
RfD	reference dose
RI	remedial investigation
RL	reporting limit
RW	Rescue Wing
SARA	Superfund Amendments and Reauthorization Act of 1986
SCG	standards, criteria, and guidance
SCWA	Suffolk County Water Authority
SI	site investigation
SVE	soil-vapor extraction
SVOC	semivolatile organic compound
TCA	trichloroethane
TCE	trichloroethylene

TOGS	Technical and Operational Guidance Series
ULV	upper limit value
USACE	U. S. Army Corps of Engineers
UST	underground storage tank
VOC	volatile organic compound

1.0 NTRODUCTION

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 Environmental Restoration Branch (NGB/A7CVR) 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, 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) 106th Rescue Wing (RW), IRP Sites 4 (Aircraft Refueling Apron Site), 7 (Former Fire Training Area), and 9 (Ramp Drainage Outfall), located at the Francis Gabreski International Airport, Westhampton Beach, New York. Groundwater has been impacted at these sites by past releases from aircraft fueling, maintenance and 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.

SAIC Engineering of New York, P.C., a wholly owned subsidiary of Science Applications International Corporation (SAIC), has prepared this document for the ANG under the National Guard Bureau Contract No. DAHA92-01-D-0008, Delivery Order 0038.

This Proposed Remedial Action Plan identifies the proposed remedy, summarizes the remedial action alternatives considered, and discusses why the proposed remedy was selected. Due to the close proximity of Sites 4 and 9 as well as contaminants that have migrated from Site 4 to Site 9, these sites are discussed together throughout this document. The proposed remedies for all three sites are discussed in detail in Chapter 5 and are intended to attain the remediation goals identified in Chapter 3.

1.1 POTENTIAL IMPACTS

Potential impact to human health and environment was evaluated in risk assessments and reported in the Revised Draft RI written in January 1999 (S&W 1999) and the Final Remedial Investigation (RI) (PEER 2004).

For Sites 4 and 9, a human health risk assessment was conducted using data collected from 1994 through 1998 (S&W 1999). Chemicals of concern (COC) were identified at Site 4 for surface soil polycyclic aromatic hydrocarbons (PAHs) and groundwater (including benzene, toluene, ethylbenzene, total xylenes (BTEX), naphthalene, and 2-methylnaphthalene). At Site 9, only surface soil concentrations resulted in COCs being identified. COCs for surface soil included PAHs, lead, and cadmium. It was concluded, however, that risks associated with all media were within acceptable levels for human receptors for both noncancer and cancer causing chemicals. No further action was recommended for both Sites 4 and Site 9. Though risk calculations were not rerun during the Final RI (PEER 2004), the groundwater concentrations for COCs were evaluated with respect to the results of the risk assessment. It was

determined from this information that groundwater contamination at Sites 4 and 9 was delineated and that remedial action should be conducted. No further action was recommended for surface soil and subsurface soil at both sites.

Supplemental sampling conducted in 2004 and 2006 will serve as the baseline concentrations of groundwater for the remedial action. These investigations have defined the vertical and horizontal extents of groundwater contamination and will serve as the basis of design for the preferred remedy alternative. A full description of contaminant nature and extent is presented in Section 3.2 Nature and Extent of Impacted Media.

A full risk assessment was conducted using all available data through the 2001 sampling for Site 7 and reported in the Final RI (PEER 2004). Lead was identified in surface soil; volatile organic compounds (VOCs) and chromium were identified in subsurface soils; and VOCs, semivolatile organic compounds (SVOCs), and metals (cadmium, lead, and selenium) were identified in groundwater, and all were considered contaminants of potential concern (COPC). Further revaluation in the human health risk assessment (HHRA) indicated that lead in surface soil does not pose an unacceptable risk. Furthermore, the HHRA indicated that subsurface soil is not a complete pathway for human exposure, but did have some concentrations of chemicals in the saturated zone that may be contributing to groundwater contamination. All volatile and semivolatile compounds in groundwater were eliminated as COPCs. Arsenic was retained as COPC because future hypothetical risk scenarios indicated that risk estimates for non-cancer effects to children exceeded the EPA's acceptable risk. Lead was retained as a COPC because there were no threshold values established.

Analytical results from groundwater samples collected in 2004 indicate the absence of VOC and SVOC compounds in groundwater at Site 7. In addition, concentrations of arsenic and lead are within the range of background concentrations established in the Final RI (PEER 2004).

1.2 PROPOSED REMEDY

This Proposed Remedial Action Plan (PRAP) has considered multiple remedial alternatives for each site. The following sections present the proposed remedial action, discuss other options considered, and provide the rationale for the selection of the proposed remedial action for each site.

The proposed remedy for Sites 4 and 9 includes the installation of an in-situ air-sparge *g*roundwater treatment system as summarized below:

- Preconstruction design and permitting, and work plan development.
- Install air-sparge wells within the source area of the contaminated groundwater plume to in-situ remediate the groundwater.
- Construct and operate the air sparge system.
- Conduct groundwater sampling to monitor performance and quantify the rate of reduction for the groundwater contaminants.
- Operate and maintain the air-sparge system until concentrations of chemicals in groundwater achieve site closure criteria.

- Conduct the required NYSDEC closure monitoring once groundwater remediation criteria are achieved.

A total of 50 sparge points, 38 at site 4 and 12 at site 9, will be installed. The air-sparge wells will be installed to an approximate depth of 45 ft below ground surface (bgs) with a 5-ft screened interval. A soil-vapor extraction (SVE) system is not required to capture soil vapors as a component to the air sparge system since there are no overlying structures near the proposed sparge system. In addition, the air sparge system will be operated such that it minimizes volatilization of contaminants into the vadose soils but stimulates aerobic bioremediation in the groundwater. Surface and breathing zone vapors will be monitored during operation of the sparge system using a photionization device (PID) or equivalent. Groundwater sampling would be performed semiannually for the first two years followed by annual sampling until conditions are indicative that closure monitoring should be conducted. Closure monitoring will be conducted as required by NYSDEC.

Current concentrations of contaminants at Site 7 do not warrant a remedial action. However, the following proposed actions at Site 7 will return the site to unrestricted use and establish a monitoring program to meet site closure requirements:

- Analyze groundwater samples for VOCs, SVOCs, and metals on a quarterly basis for one year as part of the site closure process. The wells to be sampled will be agreed upon by ANG and NYSDEC prior to the initiation of compliance monitoring. Reevaluation will be required if concentrations exceed regulatory limits within the one year monitoring period for closure.

This document is a summary of the information that can be found in greater detail in the investigation reports and documents. To better understand Sites 4, 7, and 9, and the associated investigation, the public is encouraged to review the project documents at the following location:

Westhampton Free Library
7 Library Street
Westhampton Beach, NY 11978

1.3 PUBLIC PARTICIPATION

This PRAP has been issued as a component of the citizen participation developed pursuant to New York State Environmental Conservation Law and 6 NYCRR Part 375. The proposed remedy offered in this PRAP may be modified or an entirely new alternative may be chosen as a result of public comments on this PRAP. It is therefore in the best interest of both the public and the government that the public fully review all available information and provide their input.

A public comment period has been set from November 1, 2006 to November 30, 2006 to provide an opportunity for public participation in the selection of a remedy for IRP Sites 4, 7, and 9. Written comments may be submitted to the 106th Rescue Wing Environmental Manager by November 30, 2006 at the following address:

Anthony Vassell
106th RW, NYANG EM
150 Old Riverhead Road
Westhampton Beach, NY 11978-1201
Anthony.Vasell@NYSUFF.ang.af.mil

Public comments received from the review of this PRAP will be assimilated and/or summarized and responses to each will be prepared and included in the administrative record held by the Westhampton Beach Library as described in the preceding section.

2.0 SITE BACKGROUND

2.1 PROJECT BACKGROUND

The 106th RW of the NYANG is located at the Francis Gabreski International Airport in Suffolk County, New York, on the eastern end of Long Island. Francis Gabreski International Airport, formerly known as Suffolk County Airport, is on Old Riverhead Road, approximately 2 miles north of the Atlantic Ocean shoreline in Westhampton Beach. The airport is owned by Suffolk County. The 106th RW leases approximately 70 acres of runways, hangars, and maintenance/service facilities on the southwest side of the airport. The airport is bounded to the north by undeveloped land, to the east by the Quogue Wildlife Refuge, to the south by the Long Island Railroad, and to the west by Old Riverhead Road. The Francis Gabreski International Airport Master Plan reports the current area of the airport as 1,486 acres (Latino 2002).

The airport property was acquired in 1942 by the Civil Aeronautics Authority and was used for military training, aircraft maintenance, and armed forces support until 1969. Since 1970, Suffolk County has leased portions of the airport to numerous tenants, including the NYANG. In 1990, Suffolk County purchased the property and began operation of the Suffolk County Airport. The name of the airport was changed in 1999 to the Francis Gabreski International Airport, in honor of the former base commander and fighter pilot ace.

2.2 SITE DESCRIPTIONS AND HISTORY

2.2.1 Sites 4 and 9

Site 4 encompasses a grassy area adjacent to the refueling apron, southeast of Building 358. The refueling apron was used from the 1950s through the 1980s. Fuel was pumped from the on-base Petroleum, Oil, and Lubricant Tank Farm, located approximately 3,000 ft southeast of the refueling apron, to fuel outlets in a depressed concrete area at the apron. The depressed area was constructed to prevent potential surface releases of fuel from migrating onto the grassy area. Unused fuel was pumped back to the tank farm. It was estimated that hydraulic oil (50 gal/year), trichloroethylene (TCE) (30 gal/year), and fuel were released here, but that much of this material is believed to have drained to catch basins along the edge of the apron (ABB-ES 1997).

Two fuel spill incidents are known to have occurred at Site 4. The first spill occurred on July 6, 1987. Reportedly, the fire department applied foam to the area of the spill and the flow of fuel, water, and foam was stopped at the drains. The remainder of the spill was allowed to evaporate on the ramp surface. To prevent any residual floating product from leaving the installation, absorbent matting and powdered absorbent were placed along the outfall. The spill does not have a NYSDEC spill number, and the quantity of fuel spilled is not known (ANC/CEVR 2003). A second spill occurred on July 8, 1994 and was assigned the NYSDEC spill number "94-04858." During the second spill, approximately 100 gal of jet propellant (JP)-8 spilled on to the ramp during a heavy rain event. The material washed down the adjacent storm drains to a drainage ditch at an outfall located approximately 800 ft south of the refueling apron. This ramp drainage outfall was identified as Site 9. Approximately 300 gal of an oil-water mixture from this spill was recovered (NGB/A7CVR 2003).

Site 9 consists of an outfall, which receives drainage from the refueling apron, several hangars, a drainage ditch and surface drainage from Site 4. Surface drainage from the refueling apron is collected at five

catch basins near the fuel outlets and then directed through underground pipes to the drainage outfall, at the north end of Site 9. The drainage ditch extends approximately 400 ft south of the outfall point along a ditch where it infiltrates into the subsurface.

Site 9 was designated when Site 4 was split into two sites in 1990 because of detected chemicals at the outfall. By 2001, contaminants in groundwater had migrated from Site 4 to Site 9 such that the plumes were commingled. For this reason, the two sites are discussed together through the remainder of this document.

2.2.2 Site 7

Site 7 was used for fire training exercises by the Air Force from 1943 to 1971. It is situated 130 ft northwest of the taxiway on the southeast side of the airport, on a 10-in.-thick, concrete hardstand approximately 400 ft long by 50 ft wide, and bordered by a 10-ft-wide asphalt apron. The area was originally an unlined pit encompassing 1 acre, located 3,000 ft southeast and across the airport from the current ANG facility. Waste fuels, jet fuel and solvents (e.g., kerosene, mineral spirits, trichloroethylene, 2-butanone, toluene, etc.) were reportedly poured directly on the ground and ignited for fire training exercises.

The area was paved with a concrete hardstand in 1971 after ANG took over operations. A curb was constructed in 1978 to act as a berm around the burn area (approximately 1 ft high and 50 by 50 ft in size). Burn procedures were modified by floating a layer of jet fuel inside the berm on water, then either separating the fuel into a concrete underground storage tank (UST) or burning off the excess. Fuel to be used in training exercises was stored in an aboveground steel tank located about 250 ft south-southeast of the former fire training area (FTA). Both tanks were connected to the former FTA by buried piping. The former FTA is located about 3,200 ft, or 0.6 miles, upgradient of the Suffolk County Water Authority (SCWA) Meeting House Road well field. Use of the site for fire training was discontinued by ANG in 1986. The water contained in the UST was sampled on July 16, 1987, for lead and petroleum hydrocarbons, with no detections of the analytes (E.C. Jordan 1989).

2.3 LOCAL GEOLOGY

The glacial sediments underlying the airport are mainly outwash deposits consisting of 100 to 120 ft of stratified fine to coarse sand and gravel. Sieve analyses of two subsurface samples indicated the following average percentages: 90.5% sand, 7.9% gravel, and 1.6% silt/clay. Surface soil was found to contain higher percentages of silt (ABB-ES 1997). These upper Pleistocene sediments are composed of glacial outwash deposits; lucastrine and marine deposits; and terminal, ground, and ablation-moraine till deposits. The sediments under the airport are mostly outwash deposits consisting of stratified fine to coarse sand and gravel of light- to dark-brown, tan, and yellowish-brown color. Till deposits known as the Ronkonkoma Terminal Moraine are expressed as hills approximately 2 miles north of the airport. Lacustrine and marine deposits are usually thin and discontinuous and are found locally throughout Long Island.

An approximately 40-ft-thick clay bed, Gardiners Clay, lies above the Magothy Formation and below the glacial deposits below the airport. This clay is present at about 100 ft below mean sea level at the airport and extends southward where it overlaps the Monmouth Greensand. The Gardiners Clay pinches out just north of the airport, but equivalent clay bodies can be found locally at various locations on Long Island. This unit is made up of green and gray clay, silt, and clayey and silty sand, including some interbedded clayey and silty gravel. This layer as a whole has low hydraulic conductivity and tends to confine water in the underlying and overlying aquifer (Dames and Moore 1986).

2.4 HYDROGEOLOGY

The Upper Glacial Aquifer forms the shallowest aquifer beneath the airport. This aquifer correlates to the saturated interval of the glacial outwash deposits of the Wisconsin Glaciation. This water-bearing unit is an unconfined aquifer present directly below the airport. Groundwater elevations are approximately 15 to 19 ft above the National Geodetic Vertical Datum, which varies seasonally. The clean, coarse sand and gravel are very porous and highly permeable, so that a high proportion of rainfall infiltrates where it falls. There is little surface run-off after precipitation events. The glacial deposits store large quantities of water and, due to their high porosity and permeability, yield large quantities of water to wells. The glacial deposits are the source of nearly all groundwater pumped in central Suffolk County. There are no effective barriers to the movement of water anywhere in the unit, but there may be substantial variation in permeability over short distances. Some of these minor variations in water-bearing characteristics might become significant in connection with possible movement of a contaminant. As the moraine and outwash deposits were developed by water flowing generally from north to south, individual lenses of sand and gravel may be elongated in this direction. Thus, there may be threads of material with relatively higher permeably material along which water might move a little more rapidly under proper hydraulic conditions. Hydraulic conductivity of the outwash deposits was estimated to be about 2,000 gpd/ft^2 (9.4×10^{-2} cm/s) (ABB-ES 1997), and transmissivity is approximately 200 gpd/ft (2.9×10^{-1} cm^2/s) (Dames and Moore 1986).

The direction of groundwater movement beneath the Francis Gabreski International Airport (i.e., in the Upper Glacial Aquifer) is toward the south-southeast. Depth to groundwater averages 35 to 40 ft below ground surface (bgs). Slug tests performed on installation monitoring wells and piezometers (screened in the Upper Glacial Aquifer) produced hydraulic conductivities ranging from 1.6×10^{-2} to 5.2×10^{-2} cm/sec (Dames and Moore 1986).

The Gardiners Clay, as described in the preceding section, acts as an aquitard between the Upper Glacial Aquifer and the Magothy Aquifer located approximately 150 ft to approximately 1000 ft below mean sea level. Migration of contaminants downward into lower aquifers is very unlikely (Dames and Moore 1986).

Groundwater is the only water supply source for Suffolk County. Most of the water in surrounding area of the Francis Gabreski International Airport is obtained from the Upper Glacial Aquifer; the rest is obtained from the Magothy and Lloyd aquifers. At present, SCWA supplies the majority of the water in the area, while several smaller companies supply the rest. SCWA operates 18 wells in 4 well fields within a 4-mile radius of the site, and the nearest public supply well field is located 0.6 miles southeast of Site 4 and 9.

2.5 PREVIOUS SITE INVESTIGATIONS

2.5.1 Site 4 (Aircraft Refueling Apron Site) and Site 9 (Ramp Drainage Outfall)

A Phase I Records Search was conducted in 1987 (HMTC 1987) that included Site 4. A tracer study was conducted in 1988 to identify potential leaks in the hydrant lines. Potential leaks were identified in the fuel lines northwest of the distribution pumps and in one storage tank at the tank farm (neither were part of Site 4). As a result of the findings of the Records Search (HMTC 1987), a Site Investigation (SI) was conducted for Sites 4, 5, 8, and 9 by ABB Environmental in 1994 (ABB-ES 1997). Soil sampling performed in 1994 at Site 4 indicated exceedances of NYSDEC action levels for VOCs (e.g. BTEX) and chlorobenzene, and the metal arsenic. The detected concentration of arsenic does not exceed the revised NYSDEC soil action levels. Groundwater sampling results indicated exceedances of NYSDEC action

levels and/or maximum contaminant levels (MCLs) for BTEX, chlorobenzene, naphthalene, 2-methylnaphthalene, and chromium. According to the SI Report (ABB-ES 1977), suspected sources included spills at the two fuel distribution pumps, releases at a sump tank, and leakage along subsurface fuel lines (ABB-ES 1997). Other potential sources identified were the defueling tanks and the associated subsurface piping previously located near the sump tank. The 106th RW indicated that the U. S. Army Corps of Engineers (USACE) had removed subsurface lines and tanks at Site 4 and that the contaminants at Site 4 were associated with historic uses of JP-4. Fuel distribution pumps at the concrete apron have been inactive since 1980. Free-phase petroleum product was not observed during previous investigations at this site (ABB-ES 1997).

The Revised Draft RI Report (S&W 1999) reported that six PAHs and lead exceeded previous NYSDEC action levels in surface and subsurface soils collected in 1998. Groundwater sampling was also conducted using direct-push methodology in 1998 at Site 4. The samples had exceedances of NYSDEC action levels and/or MCLs by fuel-related VOC and SVOC compounds, including BTEX, naphthalene, and 2-methylnaphthalene. A total of six monitoring wells were installed at Site 4, including SW-5, -6, -7, and -10, and deep wells SW-8 and -9 and two rounds of samples were collected.

A Final RI (including Sites 4, 7, and 9) was conducted in 2001 and the final document submitted in 2004 (PEER 2004). Field activities included sampling existing wells that had exceeded action levels in prior sampling events. Conclusions based on historical and 2001 data indicated that groundwater was contaminated and that saturated soil may be acting as a secondary groundwater contamination source. The RI recommended that no further action was required for surface and subsurface soil and no further investigation of groundwater was required. However, it was recommended that an evaluation and implementation of a groundwater remedial action should be conducted.

Supplemental sampling conducted in 2004 (SAIC 2006) indicates that these groundwater contaminants still exceed action levels at Sites 4 and 9. In addition, the results of the sampling indicate that the groundwater plume geometry and size has changed.

PAHs and several metals were detected in surface and shallow subsurface soil in the upper portions of the ramp drainage outfall at Site 9. Some of these constituents exceeded NYSDEC action levels. Some metal concentrations also exceeded NYSDEC action levels, although none exceeded background concentrations for the eastern United States (ABB-ES 1997).

Site 9 surface and subsurface soils were investigated in 1998 (S&W 1999). Seven SVOCs were found to exceed NYSDEC action levels: the PAHs – pyrene, benzo(*a*)anthracene, chrysene, benzo(*b*)fluoranthene, benzo(*k*)fluoranthene, benzo(*a*)pyrene, and dibenzo(*a,h*)anthracene; the metals – cadmium and lead – also exceeded previous NYSDEC action levels. No subsurface exceedances were found, and direct-push groundwater was not investigated.

Field activities, comprised of sampling the two permanent monitoring wells at the site, were conducted during the Final RI (PEER 2004) in 2001. Sample results indicated groundwater at Site 9 was being impacted by migration of contaminated groundwater from Site 4, but concentrations were not high enough for any contaminants of potential concern to be identified.

Supplemental groundwater sampling of both permanent wells at Site 9 was conducted in 2004 (SAIC 2006) as a baseline for subsequent remedial actions. The results indicated that both VOCs and SVOCs exceed NYSDEC action levels.

In July 2006, a supplemental site investigation was performed in order to refine the known extents of the groundwater plume at Sites 4 and 9. Groundwater samples were collected from 18 direct-push technology (DPT) borings and various depths. Groundwater samples were collected from each boring at approximately 10 foot intervals starting with the first water encountered to a depth of 30 feet below the water table. Upon completion of the supplemental DPT investigation, four new monitoring wells were installed and sampled. The supplemental investigation and new monitoring wells have provided further delineation of the groundwater plume at Sites 4 and 9. The results indicate concentrations of benzene, toluene, ethylbenzene and xylene that still exceed NYSDEC action levels and/or MCLs. See Appendix B for a complete listing of analytical results and Section 3 for current plume maps.

Table 2-1 summarizes the maximum detected VOC and SVOCs in groundwater from monitoring wells during the 2004 and 2006 supplemental sampling events.

2.5.2 Site 7 (Former Fire Training Area)

A draft consent decree was issued on June 11, 1986, requiring that a SI be developed and implemented for the former FTA, to be followed by development and implementation of a Remedial Action Plan. The complaint was filed by the state of New York against the United States of America, et al., alleging that the United States caused the release of hazardous substances into the environment at the Suffolk County Airport, and as a consequence, soil and groundwater had become contaminated with hazardous substances. The former FTA was not included in the Phase I Records Search during 1987 through 1989 because SI and RI/feasibility study (FS) activities were already underway (HMTC 1987) as a result of this decree.

The SI was conducted in 1989 (E.C. Jordan Co 1989). A series of monitoring wells were installed at the site to assess and track groundwater contamination, and an extensive surface and subsurface soil sampling program was performed to define surface and subsurface soil contamination (YEC, Inc., 1989). Over the course of investigations at Site 7, a total of 22 monitoring wells and 4 piezometers were installed and sampled at the former FTA, and compared to NYSDEC action levels (ABB-ES 1997). VOCs that were detected all exceeded their action limits, including BTEX; 1,1-dichloroethane (1,1-DCA); 1,1,1-trichloroethane (1,1,1-TCA); tetrachloroethene (PCE); and acetone. One SVOC, bis(2-ethylhexyl)phthalate (BEHP), also exceeded the NYSDEC action level. Lead was detected, but did not exceed the previous NYSDEC action level (ABB-ES 1997).

Initial investigations at the former FTA indicated detections of 2-butanone. However, the subsequent "Evaluation of 2-Butanone in Groundwater Samples" (ABB-ES 1992) concluded that the 2-butanone in samples collected from the former FTA was a sampling artifact resulting from the use of methyl hydrate as a decontamination fluid. This was demonstrated through the use of chromatographic fingerprinting, statistical analysis of data, and focused field investigation.

The 1989 Site Characterization (ABB-ES 1989) of Site 7 soils included both hand-auger and soil boring sampling of surface soils (0 to 0.5 ft BGS), shallow subsurface soils (0.5 to 2.0 ft BGS), and deeper subsurface soils (more than 2.0 ft BGS). Soil samples were analyzed for VOCs, SVOCs, polychlorinated biphenyls, and lead. At one location, ethylbenzene, total xylenes, fluorene, and 2-methyl phenol exceeded NYSDEC action levels for saturated soil (30 ft BGS), and total xylenes exceeded NYSDEC action levels for unsaturated soil (20 ft BGS). All of the surface soil samples (0 to 0.5 ft BGS), 7 out of 9 soil samples from 0.5 to 2.0 ft BGS, and 3 out of 12 samples from 3.5 to 4.0 ft BGS exceeded the previous lead NYSDEC action level for lead of 4.4 mg/kg. However, all analyses were within the range of eastern United States or state of New York background concentrations of 4 to 500 mg/kg. The highest lead

concentrations were detected near the center of the former FTA, with an additional peak area near the concrete waste fuel UST.

Table 2-1. Maximum VOC and SVOC Reported Detections
Installation Restoration Program Sites 4 and 9
New York Air National Guard, Francis Gabreski International Airport, Westhampton Beach, New York

			SITE 4 & 9 Maximum Detected Contaminant Concentration
Volatile Organics (µg/L)	**NYSDEC[a]**	**MCL[b]**	
(1,1-Dimethyl-ethyl)benzene	*5**	N/A	2.9
(1-Methylpropyl)-benzene	*5**	N/A	2.6
1,2,4-Trimethyl-benzene	*5**	N/A	**515**
1,3,5-Trimethyl-benzene	*5**	N/A	**230**
Acetone	N/A	N/A	22.2 J
1-Methyl-4-(1-methylethyl)-benzene (p-Isopropyltoluene)	*5**	N/A	**12**
Benzene	1	5	0.6 J
Butylbenzene	*5**	N/A	**13.3**
Cumene (Isopropylbenzene)	*5**	N/A	**61.2**
Ethylbenzene	*5**	700	**770**
n-Propylbenzene	*5**	N/A	**76.3**
Toluene	*5**	1,000	**670**
Xylene, Total	*5**	10,000	**2,860**
Semi Volatile Organics (µg/L)			
2,4-Dimethyl-phenol	5*	N/A	1.6 J
2-Methyl-naphthalene	N/A	N/A	25
4-Methylphenol	N/A	N/A	6 J
Diethyl phthalate	N/A	N/A	3.5 J
Naphthalene	10	N/A	**44**

Notes:
[a] New York State Department of Environmental Conservation Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, Table 1 (cf. section 703.5) Water Quality Standards Surface Waters and Groundwaters, Class GA Waters, Amended August 1999
[b] Environmental Protection Agency National Primary and Secondary Drinking Water Standard Maximum Contaminant Level
[c] "5*" is the principal organic contaminant standard for groundwater of 5 ug/L applies to this substance
[d] Bolded values represent concentrations exceeding criteria.
[e] All units are in micrograms per liter (µg/L)

Abbreviations and Acronyms:
J – detected at an estimated concentration
N/A – not applicable
µg/L – micrograms per liter

A Final RI (PEER 2004) was implemented in 2001 comprised of direct-push sampling of soil and groundwater, surface soil sampling, and sampling of all existing permanent groundwater monitoring wells at the site. Two rounds of groundwater sampling were conducted in March and June 2001. Conclusions of the Final RI (PEER 2004) were that surface soil was impacted with lead, but the concentrations did not represent an unacceptable risk to human health. Subsurface saturated soil was impacted by VOCs, but a complete pathway to human receptors could not be established. It was also concluded that groundwater was impacted by site activities. Specifically, a dissolved phase VOC, SVOC, and metals plume existed at the site. It was further concluded that the full extent of the plume had not been established. It was recommended an additional investigation as well as a remedial action be conducted for groundwater at the site.

Groundwater sampling was conducted at Site 7 in 2004 (SAIC 2006) as part of a baseline sampling evaluation for subsequent remedial action at the site. Samples collected from wells at the site did not contain detectable concentrations of any VOCs or SVOCs. In addition, all metals concentrations were below NYSDEC action levels or were not detected.

In July of 2006, one 2 inch galvanized steel well (MW-00X) was abandoned in accordance with NYSDEC requirements.

Table 2-2 summarizes the maximum detected VOC and SVOCs in groundwater from monitoring wells during the 2004 supplemental sampling event.

Table 2-2. Maximum VOC and SVOC Reported Detections
Installation Restoration Program Site 7
New York Air National Guard, Francis Gabreski International Airport, Westhampton Beach, New York

			SITE 4 & 9 Maximum Detected Contaminant Concentration
Volatile Organics (µg/L)	**NYSDEC[a]**	**MCL[b]**	
1,2,4-Trimethylbenzene	*5**	N/A	0.7 J
Chloroform	7	80	1.2
Ethylbenzene	*5**	700	1
Xylene, Total	*5**	10,000	4
Semi Volatile Organics (µg/L)			
Benzoic Acid	N/A	N/A	9.5 J
Bis(2-ethylhexyl)-phthalate	*5**	N/A	2.8 J

Notes:
[a] New York State Department of Environmental Conservation Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, Table 1 (cf. section 703.5) Water Quality Standards Surface Waters and Groundwaters, Class GA Waters, Amended August 1999
[b] Environmental Protection Agency National Primary and Secondary Drinking Water Standard Maximum Contaminant Level
[c] "5*" is the principal organic contaminant standard for groundwater of 5 ug/L applies to this substance
[d] Bolded values represent concentrations exceeding criteria.
[e] All units are in micrograms per liter (µg/L)

Abbreviations and Acronyms:
J – detected at an estimated concentration
N/A – not applicable
µg/L – micrograms per liter

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3.0 DEVELOPMENT OF REMEDIAL GOALS

3.1 STANDARDS, CRITERIA, AND GUIDANCE VALUES

To evaluate the environmental media (soil, sediment, groundwater, etc.) impacted at levels of concern, the available investigation analytical data were compared to environmental standards, criteria, and guidance (SCG) values.

3.1.1 Groundwater

The SCGs for groundwater at Sites 4, 7, and 9 are based on State of New York Class GA groundwater standards. New York State water is classified by primary or best usage. Guidance and standards are developed to provide protection of the primary usage(s) assigned to each water class. Usages are described in Part 701 of the state of New York Administrative Code. The SCGs are selected by determining the applicability of the principle organic contaminant (POC) groundwater standard. This procedure consists of five steps, as outlined in the Division of Water Technical and Operational Guidance Series [Technical and Operational Guidance Series (TOGS) (NYSDEC 1991)].

Determining an action level requires finding the COC in one of three tables present in TOGS; Tables 1, 2, and 3. If the COC is not included in any of the three tables, then definitions included on page 9 of TOGS are followed. If the COC is not found in these four steps, NYSDEC assistance is required. Guidance documents include:

- State of New York Ambient Water Quality Standards and Guidance Values (TOGS, Table 1).
- Partial List of Substances Regulated by POC.
- Groundwater Standard of 5 µg/L (TOGS, Table 2).
- Partial List of Substances Not Regulated by POC.
- Groundwater Standard (TOGS, Table 3).
- Definitions of POC Classes 1 (halogenated alkanes) and 2 (halogenated ether).
- TOGS, page 9.

The relevant action levels for groundwater derived from State of New York guidance and Federal drinking water MCLs are presented in Table 3-1 below. Federal drinking water MCLs are provided for comparison. If standards or guidance values are less than laboratory reporting limits (RLs), the RLs will be used as action levels (ABB-ES 1997).

3.1.2 Soils

Organic Compounds

Soil action levels for VOCs and SVOCs were developed from NYSDEC guidance for determination of soil cleanup objectives (NYSDEC 1994). These levels reflect the most stringent value obtained from the following alternative criteria.

a. Human health-based levels that correspond to excess lifetime cancer risks of 1 in 1,000,000 for Class A and B carcinogens, or 1 in 100,000 for Class C carcinogens. These levels are calculated by NYSDEC using U. S. Environmental Protection Agency (EPA) cancer slope factors and exposure

scenarios, which ensure acceptable risk. Class A carcinogens are proven human carcinogens; Class B are probable human carcinogens; and Class C are possible human carcinogens.

Table 3-1. Groundwater Action Levels for Detected Compounds

Volatile Organics (ug/L)	NYSDEC [a]	MCL [b]
(1,1-Dimethyl-ethyl)benzene	5 [c]	N/A
(1-Methylpropyl)-benzene	N/A	N/A
1,2,4-Trimethyl-benzene	5	N/A
1,3,5-Trimethyl-benzene	5 [c]	N/A
Acetone	N/A	N/A
1-Methyl-4-(1-methylethyl)-benzene	N/A	N/A
Benzene	1	5
Butylbenzene	5 [c]	N/A
Chloroform	7	80
Cumene (Isopropylbenzene)	5 [c]	N/A
Ethylbenzene	5 [c]	700
n-Propylbenzene	5 [c]	N/A
Toluene	5 [c]	1,000
Xylene, Total	5 [c]	10,000

Notes:
[a] New York State Department of Environmental Conservation Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, Table 1 (cf. section 703.5) Water Quality Standards Surface Waters and Groundwaters, Class GA Waters, Amended August 1999
[b] Environmental Protection Agency National Primary and Secondary Drinking Water Standard Maximum Contaminant Level
[c] "5*" is the principal organic contaminant standard for groundwater of 5 ug/L applies to this substance
[d] All units are in micrograms per liter (µg/L)

Abbreviations and Acronyms:
N/A – not applicable

b. Human health-based levels for systemic toxicants, calculated from reference doses (RfDs). RfDs represent an estimate of daily exposure an individual can experience without appreciable risk of health effects during a lifetime.

c. Environmental concentrations protective of groundwater/drinking water quality. These concentrations are based on the Water-Soil Equilibrium Partition Theory, which assumes that organic matter present in soils will adsorb organic compounds and attenuate continued migration. The concentrations are dependent on the amount of carbon present in the soil and whether or not the soil is in contact with groundwater. This approach predicts a maximum, estimated soil concentration that does not generate a leachate likely to impact groundwater quality above applicable standards.

Human health-based criteria were compiled from EPA Health Effects Assessment Summary data (O'Toole 1994). Environmental concentrations protective of groundwater/drinking water quality are based on NYSDEC calculations, which assume 1% total organic carbon and a correction factor of 100 for saturated soils. Soils located within 5 ft of the water table were considered saturated (ABB-ES 1997).

The action levels for organic compounds in soils and sediments relative to state of New York guidance and RLs are presented in the Final RI (PEER 2004). RLs that exceed state of New York guidance will be used as action levels. Site background data from the SI Report are included in this table for comparison because background concentrations that exceed health-based levels can be used as action levels. Soils with a discernible odor of a particular chemical or substance will be considered indicative of a release, regardless of contaminant concentration(s) (ABB-ES 1997).

Inorganic Compounds

Action levels for inorganic constituents were developed from NYSDEC guidance for determination of soil cleanup objectives (NYSDEC 1994). The levels are based on the upper limit value (ULV) of site background concentrations, excluding outliers, as recommended by NYSDEC (ABB-ES 1997). The ULV was calculated from the mean of background constituent concentrations plus three standard deviations.

Background data for which coefficient of variance (CV) was greater than 0.50 were re-evaluated without outliers and the maximum allowable concentration or ULV for individual constituents was calculated again by adding the new background mean to 3 times the standard deviation. Outliers, which do not exceed this upper limit, are not considered indicative of a release. Calculations can be found in Appendix K of the ABB-ES 1997 SI Report.

NYSDEC action levels for the metals arsenic, cadmium, chromium, lead, selenium, and silver in surface soils, sediment, and subsurface soils are summarized in the Final RI (PEER 2004). Using the results of the soil analyses from the Background Site (see Section 5.2.3 of the Final RI Report), new ULVs were calculated for these metals. The new ULVs were evaluated using the CV test, and those with their CV < 0.50 have been adopted for use. Metals failing the CV test for their new ULVs were chromium and lead in surface soils and sediment, and chromium in subsurface soils.

In the Final RI (PEER 2004), the new ULVs are adopted as "revised action levels" for evaluating the above metals in soil. The new ULVs are considered to represent the upper limit of background concentrations, as used in the text and tables in the Final RI (PEER 2004).

Action levels for the remaining metals are provided in the Final RI (PEER 2004). These action levels are based on NYSDEC TAGM #4046.

3.2 NATURE AND EXTENT OF IMPACTED MEDIA

3.2.1 Soil

Previous investigations have concluded that risks associated with surface and subsurface soils are within the acceptable limits and no soil remediation is required. This PRAP therefore only addresses groundwater.

3.2.2 Groundwater Sites 4 and 9

Groundwater sampling results performed in 1994 at Site 4 and 9 indicated exceedances of previous NYSDEC action levels for BTEX, chlorobenzene, naphthalene, 2-methylnaphthalene, and chromium. Groundwater sampling was also conducted using direct-push methodology in 1998 at Site 4 and 9 (S&W 1999).

A supplemental sampling effort was performed in 2004 to determine the existing nature and extent of VOC/SVOC contamination in groundwater and reevaluate groundwater flow (SAIC 2006). A total of eight monitoring wells were sampled (SW-06, SDW-023, SW-08, SW-09, SDW-021, SDW-022, SW-07, and SW-09) across the two sites for VOCs, SVOCs, and metals. Based on 2004 gauging data, groundwater flow is presented in Figure 3-1. Results of the 2004 sampling indicate that multiple VOCs exceed the action levels across Sites 4 and 9 (see Figure 3-2). The highest concentrations obtained during the 2004 supplemental sampling effort (SAIC 2006) were found at SW-06, SDW-023, and SW-09 located near the centerline of the plume.

Naphthalene is the only SVOC detected at concentrations greater than the action levels in the 2004 sample data (see Figure 3-3). The concentrations follow a similar pattern with highest concentrations down the centerline of the plume (SW-06, SDW-023, and SW-09). Metals (aluminum, iron, manganese, and sodium) also exceed the action levels in groundwater at the sites (see Figure 3-4) but concentrations are within the background ranges used in the Final RI (PEER 2004).

An additional supplemental site investigation was performed in July 2006 in order to further delineate the groundwater plume at Sites 4 and 9. Eighteen DPT borings were completed and groundwater samples were taken from approximately 10-ft intervals starting with the first water encountered to a depth of 30-ft below the water table. An onsite mobile laboratory was utilized to analyze the samples for VOCs by EPA Method 8260. The sample results were utilized during the investigation to dynamically adjust subsequent boring locations. The sampling results were also used to optimally place an additional four monitoring wells. Figure 3-5 depicts the extents of benzene in groundwater. Figure 3-6 depicts the extents of the total BTEX contamination. Tables presenting the supplemental sampling results for the DPT points and the new monitoring wells are located in Appendix B.

3.2.3 Groundwater at Site 7 – Former Fire Training Area

As discussed, groundwater sampling at Site 7 was conducted under the Final RI (PEER 2004) to supplement previous investigations. VOCs and SVOCs were detected in exceedance of NYSDEC action levels, including benzene, carbon disulfide, chloroform, ethylbenzene, xylenes (total), 4-methyl-phenol, and naphthalene. The metals arsenic, cadmium, lead, and selenium were detected exceeding NYSDEC action levels and/or MCLs. Additional sampling was conducted as part of baseline sampling for the planned remedial action at Site 7 in 2004. These data represent the most current concentrations available to evaluate the groundwater plume. Of the monitoring wells sampled at Site 7 in 2004, only monitoring well MW-23 reported detections of any VOCs at concentrations above the laboratory method detection limit. 1,2,4-trimethylbenzene, chloroform, ethylbenzene, and total xylenes were identified in monitoring well MW-23; however, none of these concentrations exceeded their respective regulatory criteria. Historically benzene, carbon disulfide, chloroform, ethylbenzene, and total xylenes have exceeded regulatory criteria in one or more of the wells sampled (see Figure 3-7).

A total of 2 SVOCs were detected in the groundwater samples collected at IRP Site 7 in 2004. Benzoic acid and Bis(2-ethylhexyl)phthalate were both detected at estimated (J) concentrations below their respective regulatory criteria. Historically, 4-methyl-phenol, and naphthalene have exceeded regulatory criteria, but were not detected in the 2004 samples collected.

A total of 12 inorganic compounds were detected in the groundwater samples collected at IRP Site 7 in 2004, three of which, aluminum, iron, and manganese were detected above their respective established MCLs. Manganese exceeded the MCL at a single location, monitoring well MW-106 while iron and aluminum exceeded their respective MCLs in two and three Site 7 wells respectively (see Figure 3-8). None of the reported concentrations were above the background range reported in the 2004 Final RI (PEER 2004).

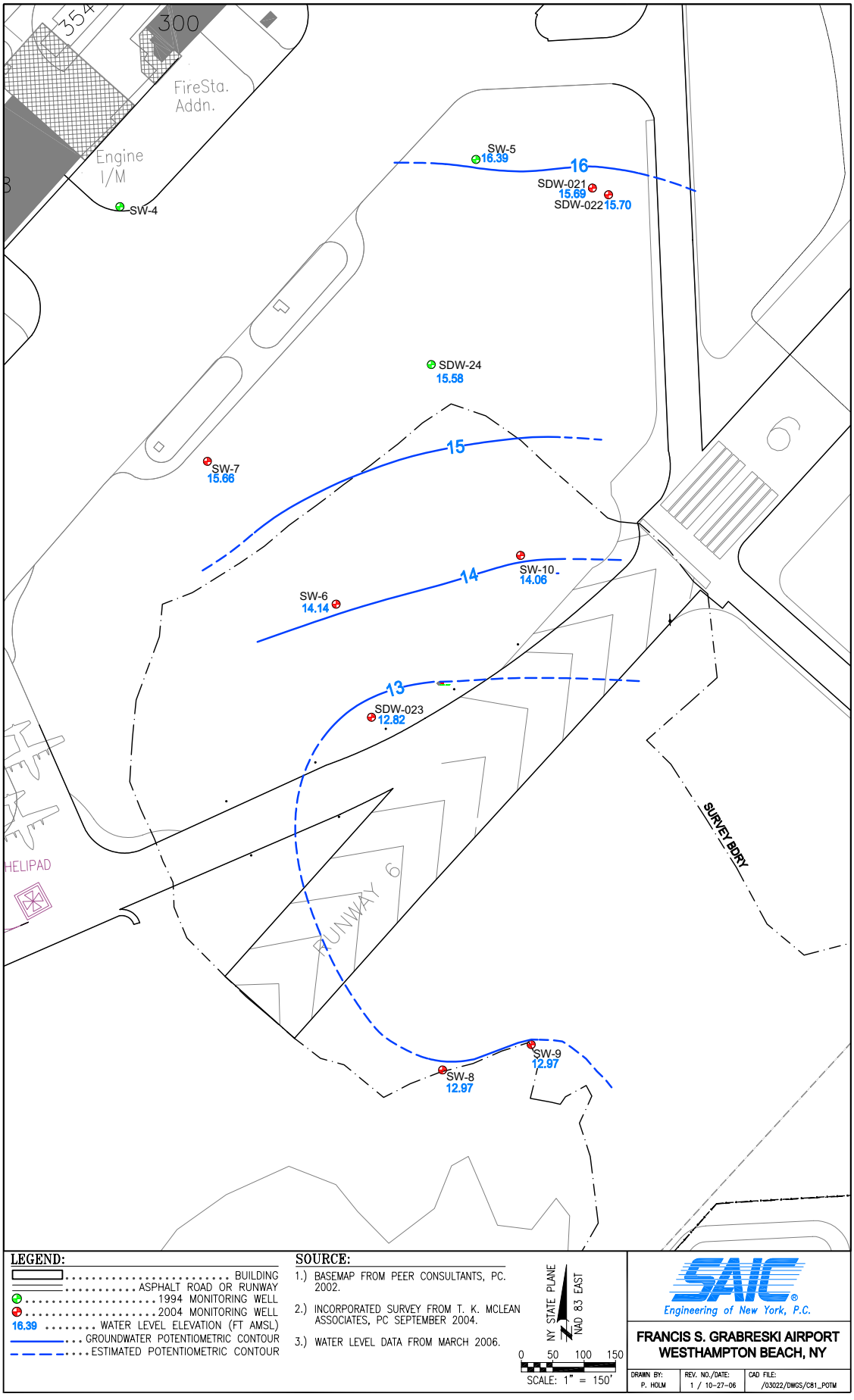

Figure 3-1. Sites 4 & 9 Groundwater Potentiometric Map

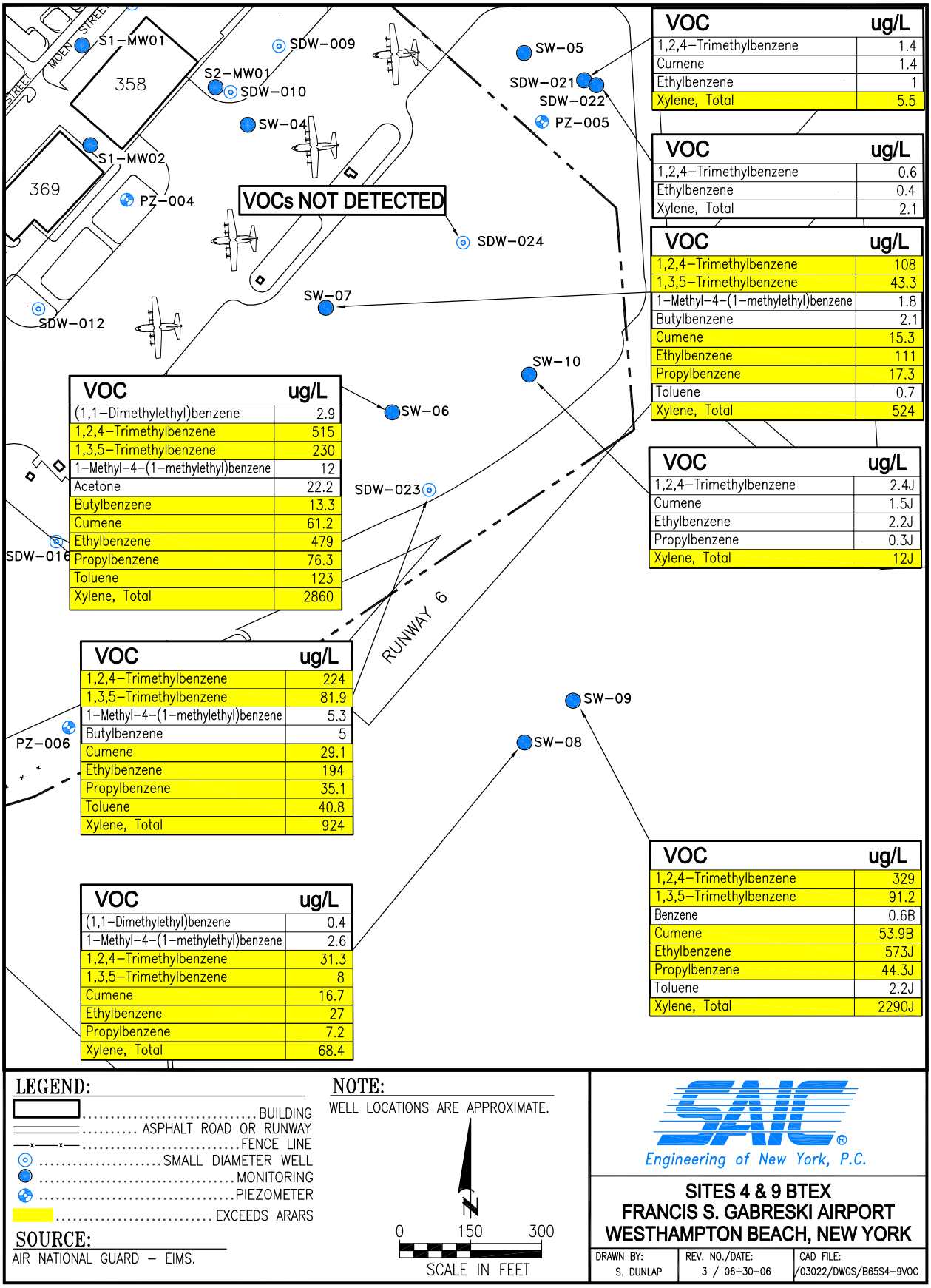

Figure 3-2. Sites 4 and 9 VOCs in 2004.

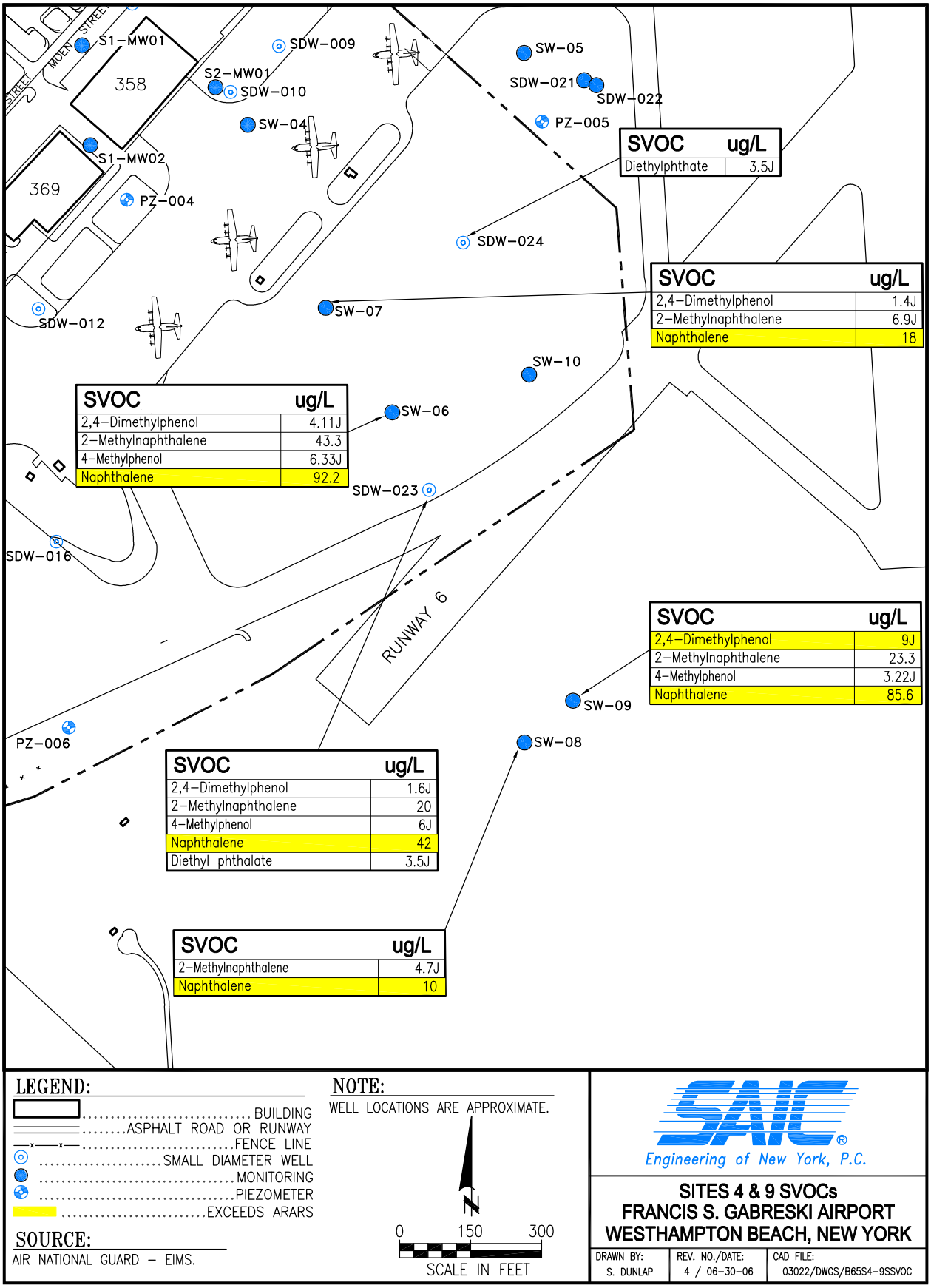

Figure 3-3. Sites 4 and 9 SVOCS in 2004

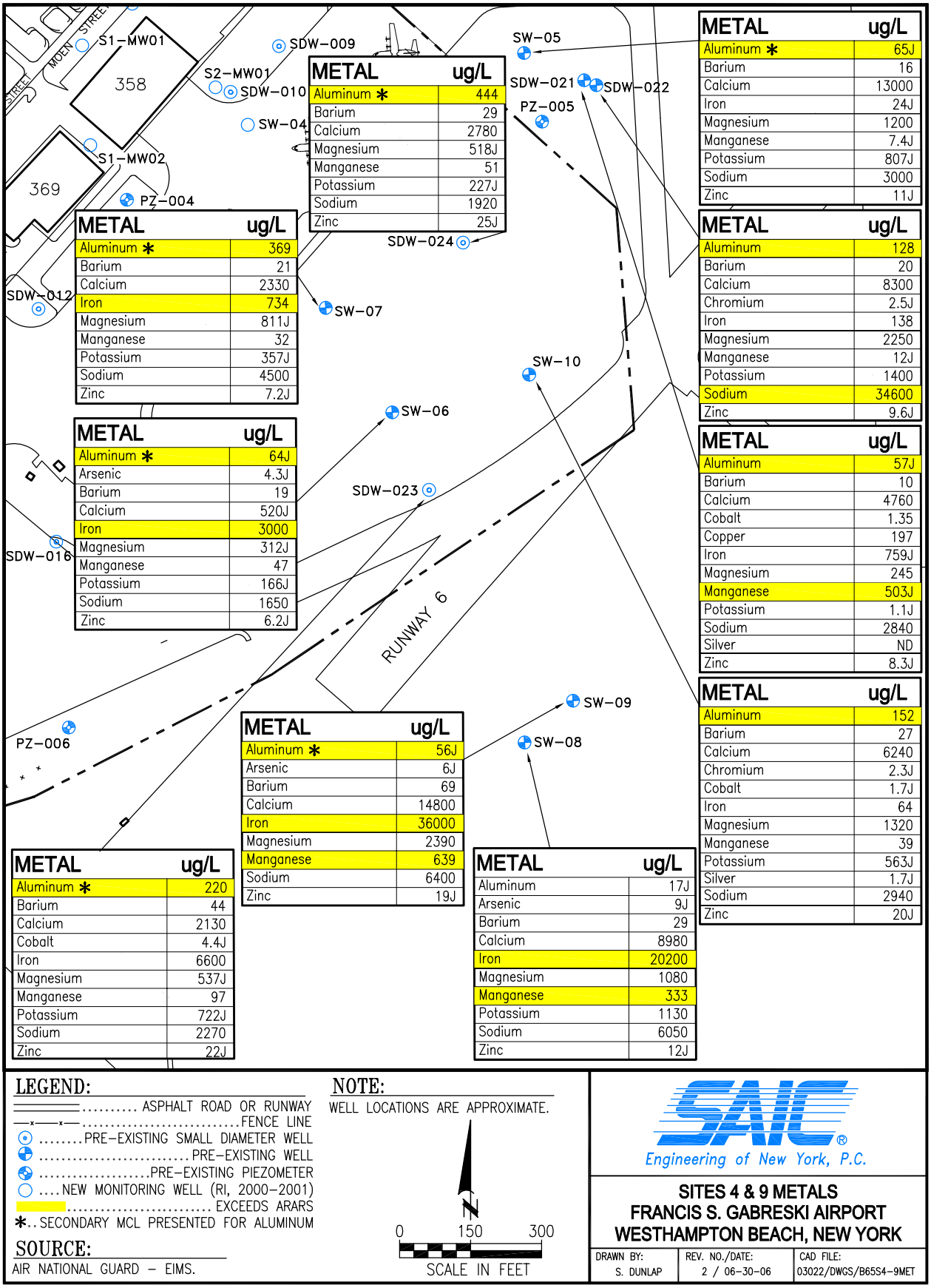

Figure 3-4. Sites 4 and 9 Metals in 2004

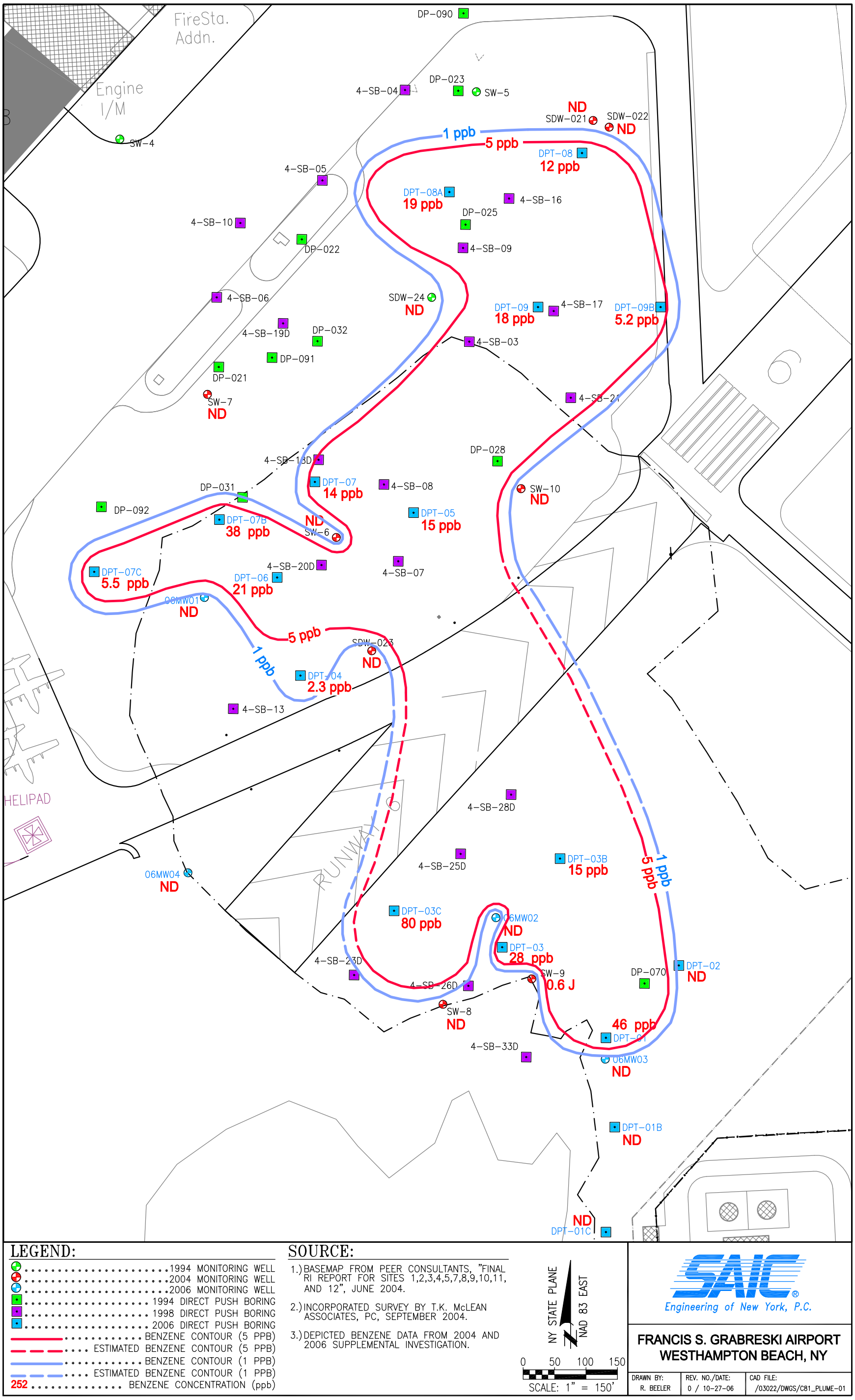

Figure 3-5. Sites 4 and 9 Benzene Concentrations in 2006

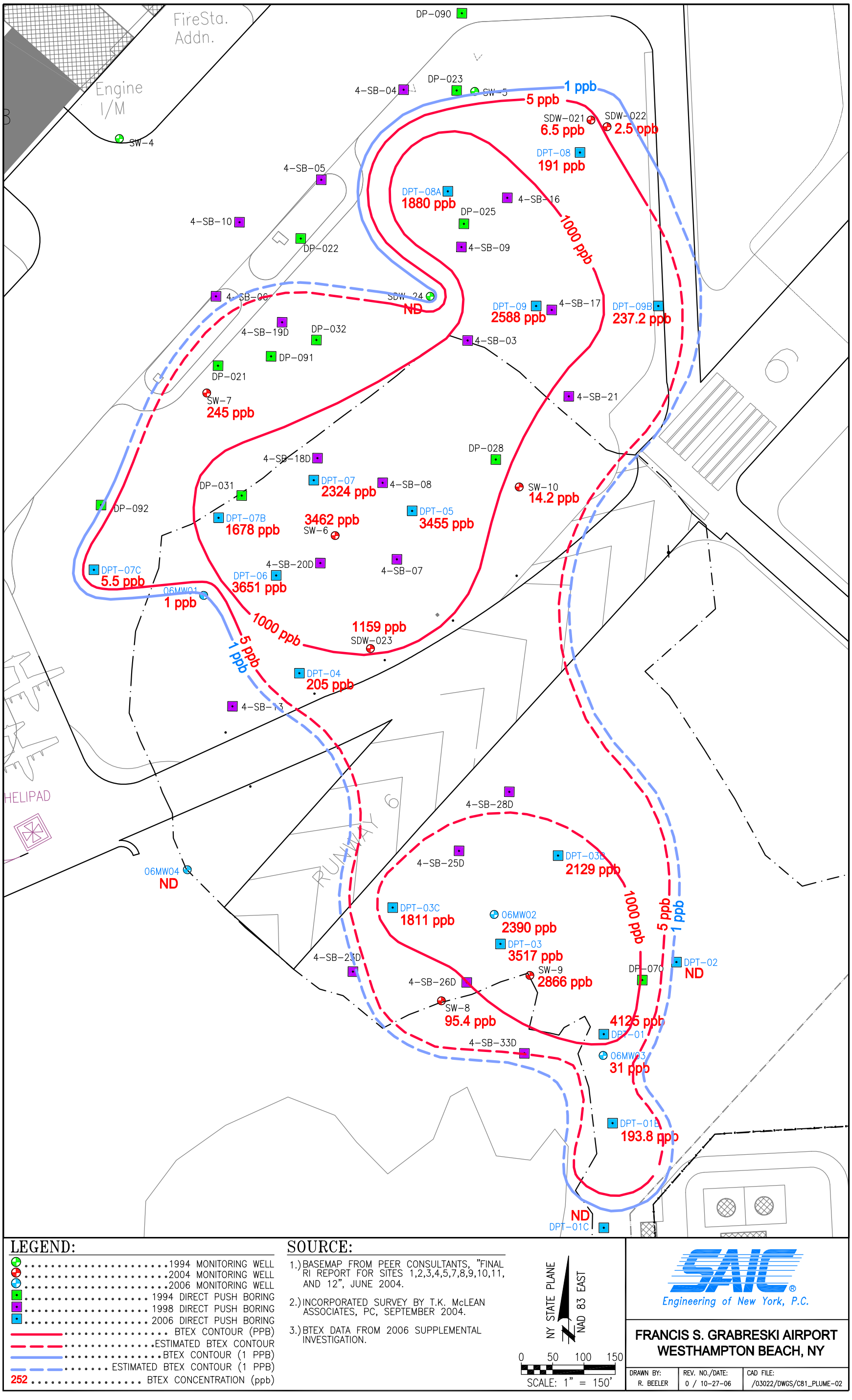

Figure 3-6. Sites 4 and 9 BTEX Concentrations in 2006

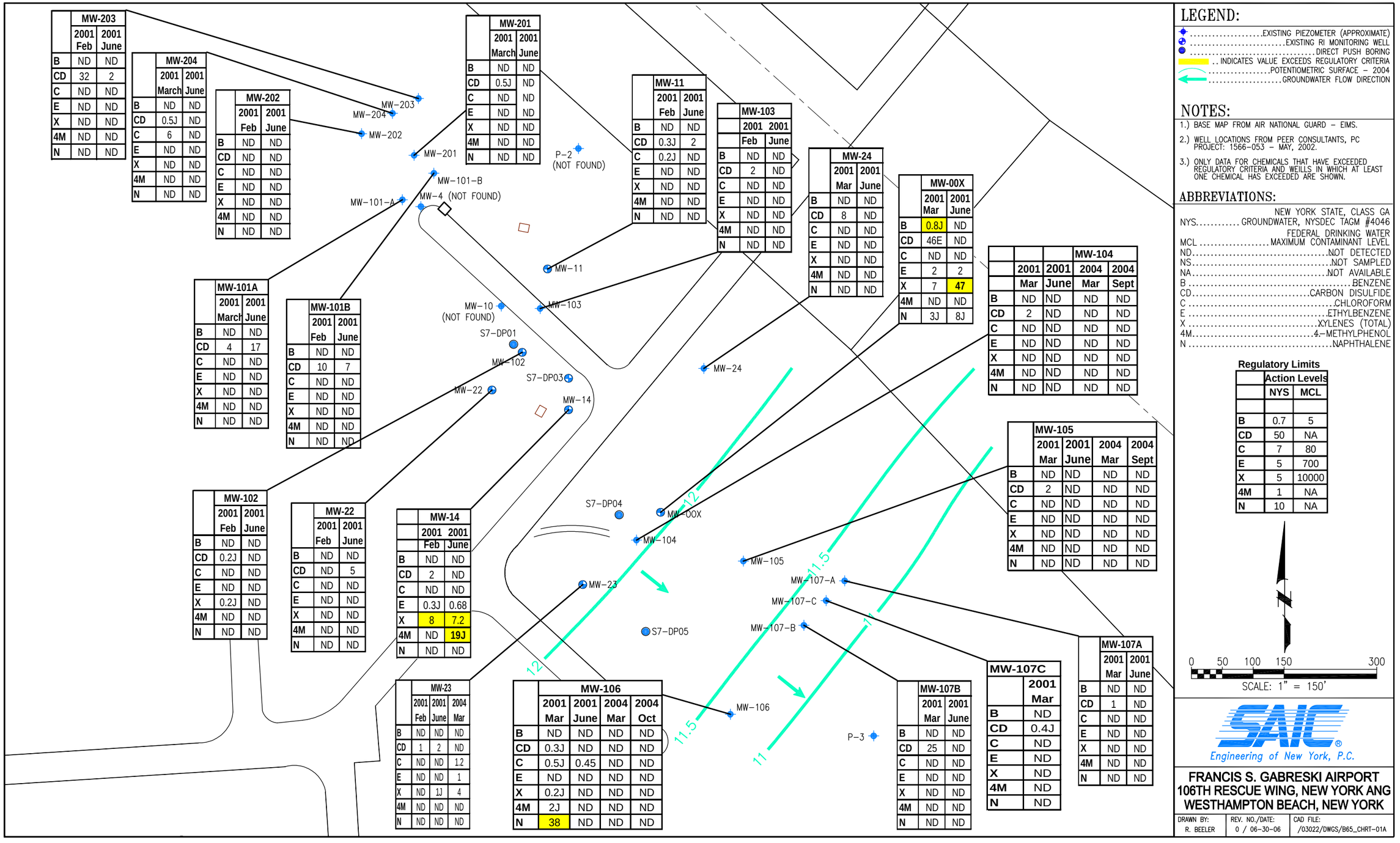

Figure 3-7. Site 7 VOCs and SVOCs

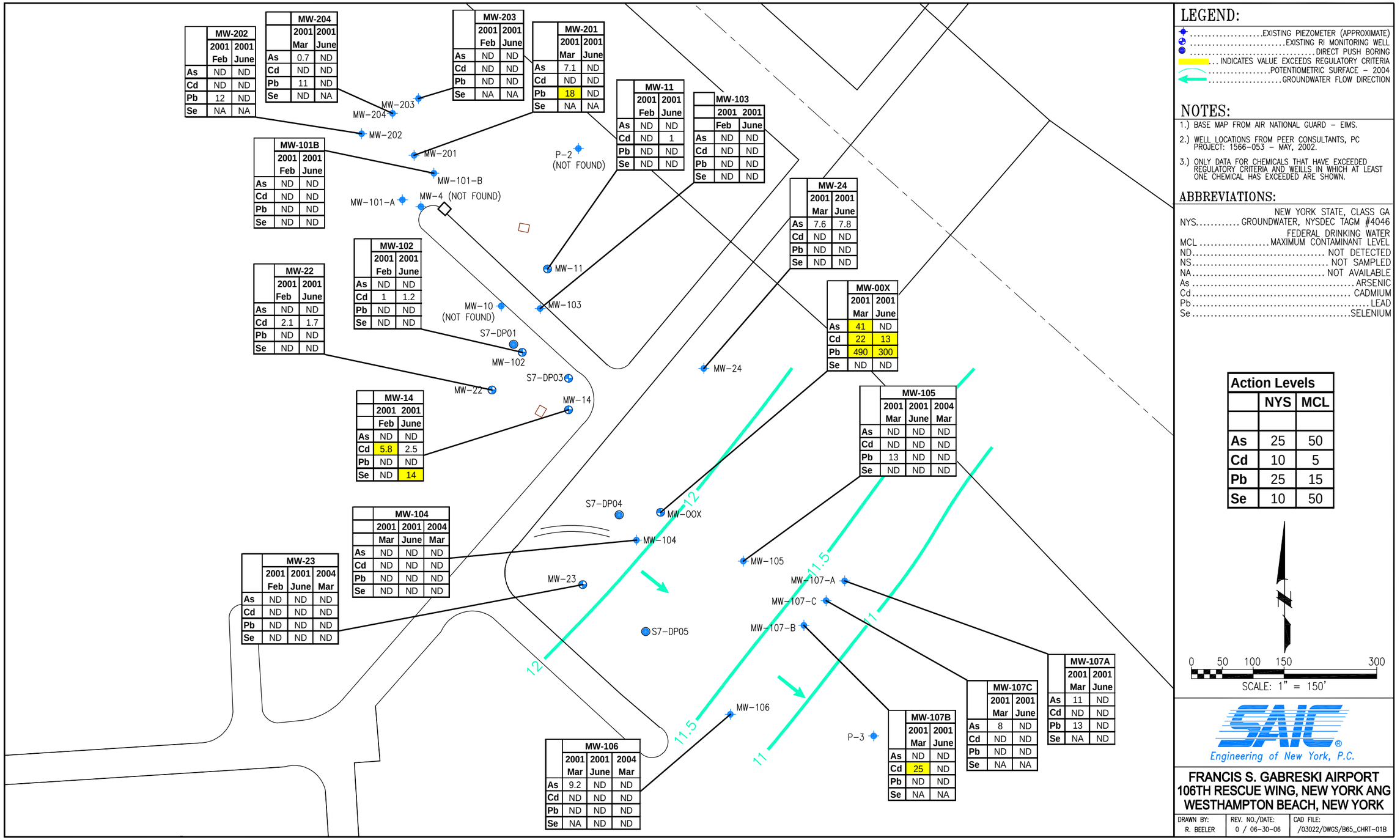

Figure 3-8. Site 7 Metals

VOC contamination was not identified in the groundwater samples collected at IRP Site 7 in March and September 2004. Although benzene, 4-methylnaphthalene, and naphthalene were reported at concentrations exceeding their regulatory criteria in monitoring wells MW-23 and MW-106 during the Final RI (PEER 2004), those constituents were not detected during the 2004 sampling events. Few SVOCs and inorganics were reported in the groundwater samples collected with all reported concentrations being below the established regulatory criteria or in the case of the inorganics, below the established background values.

3.3 SUMMARY OF HUMAN EXPOSURE PATHWAYS

This section describes the types of human exposures that could present added health risks to persons at or around the site. An exposure pathway is the manner by which an individual may come in contact with a contaminant. Five elements are required for a pathway to be considered "complete" (that is, for humans to become exposed to site contaminants), as follows:

1. A source of contamination.
2. Environmental media and transport mechanisms.
3. A point of exposure.
4. A route of exposure.
5. A receptor population.

Ingestion of groundwater was determined to be a potential pathway for groundwater from Site 7, however, concentrations of contaminants less than MCLs and the distance to well fields (approximately 0.6 mile) were discussed as being conservative. Subsequent sampling in 2004 indicated that concentrations in groundwater were even less than originally evaluated in the Final RI (PEER 2004). All other pathways were determined as incomplete or had no contaminants of potential concern associated with them.

For Sites 4 and 9, the revised draft Remedial Investigation (S&W 1999) considered all media including surface soil, subsurface soil, and groundwater contact and ingestion as complete exposure pathways. None of the media or pathways were determined to provide unacceptable risks to humans.

3.4 SUMMARY OF REMEDIATION GOALS

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375-1.10. The overall remedial goal is to restore the site to pre-release conditions to the extent feasible and required by law. At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and/or the environment presented by the environmental contaminants through the proper application of scientific and engineering principles.

The goals selected for this site are:

- Maintain the current land use of the property for the foreseeable future and restrict use of the site to the intended future commercial/military use;
- Eliminate and/or mitigate exposures to chemical constituents present in the groundwater at the site;
- Remove or control identified sources of potentially significant impacts;

- Control groundwater, as needed, to reduce or eliminate further migration of site constituents above remediation goals; and
- Monitor groundwater to evaluate long-term groundwater quality.

4.0 REMEDIAL ALTERNATIVES

The selected remedies for Site 4, 7 and 9 must be protective of human health and the environment; be cost effective; comply with other statutory laws; and utilize permanent solutions, alternative technologies, or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for Sites 4 and 9 will be identified and evaluated in this chapter.

4.1 SUMMARY OF THE EVALUATION OF ALTERNATIVES

Each of the alternatives was analyzed using the seven evaluation criteria outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 *Code of Federal Regulations (CFR)* Section 300.430; EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988b); the NYSDEC TAGM 4030, *Selection of Remedial Actions at Inactive Hazardous Waste Sites;* and the Final ANG Installation Restoration Program Investigation Protocol. Each alternative was assessed to determine if it met the following criteria:

Threshold Criteria

- Overall protection of human health and the environment, and
- Compliance with SCGs.

Primary Balancing Criteria

- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost.

The criterion of cost was assessed using relative costs for the alternatives.

For an alternative to be eligible for selection, NCP requires that it meet the threshold criteria. If these criteria are met, the primary balancing criteria are evaluated to provide the best balance of trade-offs among alternatives. In addition, consideration is given to principal threats and practicable remediation [see 40 *CFR* Section 300.430(a)(1)(iii)]. EPA defines the term "principal threats" as one of two conditions: (1) toxic concentrations several orders of magnitude above levels for unrestricted use, or (2) wastes that are both highly mobile and unable to be contained (EPA 1992). The term "practicable" is a site-specific, subjective term. EPA has defined practicability for specific sites based on cost effectiveness, impacts, implementability, and the extent of SCG compliance.

The potential remedial alternatives for Site 4 and 9 are discussed below, followed by potential site actions for Site 7. The alternatives to be evaluated for Sites 4 and 9 are:

1. Monitored Natural Attenuation (MNA),
2. Groundwater Pump-and-Treat,
3. Air Sparging, and
4. Enhanced Bioremediation of Groundwater.

4.2 EVALUATION OF ALTERNATIVE 1 FOR SITES 4 AND 9 – MONITORED NATURAL ATTENUATION

4.2.1 Description

Monitored natural attenuation or **"**MNA" is the process by which a natural system's ability to attenuate contaminant(s) at a specific site is confirmed, monitored, and quantified. Contaminant concentrations may attenuate in natural systems through biodegradation, sorption, volatilization, chemical or biological stabilization, transformation, dispersion, dilution, or the destruction of contaminants. Alternative 1 consists of the following elements:

- Continue to restrict site access by maintaining security around Sites 4, 7, and 9 at Francis Gabreski International Airport.

- Prevent the use of on-site groundwater at the 106th RW.

- Conduct groundwater monitoring at each site to better quantify natural attenuation and monitor its performance. Analyze groundwater samples for VOCs, SVOCs, and natural attenuation parameters annually until attenuation is complete.

- Measure the success of this process by the rate at which the groundwater approaches groundwater quality standards and the reduction of BTEX, naphthalene, and 2-methylnaphthalene.

4.2.2 Overall Protection of Human Health and the Environment

Protection of human health and the environment can be achieved if both of the major elements of Alternative 1 – continuing to restrict site access and natural attenuation – can be successfully implemented. Sites 4 and 9 are part of a controlled facility. Restricted access to the site would continue to prevent contact with site groundwater, while the natural attenuation process would reduce, or eliminate, the risk of exposure to the BTEX, naphthalene, and 2-methylnaphthalene.

Evidence indicates that natural attenuation may already be occurring at Site 4. Geoprobe sampling performed in 1998 (S&W 1999) showed BTEX concentrations in locations SB-07 and -09 were 11,400 and 6,500 µg/L, respectively. During the 2004 supplemental sampling (SAIC 2006), wells close to the geoprobe sampling, SW-06 and SDW-024, had BTEX concentrations of 3,462 µg/L and non-detect, respectively. Naphthalene has also naturally attenuated going from the highest concentration found in 1998 of 288 µg/L in SB-07 to 14.3 µg/L in SW-06 in 2004. Also, it was concluded in the Final RI (PEER 2004) that conditions indicative of biological activity (at monitoring wells SDW-011, SDW-023, SW-06, SW-07, SW-08, and SW-09), as well as the overall decrease in contaminant concentrations and areal extent of the plume, indicate that natural attenuation may be occurring at this site.

4.2.3 Compliance with Standards, Criteria, and Guidance

Groundwater exceeding remediation goals for BTEX, naphthalene, or 2-methylnaphthalene would not be eliminated in the near term, but the volume of groundwater exceeding remediation goals would most likely be reduced, especially given the evidence showing that this is already occurring.

4.2.4 Long-Term Effectiveness and Permanence

Under Alternative 1, the magnitude of risk would be significantly reduced and eventually eliminated. Continuing to restrict site access would provide short-term control of risk, while natural attenuation processes would help to control BTEX, naphthalene, or 2-methylnaphtalene and thereby reduce long-term impacts to groundwater.

4.2.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

Natural attenuation is a gradual treatment process. However, sufficient data exist to demonstrate that natural attenuation is already occurring at Sites 4 and 9. BTEX, naphthalene, or 2-methylnaphthalene in the groundwater are degrading via oxygen, nitrate, ferric iron, and sulfate reduction and methane fermentation. Evidence indicates that, under Alternative 1, the toxicity and volume of contaminated groundwater would continue to decrease gradually over time.

4.2.6 Short-Term Effectiveness

Construction work required for Alternative 1 would be limited to installing new monitoring wells to delineate and monitor the existing plume. Installing new wells is a common activity at the site and site workers and the local community would not be impacted. The existing site use and access restrictions currently control the groundwater use. The time for remedial objectives to be achieved would likely be up to 30 years.

4.2.7 Implementability

Natural attenuation can be a reliable approach to remediation and appears to already be occurring at the site based on the shrinking BTEX and naphthalene plumes, based on a comparison of the 1998 RI (S&W 1999) and the more recent 2004 and 2006 supplemental investigations. Vendors and equipment for installing monitoring wells are available, and field staff with natural attenuation monitoring experience is readily available. Under Alternative 1, it would be very easy to undertake additional remedial actions if necessary.

4.2.8 Cost

The estimated cost of Alternative 1 would be $1.75 million and includes monitoring groundwater annually for 30 years. The detailed cost for this alternative is presented in Appendix A.

4.3 EVALUATION OF ALTERNATIVE 2 FOR SITES 4 AND 9 – PUMP AND TREAT

4.3.1 Description

Alternative 2 consists of installing a pump-and-treat *g*roundwater control and treatment system. The alternative would include the following elements:

- Full scale system design
- Preconstruction permitting

- Install extraction wells downgradient of the source areas; thus, preventing migration of impacted groundwater.

- Treat collected groundwater to meet discharge requirements.

- Discharge treated groundwater directly into the Site 9 drainage basin or to the nearest sanitary sewer. State discharge requirements would need to be met for a discharge to on-site locations. Pre-treatment requirements would need to be met for a discharge to the local sanitary sewer system.

- Install new monitoring wells to monitor the plume's leading edge.

- Conduct quarterly groundwater sampling to monitor performance.

- Operate and maintain the pump and treat system until closure requirements are met.

For Alternative 2, the number of groundwater extraction wells would be three to five based on a calculated radius of influence of 75 ft along a 500-ft border. Extraction wells would be installed in a line perpendicular to the direction of groundwater flow (in approximately an east-west orientation). Based on parametric analysis of similar sites, the flow of groundwater collected from each extraction well would be approximately 25 gallons per minute (gpm) from a 10-ft screened interval.

The extracted groundwater would be treated ex-situ by an air stripper. The process has been widely and successfully applied to groundwater remediation for a number of contaminants, including BTEX, naphthalene, 2-methylnaphthalene. Common air stripping configurations for extracted groundwater impacted by VOCs and SVOCs include a low profile tray tower to treat the contaminated groundwater followed by a carbon adsorption of the vapor phase. This system would be sized to treat the total inflow from the extraction wells of 75 to 125 gpm. Groundwater and treated water sampling would be performed as appropriate until site closure requirements are met.

4.3.2 Overall Protection of Human Health and the Environment

This alternative would reduce potential risks to human health and the environment by addressing impacted groundwater, and thereby controlling potential impacts to downgradient, off-site receptors. Implementing this alternative would, over time, remediate the entire groundwater plume to below SCGs.

4.3.3 Compliance with Standards, Criteria, and Guidance

Under this alternative, the site would meet remediation goals with time. Groundwater remediation goals would be met as a result of extraction and ex-situ treatment of groundwater.

4.3.4 Long-Term Effectiveness and Permanence

Contaminants within groundwater would be removed and treated. Permanent control would result from this alternative by removing contaminants from the groundwater.

4.3.5 Reduction of Toxicity, Mobility, or Volume

Toxicity, mobility, and volume of the impacted groundwater would be reduced. Toxicity would be gradually reduced as a result of treating groundwater. The mobility of impacted groundwater would be

restricted with a barrier wall of extraction wells. The volume of groundwater intercepted by the wells would be reduced via pumping and treating.

4.3.6 Short-Term Effectiveness

No significant short-term impacts on site workers or the community would be expected under this alternative. Construction work from Alternative 2 would be limited to installing monitoring and extraction wells southeast of the existing plume. Installation of the groundwater control system would require several weeks of site work. This alternative would be effective in preventing movement of water off-site in the short-term; however, reducing the toxicity and volume of the impacted groundwater would require a long-term operation.

4.3.7 Implementability

Pump and treat systems have been widely and successfully applied at similar sites. Initial installation is readily implementable. Long-term operations and maintenance for this alternative involve more uncertainties with the length of time required to treat the entire contaminant plume.

4.3.8 Cost

The estimated cost of the options under Alternative 2 would be $3.29 million assuming a 10-year treatment period. The detailed cost for this alternative is presented in Appendix A.

4.4 EVALUATION OF ALTERNATIVE 3 FOR SITES 4 AND 9 – AIR SPARGING WITH MNA

4.4.1 Description

Alternative 3 consists of installing an in situ *g*roundwater treatment system for source areas of contamination and MNA for dissolved phase contamination down gradient of the source areas. The alternative would include the following elements:

- Preconstruction design and permitting, and work plan development.
- Install air-sparge wells within the contaminated groundwater plume to treat source areas of groundwater and enhance aerobic bioremediation.
- Construct and operate the air sparge system.
- Employ MNA for the low levels of dissolved phase groundwater contamination outside the source areas
- Conduct groundwater sampling to monitor MNA and air sparge performance, and quantify the rate of reduction for the groundwater contaminants.
- Operate and maintain the air-sparge system until concentrations of chemicals in groundwater achieve site closure criteria.
- Conduct the required NYSDEC closure monitoring once groundwater remediation criteria are achieved.

For Alternative 3, the number of air-sparge wells would be approximately 50 with an approximate radius of influence of 40 ft (see Figure 4-1). The air-sparge wells would be installed into the contaminated plume at a depth of approximately 45 ft bgs with a 5-ft screened interval. Groundwater sampling of eight monitoring wells would be performed semiannually for 2 years and annually for 3 years or until concentrations are below criteria. At that time, four quarterly sampling events would be performed to meet regulatory requirements for site closure.

4.4.2 Overall Protection of Human Health and the Environment

This alternative would reduce potential risks to human health and the environment by addressing impacted groundwater; thereby, controlling potential impacts to downgradient, off-site receptors. Implementing this alternative would remediate the groundwater plume's highest concentrations to below SCGs, then the groundwater contaminants outside the treatment areas would be allowed to naturally attenuate.

4.4.3 Compliance with Standards, Criteria, and Guidance

Under this alternative, the site would meet remediation goals in the near term. This alternative would remove any residual source of petroleum contamination and treat groundwater outside the immediate treatment area through MNA.

4.4.4 Long-Term Effectiveness and Permanence

Contaminants within the groundwater plume source area would be treated in place. Over the long term, as MNA occurs, the site would be expected to meet groundwater quality standards. Permanent reductions in toxicity and volume would result from this alternative.

4.4.5 Reduction of Toxicity, Mobility, or Volume

Toxicity and volume of the impacted groundwater would be reduced. Toxicity would be gradually reduced as a result of the in-situ treatment. The mobility of impacted groundwater would be reduced by the air-sparge system and treated in place.

4.4.6 Short-Term Effectiveness

No significant short-term impacts on site workers or the community would be expected under this alternative. Construction work under Alternative 3 would be limited to installing monitoring and air-sparge wells within the existing plume. Installation of the air sparge system would require up to several weeks of site work. This alternative would be effective in the short term in reducing the volume and toxicity of the contaminated groundwater in the source area.

4.4.7 Implementability

Air-sparge systems have been widely and successfully applied at similar sites. There are few implementation issues. Long-term operations and maintenance for this alternative involve more uncertainties with the length of time required to treat the entire contaminant plume, but primarily impacts the cost.

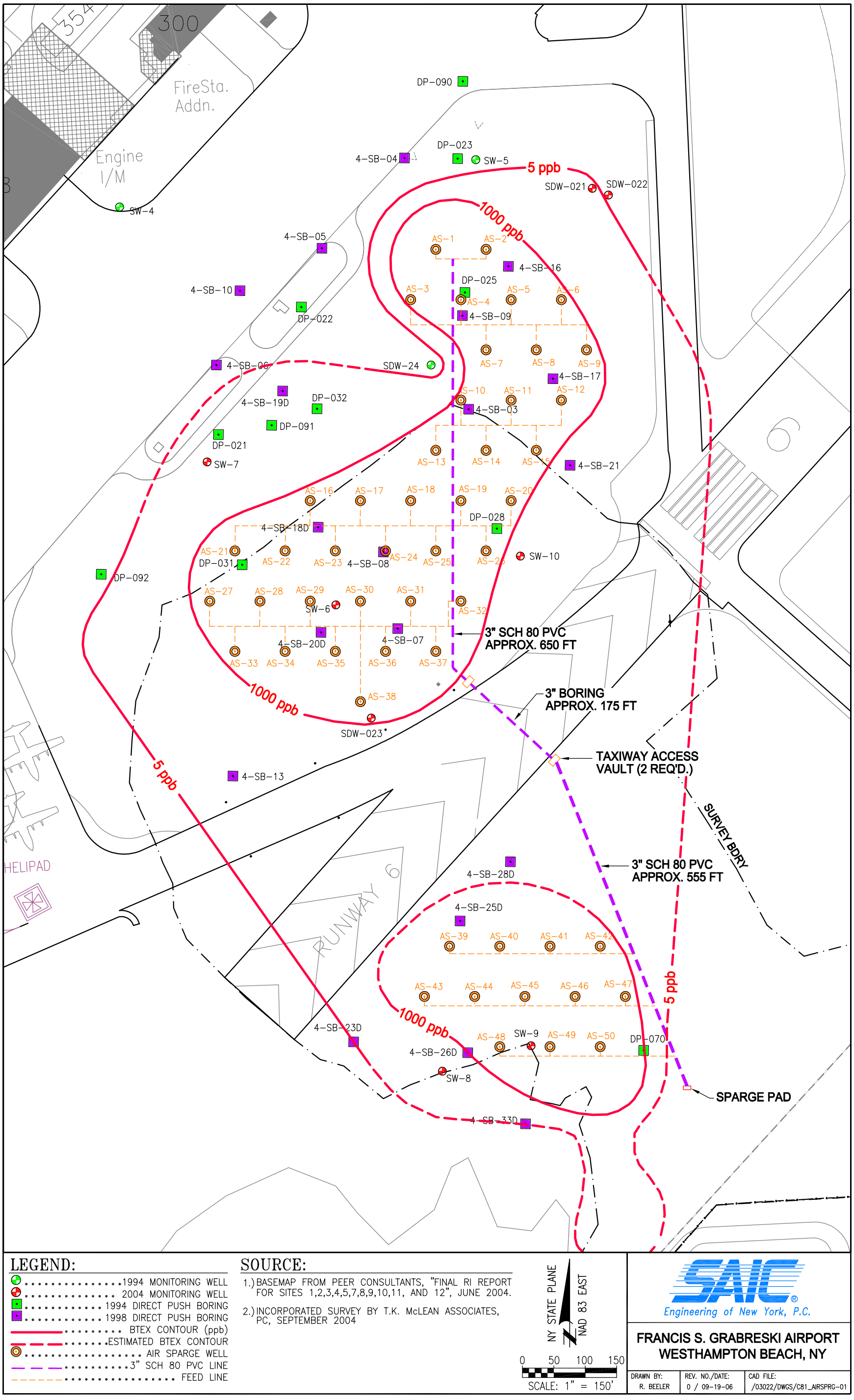

Fig. 4-1. Air Sparge Layout

4.4.8 Cost

The estimated cost of the options under Alternative 3 would be $780,000 assuming a 5-year treatment period and 6-year monitoring period. The detailed cost for this alternative is presented in Appendix A.

4.5 EVALUATION OF ALTERNATIVE 4 FOR SITE 4 AND 9 – ENHANCED BIOREMEDIATION WITH MNA

4.5.1 Description

Alternative 4 consists of injecting oxygen release compound (ORC) into the contaminated groundwater plume source area with MNA for areas outside the treatment area. The alternative would include the following elements:

- Inject ORC into the source of the contaminated groundwater plume..
- Install new monitoring wells down-gradient plume's leading edge.
- Conduct groundwater sampling to monitor performance and to quantify attenuation rates.
- Monitoring the attenuation of contaminants.

For Alternative 4, ORC will be injected with a direct-push rig using a grid spacing of 10 ft to a depth of approximately 45 ft bgs. There are 2,371 injection points required to cover the source area of the contaminant plume. The ORC will be injected at a rate of 35 lbs per well, assuming a 15-ft contaminant depth. It is assumed that a polishing step would be required for 50% of the injection points at the same injection rates. Groundwater sampling of eight monitoring wells would be performed semiannually for 2 years and annually for 3 years or until concentrations are below criteria. At that time, four quarterly sampling events would be performed to meet regulatory requirements for site closure.

4.5.2 Overall Protection of Human Health and the Environment

This alternative would reduce potential risks to human health and the environment by addressing impacted groundwater; thereby, controlling potential impacts to downgradient, off-site receptors. Implementing this alternative would remediate the groundwater plume's highest concentrations (source area) to below SCGs. The groundwater contaminants outside the treatment area would be allowed to naturally attenuate.

4.5.3 Compliance with Standards, Criteria, and Guidance

Under this alternative, the site would meet remediation goals in the near term. The source of the impacted groundwater would be removed from the site. Groundwater exceeding remediation goals for BTEX, naphthalene, or 2-methylnaphthalene would be eliminated. Over the long term, as MNA occurs, the site would be expected to meet groundwater quality standards.

4.5.4 Long-Term Effectiveness and Permanence

Contaminants within the source area of the groundwater plume would be treated in place. Over the long term, as MNA occurs, the site would be expected to meet groundwater quality standards. Permanent reductions in toxicity and volume would result from this alternative.

4.5.5 Reduction of Toxicity, Mobility, or Volume

Toxicity and volume of the impacted groundwater would be reduced. Toxicity would be gradually reduced as a result of in-situ treatment. The mobility of impacted groundwater would be reduced through in-situ treatment.

4.5.6 Short-Term Effectiveness

No significant short-term impacts on site workers or the community would be expected under this alternative. Construction work under Alternative 4 would be limited to injecting ORC with a Geoprobe within the existing plume. Injection of ORC would require several months of site work. This alternative would be effective in the short term in reducing the volume and toxicity of the plume's source area. The groundwater concentrations outside the treatment area would, however, require longer-term monitoring.

4.5.7 Implementability

Injecting ORC with a direct-push rig has been widely and successfully applied at similar sites. There are few implementation issues. Long-term performance for this alternative involves more uncertainties with the length of time required to treat the entire contaminant plume, but primarily impacts the cost.

4.5.8 Cost

The estimated cost of the options under Alternative 4 would be $2.53 million, assuming a 5-year treatment and 1-year monitoring period. The detailed cost for this alternative is presented in Appendix A.

4.6 COMPARISON OF ALTERNATIVES FOR SITE 4 AND 9

A comparison of alternatives for Site 4 and 9 is presented below. In addition, a summary of comparisons is provided in Table 4-1.

4.6.1 Overall Protection of Human Health and the Environment

Potential exposure to chemical constituents would be substantially reduced with Alternatives 2, 3, and 4. Alternatives 3 and 4 are the most protective in the short term because the sources impacting groundwater would be treated and controlled. Alternative 2 is the most protective over the long term because it controls and treats the entire contaminated groundwater plume above SCGs. Alternative 1 would be protective over the long term due to natural attenuation, but there are more uncertainties with mobility and the length of time required to reduce exposure to site groundwater.

4.6.2 Compliance with Standards, Criteria, and Guidance

Alternatives 3 and 4 would eliminate on-site groundwater in the source area and would meet the objective of removing or controlling sources of significant impacts, and would do so in the shortest period of time.

Alternative 2 would control and eventually eliminate source area contamination, but would take a longer period of time. Likewise, Alternative 1 would eliminate on-site groundwater in the source area and would meet the objective of removing or controlling sources of significant impacts, but would take the longest period of time.

Table 4-1. Summary of Comparative Analysis of Alternatives for Sites 4 and 9

Alt.	Protective of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Performance	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability	Cost
1	Can reduce impacts from contaminated groundwater. Requires maintaining institutional controls for long periods of time	Groundwater quality standards would be met based on the existing natural attenuation of contaminants; however, uncertainties exist on the time required	Long-term risk can be significantly reduced	Toxicity and volume of impacted groundwater would decrease. Mobility would not be changed.	Short-term risk is relatively low	Yes	$1.75 million
2	Impacts from site groundwater on downgradient areas would be reduced or eliminated	Groundwater quality standards would be met over time	Impacted groundwater in source area would be treated and would provide a permanent remedy	Toxicity, mobility, and volume of impacted groundwater would be reduced	Short-term risk would be minimized with the use of engineering and safety controls	Yes	$3.29 million
3	Impacts from site groundwater on downgradient areas would be reduced	Groundwater quality standards would be met	Impacted groundwater in source area would be treated and would provide a permanent remedy	Toxicity, mobility, and volume of impacted groundwater would be reduced	Short-term risk would be minimized with the use of engineering and safety controls	Yes	$0.78 million
4	Impacts from site groundwater on downgradient areas would be reduced	Groundwater quality standards would be met	Impacted groundwater in source area would be treated and would provide a permanent remedy	Toxicity, mobility, and volume of impacted groundwater would be reduced	Short-term risk would be minimized with the use of engineering and safety controls	Yes	$2.53 million

ARAR = Applicable or relevant and appropriate requirement.
BTEX = Benzene, toluene, ethylbenzene, xylenes.

4.6.3 Long-term Effectiveness and Permanence

Alternative 1 would be effective in the long term. The natural attenuation process would be the slowest, but evidence exists that contaminants are already naturally attenuating. Alternatives 2, 3, and 4 would be the most effective means of ensuring long-term protection because the highest concentrations of groundwater would be controlled. Alternatives 2 and 3 control and treat the on-site groundwater within the source areas.

4.6.4 Reduction of Toxicity, Mobility, or Volume

Alternative 1 would reduce the toxicity and volume of impacted groundwater, but would not reduce the mobility of contaminants. Alternative 2 would eliminate the toxicity, mobility, and volume of impacted groundwater and would reduce the impacts to off-site receptors. Alternatives 3 and 4 would reduce the toxicity, mobility, and volume of constituents in impacted groundwater within the source areas .

4.6.5 Short-Term Effectiveness

There would be no significant short-term risks to the community, the environment, or site workers associated with any of these alternatives, as long as there is proper handling and monitoring of any water or air emissions from the ex-situ groundwater treatment system.

4.6.6 Implementability

Alternatives 1, 3, and 4 would be very easy to implement. Alternative 2 is also implementable, but there are more uncertainties with the length of operations and maintenance of the treatment system that would be required.

4.6.7 Cost

Costs for all four Alternatives are summarized below, with Alternative 3 providing the lowest cost.

Alternative 1	Monitored Natural Attenuation	$1.75 million
Alternative 2	Pump and Treat the Groundwater	$3.53 million
Alternative 3	Air Sparging Groundwater	$0.78 million
Alternative 4	Enhanced Bioremediation of Groundwater	$2.53 million

4.7 SITE 7 – FORMER FIRE TRAINING AREA EVALUATION OF ALTERNATIVES

Current conditions at Site 7 as described in Sections 3.2.3 and 3.3 above, indicate that no remedial action is warranted at this time. Chemical concentrations in groundwater are below action levels and/or are within natural background concentrations for inorganics and risk assessments for soil have indicated that risks associated with soils are not at unacceptable levels. Monitoring of groundwater is required for site closure with a minimum of four quarters of monitoring required to show that groundwater concentrations are consistently below action levels.

The lack of contamination precludes the necessity for a comparison of remedial alternatives. To fulfill the requirements of this PRAP, the alternative of No Further Action with Monitoring is evaluated in the following section.

4.7.1 Description

No further action with monitoring is the process by which interim measures are being proposed to evaluate the site. Monitoring will also confirm the lack of contamination and monitor for possible rebound of contaminant levels over time. Alternative 1 consists of the following elements:

- Continue to restrict site access.
- Prevent the use of on-site groundwater.
- Sample a suite of wells for VOCs, SVOCs, and metals for site closure purposes until closure criteria are met or reevaluation of a remedy is required by contamination rebound.

4.7.2 Overall Protection of Human Health and the Environment

Protection of human health and the environmental can be achieved if both of the major elements of Alternative 1 – continuing to restrict site access and monitoring – can be successfully implemented. Site 7 is part of a controlled facility. Restricting access to the site would continue to reduce contact with site groundwater, while monitoring would continue to track concentration levels of the plume.

4.7.3 Compliance with Standards, Criteria, and Guidance

Groundwater currently meets VOC and SVOC criteria. Groundwater exceeding for arsenic and lead are within established background ranges and do not require remediation.

4.7.4 Long-Term Effectiveness and Permanence

Under Alternative 1, the permanence of the current concentrations would be established under the monitoring program and the site would be closed. If rebound was to occur, the groundwater monitoring would identify it and reevaluation of alternatives may be required.

4.7.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

Toxicity levels at the site are already less than the acceptable levels. The monitoring is designed to ensure these levels are permanent and not just short-term variations.

4.7.6 Short-Term Effectiveness

The existing site use and access restrictions currently control the groundwater use. The time required for closure monitoring is likely one year.

4.7.7 Implementability

This alternative could be easily implemented. Field staff with monitoring experience are readily available and site access and groundwater restrictions can be easily employed.

4.7.8 Cost

The estimated cost of Alternative 1 would be $108,000 and includes costs for monitoring groundwater quarterly for one year. The detailed cost for this alternative is presented in Appendix A.

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5.0 RECOMMENDED REMEDIAL ALTERNATIVE

5.1 DESCRIPTION OF RECOMMENDED ALTERNATIVE

Based upon the results of previous investigations and the evaluation presented in Chapter 4, the recommended alternative for Sites 4 and 9 is Alternative 3. The recommended alternative for Site 7 is Alternative 1.

5.1.1 Site 4 and 9 – Aircraft Refueling Apron Spill Site/Ramp Drainage Outfall

Alternative 3 consists of installing an in situ *g*roundwater treatment system and includes the following elements:

- Preconstruction design and permitting, and work plan development.
- Install air-sparge wells within the contaminated groundwater plume to treat source areas of groundwater and enhance aerobic bioremediation.
- Construct and operate the air sparge system.
- Conduct groundwater sampling to monitor performance and quantify the rate of reduction for the groundwater contaminants.
- Operate and maintain the air-sparge system until concentrations of chemicals in groundwater achieve site closure criteria.
- Conduct the required NYSDEC closure monitoring once groundwater remediation criteria are achieved.

For Alternative 3, the number of air-sparge wells would be approximately 50 with an approximate radius of influence of 40 ft (see Figure 4-1). The air-sparge wells would be installed into the contaminated plume at a depth of approximately 45 ft bgs with a 5-ft screened interval. Groundwater sampling of eight monitoring wells would be performed semiannually for 2 years and annually for 3 years or until concentrations are below criteria. At that time, four quarterly sampling events would be performed to meet regulatory requirements for site closure.

5.1.2 Site 7 – Former Fire Training Area

Alternative 1 consists of the following elements:

- Continue to restrict site access.
- Prevent the use of on-site groundwater.
- Sample a suite of wells for VOCs, SVOCs, and metals for site closure purposes until closure criteria are met or reevaluation of a remedy is required by contamination rebound.

5.2 ASSESSMENT OF RECOMMENDED ALTERNATIVE USING EVALUATION CRITERIA

5.2.1 Overall Protection of Human Health and the Environment

The recommended alternative would provide overall protection of human health and the environment. Impacted groundwater would be treated in-situ preventing the movement of significantly impacted groundwater. The air-sparging system would help treat BTEX- and naphthalene-impacted groundwater remaining in place and would also enhance natural attenuation.

5.2.2 Compliance with Standards, Criteria, and Guidance

Groundwater contaminants in the source area would be treated in place by the air sparging. Groundwater beyond the source areas would be allowed to naturally attenuate. If natural attenuation does not reduce the levels of VOCs, additional measures would be evaluated and then implemented to ensure remediation (e.g., expanding the air sparging).

5.2.3 Long-Term Effectiveness and Permanence

Containment and treatment of the groundwater contaminants is a permanent remedy that significantly reduces the magnitude of risk remaining after remediation. A monitoring program would be initiated during and after treatment operations to verify long-term effectiveness and permanence.

5.2.4 Reduction of Toxicity, Mobility, or Volume

Containment and treatment of groundwater contaminants in the source area will significantly lower the toxicity, mobility, and volume of impacted groundwater at Site 4 and 9. The toxicity, mobility, and volume of groundwater contaminants outside of the treatment area will be reduced through natural attenuation.

5.2.5 Short-Term Effectiveness

Short-term risks to site workers will be minimized during the remedial action with the use of controls, such as personal protective equipment and monitoring. Access to the site will be controlled during the remediation effort.

5.2.6 Implementability

The air-sparging system has been widely and successfully applied at similar sites. Initial installation is readily implementable. Long-term operations and maintenance for this alternative involve more uncertainties with the length of time required to treat the entire contaminant plume, but primarily impacts the cost.

5.2.7 Cost

The estimated present worth of the recommended alternative would be $780,000 assuming a 5-year treatment period and 6 years of monitoring.

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APPENDIX A
DETAILED COST ESTIMATE

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Gabreski Air National Guard Sites 4, 9, and 7 Proposed Remedial Action Plan, West Hampton, New York
Summary Groundwater Alternatives

	GROUNDWATER ALTERNATIVES FOR SITES 4 and 9	Duration	Non Discounted Cost		
			Capital Cost	O&M Cost	Total
1	Natural Attenuation	30 yr	$35,078	$1,717,569	$1,752,647
2	Pump and Treat	10 yr	$503,271	$2,787,928	$3,291,200
3	Air Sparging	5 yr	$378,707	$401,290	$779,997
4	Oxygen Release Compound	5 yr	$2,250,121	$275,129	$2,525,249

	GROUNDWATER ALTERNATIVES FOR SITE 7	Duration	Non Discounted Cost		
			Capital Cost	O&M Cost	Total
1	No Further Action with Monitoring	1 yr	$107,765	$0	$107,765

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 1 - Natural Attenuation
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
Capital Cost			
Site Work			
Install Monitoring Wells	ea	2	
Install Monitoring Wells	$/ea	12,000	Based on RACER model. Inc. sampling IDW.
O&M			
Groundwater Sampling & Analysis	events	30	S&A will be performed annually for 30 years.
Sampling Labor	hrs/event	96	Includes 11 wells in 4 days. Add 1 day travel for sampling and 1 day travel/labor to dispose IDW water. Total effort = 2 FTE x 6 days = 96 hrs/yr.
Sampling Labor	$/hr	80	
Per Diem	$/event	2,304	(2 people x 6 days x $192/day)
Rental Truck and Gas	$/event	650	(1 van x 6 days x $100/day). Add $50 for gas
Sample materials	ea/event	33	Reference ECHOS 33 02 0401/0402 for disposable sampling and decon materials.
Sample materials	$/ea	25.00	
Sample equipment	$/event	2,000	Drums, water quality parameter equipment, pumps, misc tools and sampling equipment rental/purchase.
Analytical Cost	$/event	6,700	Analyze GW samples from 11 wells VOCs (14 @ $120), SVOCc (13 @ 220), and natural attenuation parameters (6 @ 360). Includes 10% duplicate, 5% rinsate, and trip blanks.
Sample Shipment	$/event	200	4 coolers @ $50 ea.
Data Management	hrs	17	Data validation
Data Management	$/hr	80	
IDW Disposal	$/lot	0	Dispose IDW water onsite.
Additional Monitoring Wells			
Install Monitoring Wells	ea	6	Assume 1 new well every 5 years for 30 years to track plume.
Install Monitoring Wells	$/ea	12,000	Based on RACER model. Inc. sampling IDW.
Monitoring Report			
Periodic Monitoring Report	$/year	12,800	Assume 160 hours @ $80/hr.
Final Review and Confirmation Report	$/event	12,800	Assume 160 hours @ $80/hr.
Monitoring Well Abandonment			
Abandon Monitoring Well	lot	1	Assume 16 wells @ 35 ft ea.
Abandon Monitoring Well	$/lot	19,000	Based on former NIKE contract.

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 1 - Natural Attenuation
Cost Estimate

CAPITAL COST **$35,078**

Activity (unit)	Quantity	Unit Cost	Total
Site Work			
Install Monitoring Wells (ea)	2	$12,000.00	$24,000
Subtotal			$24,000
Design		6%	$1,440
Office Overhead		5%	$1,200
Field Overhead		15%	$3,600
Subtotal			$30,240
Profit		6%	$1,814
Contingency		10%	$3,024
Total			$35,078

OPERATION AND MAINTENANCE **$1,717,569**

Activity (unit)	Quantity	Unit Cost	Total Cost
Groundwater Sampling and Analysis (Years 0-30)			
Sampling Labor (events)	30	$7,680	$230,400
Per Diem (events)	30	$2,304	$69,120
Cargo Van Rental / Gas (events)	30	$650	$19,500
Sample materials (events)	30	$825	$24,750
Sample equipment (events)	30	$2,000	$60,000
Analytical Cost (events)	30	$6,700	$201,000
Sample Shipment (events)	30	$200	$6,000
Data Management (events)	30	$1,360	$40,800
IDW Disposal (events)	30	$0	$0
Install New Monitoring Wells	6	$12,000	$72,000
Reports			
Periodic Monitoring Reports (events)	29	$12,800	$371,200
Final Review and Confirmation Report (ea) (year 30)	1	$12,800	$12,800
Monitoring Well Abandonment			
Abandon Monitoring Well (lot)	1	$19,000	$19,000
Subtotal O&M			$1,126,570
Design		6%	$67,594
Office Overhead		5%	$56,329
Field Overhead		15%	$168,986
Subtotal			$1,419,478
Profit		6%	$85,169
Contingency		15%	$212,922
Total			$1,717,569

TOTAL ALTERNATIVE CAPITAL AND O&M COST (Non Discounted Cost) **$1,752,647**

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 2 - Pump and Treat
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
Capital Cost			
Site Work			
Install Monitoring Wells	ea	2	
Install Monitoring Wells	$/ea	12,000	Based on RACER model. Inc. sampling IDW.
Pump and Treat			
Air Stripping	$/lot	75,707	Based on RACER Model.
Carbon Adsorption (Gas)	$/lot	46,591	Based on RACER Model.
Groundwater Extraction Wells	$/lot	77,318	Based on RACER Model.
Infiltration Gallery	$/lot	69,744	Based on RACER Model.
Overhead Electrical Distribution	$/lot	43,489	Based on RACER Model.
Residual Waste Management	$/lot	1,112	Based on RACER Model.
Miscellaneous Support Costs	$/lot	47,082	Based on RACER Model.
Installation Report	$/report	12,800	Assumes 160 hrs @ $80/hr to prepare report.
O&M	years	10	
Miscellaneous Support Costs	$/yr	20,561	Based on RACER Model.
Groundwater Extraction Wells	$/yr	17,523	Based on RACER Model.
Air Stripping	$/yr	94,095	Based on RACER Model.
Carbon Adsorption (Gas)	$/yr	47,439	Based on RACER Model.
Infiltration Gallery	$/yr	1,370	Based on RACER Model.
Groundwater Sampling & Analysis	events	20	S&A will be performed semianually for 10 years.
Sampling Labor	hrs/event	64	Includes 2 wells upgradient, 2 wells downgradient, and 2 samples from treatment system in 2 days. Add 1 day travel for sampling and 1 days travel/labor to dispose IDW water.
Sampling Labor	$/hr	80	
Per Diem	$/event	1,536	(2 people x 4 days x $192/day)
Rental Truck and Gas	$/event	450	(1 van x 4 days x $100/day). Add $50 for gas
Sample materials	ea/event	17	Reference ECHOS 33 02 0401/0402 for disposable sampling and decon materials.
Sample materials	$/ea	25.00	
Sample equipment	$/event	1,000	Drums, water quality parameter equipment, pumps, misc tools and sampling equipment rental/purchase.
Analytical Cost	$/event	3,200	Analyze GW samples from 6 locations for VOCs (9 @ $120), SVOCc (7 @ 220), and natural attenuation parameters (1 @ 360). Includes 10% duplicate, 5% rinsate, and trip blanks.
Sample Shipment	$/event	100	2 coolers @ $50 ea.
Data Management	hrs	9	Data validation
Data Management	$/hr	80	
IDW Disposal	$/lot	0	Dispose IDW water onsite.
Monitoring Report			
Annual Monitoring Report	$/year	12,800	Assume 160 hours @ $80/hr.
Final Review and Confirmation Report	$/event	12,800	Assume 160 hours @ $80/hr.
Monitoring Well Abandonment			
Abandon Monitoring Well	lot	1	Assume 11 wells @ 35 ft ea.
Abandon Monitoring Well	$/lot	15,000	Based on former NIKE contract.

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 2 - Pump and Treat
Cost Estimate

CAPITAL COST **$503,271**

Activity (unit)	Quantity	Unit Cost	Total
Site Work			
Install Monitoring Wells (ea)	2	$12,000	$24,000
Pump and Treat			
Air Stripping (lot)	1	$75,707	$75,707
Carbon Adsorption (Gas) (lot)	1	$46,591	$46,591
Groundwater Extraction Wells (lot)	1	$77,318	$77,318
Infiltration Gallery (lot)	1	$69,744	$69,744
Overhead Electrical Distribution (lot)	1	$43,489	$43,489
Residual Waste Management (lot)	1	$1,112	$1,112
Miscellaneous Support Costs (lot)	1	$47,082	$47,082
Installation Report (ea)	1	$12,800	$12,800
Subtotal			$397,843
Design		10%	$39,784
Office Overhead (Included in RACER Cost)		0%	$0
Field Overhead (Included in RACER Cost)		0%	$0
Subtotal			$437,627
Profit (Included in RACER Cost)		0%	$0
Contingency		15%	$65,644
Total			$503,271

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 2 - Pump and Treat
Cost Estimate

OPERATION AND MAINTENANCE **$2,787,928**

Activity (unit)	Quantity	Unit Cost	Total Cost
Pump and Treat (Years 0-10)			
Miscellaneous Support Costs (year)	10	$20,561	$205,612
Groundwater Extraction Wells (year)	10	$17,523	$175,230
Air Stripping (year)	10	$94,095	$940,949
Carbon Adsorption (Gas) (year)	10	$47,439	$474,385
Infiltration Gallery (year)	10	$1,370	$13,700
Groundwater Sampling and Analysis (Years 0-10)			
Sampling Labor (events)	20	$5,120	$102,400
Per Diem (events)	20	$1,536	$30,720
Cargo Van Rental / Gas (events)	20	$450	$9,000
Sample materials (events)	20	$425	$8,500
Sample equipment (events)	20	$1,000	$20,000
Analytical Cost (events)	20	$3,200	$64,000
Sample Shipment (events)	20	$100	$2,000
Data Management (events)	20	$720	$14,400
IDW Disposal (events)	20	$0	$0
Reports			
Annual Monitoring Reports (events)	9	$12,800	$115,200
Final Review and Confirmation Report (ea) (year 30)	1	$12,800	$12,800
Monitoring Well Abandonment			
Abandon Monitoring Well (lot)	1	$15,000	$15,000
Subtotal O&M			$2,203,896
Design		10%	$220,390
Office Overhead (Included in RACER Cost)		0%	$0
Field Overhead (Included in RACER Cost)		0%	$0
Subtotal			$2,424,286
Profit (Included in RACER Cost)		0%	$0
Contingency		15%	$363,643
Total			$2,787,928

TOTAL ALTERNATIVE CAPITAL AND O&M COST (Non Discounted Cost) **$3,291,200**

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 3 - Air Sparging
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
Capital Cost			
Mobilize/DeMobilize Drilling Rig & Crew	ls	2	
	$/ls	1,200	Based on RACER Model.
Organic Vapor Analyzer	ea	1	
	$/ea	2,500	Based on RACER Model.
Air Sparge System	ea	1	
	$/ea	22,990	Rietschle Rotary Claw Compressor, Model DLR 400, 230 volt, 3 phase, 30 hp,Sized for 245 scfm @ 25 psi. Includes inlet filter, pressure regulator valve, and integral air cooling. Based on vendor quote and includes shipping and installation.
Extend Electrical Service	ls	1	
	$/ls	10,000	
Field Technician	hrs	512	
	$/hrs	65	Based on RACER Model.
3/4" PVC, Schedule 40, Well Casing	lf	2,350	
	$/lf	15.89	Based on RACER Model.
3/4" PVC, Schedule 40, Well Screen	lf	250	
	$/lf	19.67	Based on RACER Model.
3/4" PVC, Well Plug	ea	50	
	$/ea	28.35	Based on RACER Model.
DPT Rig Rental	days	25	Includes rig and operator.
	$/day	2,700	Based on RACER Model.
Filter Pack	lf	250	
	$/lf	15.93	Based on RACER Model.
3/4" Well, Portland Cement Grout	lf	2,200	
	$/lf	1.47	Based on RACER Model.
3/4" Well, Bentonite Seal	ea	50.00	
	$/ea	58.50	Based on RACER Model.
1" PVC, Schedule 80, Connection Piping	lf	1,500	
	$/lf	8.44	Based on RACER Model.
2" PVC, Schedule 80, Manifold Piping	lf	1,000	
	$/lf	19.02	Based on RACER Model.
1" PVC, Schedule 80, Tee	ea	50	
	$/ea	14.56	Based on RACER Model.
1" PVC, Schedule 80, 90 Degree, Elbow	ea	50	
	$/ea	3.96	
2" x 1" Reducer, PVC Schedule 80	ea	50	Based on RACER Model.
	$/ea	37.94	
1" PVC, Sch 80, Ball Valve	ea	50	Based on RACER Model.
	$/ea	90.50	
Pressure Gauge	ea	50	
	$/ea	137.89	
Installation Report	ea	1	
	$/ea	10,000.00	

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 3 - Air Sparging
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
O&M	years	5	
Electrical Costs	$/yr	9,000	Based on RACER Model.
Technician	$/yr	7,680	Assume 8 hr/mo average for inspection and maintenance.
Miscellaneous Materials and Supplies	$/yr	1,000	Based on RACER Model.
Groundwater Sampling & Analysis	events	7	S&A will be performed semiannually for years 0-2 and annually for years 3-5.
Sampling Labor	hrs/event	64	Includes 8 wells sampled in 2 days. Add 1 day travel for sampling and 1 days travel/labor to dispose IDW water.
Sampling Labor	$/hr	80	
Per Diem	$/event	1,536	(2 people x 4 days x $192/day)
Rental Truck and Gas	$/event	450	(1 van x 4 days x $100/day). Add $50 for gas
Sample materials	ea/event	23	Reference ECHOS 33 02 0401/0402 for disposable sampling and decon materials.
Sample materials	$/ea	25.00	
Sample equipment	$/event	1,000	Drums, water quality parameter equipment, pumps, misc tools and sampling equipment rental/purchase.
Analytical Cost	$/event	4,000	Analyze GW samples from 8 locations for VOCs (12 @ $120), SVOCs (10 @ 220), and natural attenuation parameters (1 @ 360). Includes 10% duplicate, 5% rinsate, and trip blanks.
Sample Shipment	$/event	100	2 coolers @ $50 ea.
Data Management	hrs	12	Data validation
Data Management	$/hr	80	
IDW Disposal	$/lot	0	Dispose IDW water onsite.
Closure Monitoring	years	1	
Groundwater Sampling & Analysis	events	4	Closure monitoring will be performed quarterly for 1 year.
Sampling Labor	hrs/event	64	Includes 8 wells sampled in 2 days. Add 1 day travel for sampling and 1 days travel/labor to dispose IDW water.
Sampling Labor	$/hr	80	
Per Diem	$/event	1,536	(2 people x 4 days x $192/day)
Rental Truck and Gas	$/event	450	(1 van x 4 days x $100/day). Add $50 for gas
Sample materials	ea/event	32	Reference ECHOS 33 02 0401/0402 for disposable sampling and decon materials.
Sample materials	$/ea	25.00	
Sample equipment	$/event	1,000	Drums, water quality parameter equipment, pumps, misc tools and sampling equipment rental/purchase.
Analytical Cost	$/event	4,640	Analyze GW samples from 8 locations for VOCs (12 @ $120), SVOCs (10 @ 220), and metals (10 @ 100). Includes 10% duplicate, 5% rinsate, and trip blanks.
Sample Shipment	$/event	100	2 coolers @ $50 ea.
Data Management	hrs	16	Data validation
Data Management	$/hr	80	
IDW Disposal	$/lot	0	Dispose IDW water onsite.
Monitoring Report			
Annual Monitoring Report	$/year	12,800	Assume 160 hours @ $80/hr.
Final Review and Confirmation Report	$/event	12,800	Assume 160 hours @ $80/hr.
Monitoring Well Abandonment			
Abandon Sparge and Monitoring Wells	lot	1	Assume 11 monitoring wells and 50 sparge wells.
Abandon Sparge and Monitoring Well	$/lot	35,500	

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 3 - Air Sparging
Cost Estimate

CAPITAL COST **$378,707**

Activity (unit)	Quantity	Unit Cost	Total
Air Sparge System			
Mobilize/DeMobilize Drilling Rig & Crew	2	$1,200.00	$2,400
Organic Vapor Analyzer	1	$2,500.00	$2,500
Air Sparge System	1	$22,990.00	$22,990
Extend Electrical Service	1	$10,000.00	$10,000
Field Technician	512	$65.00	$33,280
3/4" PVC, Schedule 40, Well Casing	2,350	$15.89	$37,330
3/4" PVC, Schedule 40, Well Screen	250	$19.67	$4,916
3/4" PVC, Well Plug	50	$28.35	$1,418
DPT Rig Rental	25	$2,700.00	$67,500
Filter Pack	250	$15.93	$3,983
3/4" Well, Portland Cement Grout	2,200	$1.47	$3,234
3/4" Well, Bentonite Seal	50	$58.50	$2,925
1" PVC, Schedule 80, Connection Piping	1,500	$8.44	$12,663
2" PVC, Schedule 80, Manifold Piping	1,000	$19.02	$19,017
1" PVC, Schedule 80, Tee	50	$14.56	$728
1" PVC, Schedule 80, 90 Degree, Elbow	50	$3.96	$198
2" x 1" Reducer, PVC Schedule 80	50	$37.94	$1,897
1" PVC, Sch 80, Ball Valve	50	$90.50	$4,525
Pressure Gauge	50	$137.89	$6,894
Installation Report (ea)	1	$10,000	$10,000
Subtotal			$248,398
Design		6%	$14,904
Office Overhead		5%	$12,420
Field Overhead		15%	$37,260
Subtotal			$312,981
Profit		6%	$18,779
Contingency		15%	$46,947
Total			$378,707

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 3 - Air Sparging
Cost Estimate

OPERATION AND MAINTENANCE

Activity (unit)	Quantity	Unit Cost	Total Cost
O&M			
Electrical Costs	5	$9,000	$45,000
Technician	5	$7,680	$38,400
Miscellaneous Materials and Supplies	5	$1,000	$5,000
Groundwater Sampling and Analysis (Years 0-5)			
Sampling Labor (events)	7	$5,120	$35,840
Per Diem (events)	7	$1,536	$10,752
Cargo Van Rental / Gas (events)	7	$450	$3,150
Sample materials (events)	7	$575	$4,025
Sample equipment (events)	7	$1,000	$7,000
Analytical Cost (events)	7	$4,000	$28,000
Sample Shipment (events)	7	$100	$700
Data Management (events)	7	$920	$6,440
IDW Disposal (events)	7	$0	$0
Closure Monitoring (Year 6)			
Sampling Labor (events)	4	$5,120	$20,480
Per Diem (events)	4	$1,536	$6,144
Cargo Van Rental / Gas (events)	4	$450	$1,800
Sample materials (events)	4	$800	$3,200
Sample equipment (events)	4	$1,000	$4,000
Analytical Cost (events)	4	$4,640	$18,560
Sample Shipment (events)	4	$100	$400
Data Management (events)	4	$1,280	$5,120
IDW Disposal (events)	4	$0	$0
Reports			
Annual Monitoring Reports (events)	4	$12,800	$51,200
Final Review and Confirmation Report (ea) (year 30)	1	$12,800	$12,800
Monitoring Well Abandonment			
Abandon Monitoring Well (lot)	1	$35,500	$35,500
Subtotal O&M			$255,111
Design		10%	$25,511
Office Overhead		5%	$12,756
Field Overhead		15%	$38,267
Subtotal			$331,644
Profit		6%	$19,899
Contingency		15%	$49,747
Total			$401,290

TOTAL ALTERNATIVE CAPITAL AND O&M COST **$779,997**

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 4 - Oxygen Releasing Compound
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
Capital Cost			
Site Work			
Install Monitoring Wells	ea	2	
Install Monitoring Wells	$/ea	12,000	Based on RACER model. Inc. sampling IDW.
ORC Injection			
Pilot Study	$/lot	60,000	Install 3 wells, inject and monitor. Engr Est.
ORC Injection Permit	$/ea	3200	Assume 40 hrs @ $80/hr
Mob/Site Preparation	$/lot	1,000	Based on vendor quote.
Direct Push Rig and Crew	$/day	2000	Installation and injection or the ORC is $2,000/day/crew based on SAIC pilot study and Regenesis estimate. There are 2,371 injection points. Assuming 25 injection points per day. Total duration is 95 days.
Injection duration	days	95	
ORC Materials	lbs	80,070	ORC required to treat entire plume.
ORC Materials	$/lb	7.75	Regenesis quote of $7.75/lb plus assume no sales tax.
ORC Shipping	$/lot	22,000	Assume $20,000 to ship. Add $2000 to offload.
ORC Polishing			Assume 50% of Initial Treatment.
Mob/Site Preparation	$/lot	1,000	Based on vendor quote.
Direct Push Rig and Crew	$/day	2000	Installation and injection or the ORC is $2,000/day/crew based on SAIC pilot study and Regenesis estimate. There are 1,186 injection points. Assuming 25 injection points per day. Total duration is 48 days.
Injection duration	days	48	
ORC Materials	lbs	40,035	ORC required to treat entire plume.
ORC Materials	$/lb	7.75	Regenesis quote of $7.75/lb plus assume no sales tax.
ORC Shipping	$/lot	11,000	Assume $10,000 to ship. Add $1000 to offload.
Decon Pad	$/lot	5,000	Engineering estimate.
Installation Report	$/report	19,200	Assumes 240 hrs @ $80/hr to prepare report.

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 4 - Oxygen Releasing Compound
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
O&M	years	5	
Groundwater Sampling & Analysis	events	7	S&A will be performed semiannual for years 0-2 and annually for years 3-5.
Sampling Labor	hrs/event	64	Includes 8 wells sampled in 2 days. Add 1 day travel for sampling and 1 days travel/labor to dispose IDW water.
Sampling Labor	$/hr	80	
Per Diem	$/event	1,536	(2 people x 4 days x $192/day)
Rental Truck and Gas	$/event	450	(1 van x 4 days x $100/day). Add $50 for gas
Sample materials	ea/event	23	Reference ECHOS 33 02 0401/0402 for disposable sampling and decon materials.
Sample materials	$/ea	25.00	
Sample equipment	$/event	1,000	Drums, water quality parameter equipment, pumps, misc tools and sampling equipment rental/purchase.
Analytical Cost	$/event	4,000	Analyze GW samples from 8 locations for VOCs (12 @ $120), SVOCs (10 @ 220), and natural attenuation parameters (1 @ 360). Includes 10% duplicate, 5% rinsate, and trip blanks.
Sample Shipment	$/event	100	2 coolers @ $50 ea.
Data Management	hrs	12	Data validation
Data Management	$/hr	80	
IDW Disposal	$/lot	0	Dispose IDW water onsite.
Monitoring Report			
Annual Monitoring Report	$/year	12,800	Assume 160 hours @ $80/hr.
Final Review and Confirmation Report	$/event	12,800	Assume 160 hours @ $80/hr.
Monitoring Well Abandonment			
Abandon Monitoring Well	lot	1	Assume 11 wells @ 35 ft ea.
Abandon Monitoring Well	$/lot	15,000	Based on former NIKE contract.

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 4 - Oxygen Releasing Compound
Cost Estimate

CAPITAL COST **$2,250,121**

Activity (unit)	Quantity	Unit Cost	Total
Site Work			
Install Monitoring Wells (ea)	2	$12,000	$24,000
Initial ORC Injection			
Pilot Study	1	$60,000	$60,000
ORC Injection Permit (ea)	1	$3,200	$3,200
Mob/Site Preparation (lot)	1	$1,000	$1,000
Direct Push Rig and Crew (days)	95	$2,000	$190,000
ORC Materials (lbs)	80,070	$7.75	$620,543
ORC Shipping (lot)	1	$22,000	$22,000
Polishing ORC Injection			
Mob/Site Preparation (lot)	1	$1,000	$1,000
Direct Push Rig and Crew (days)	48	$2,000	$96,000
ORC Materials (lbs)	40,035	$7.75	$310,271
ORC Shipping (lot)	1	$11,000	$11,000
Decon Pad (lot)	1	$5,000	$5,000
Installation Report (ea)	1	$19,200	$19,200
Subtotal			$1,363,214
Design		6%	$81,793
Office Overhead		5%	$68,161
Field Overhead		15%	$204,482
Subtotal			$1,717,649
Profit		6%	$103,059
Contingency		25%	$429,412
Total			$2,250,121

Gabreski Air National Guard Sites 4 and 9
Groundwater Alternative 4 - Oxygen Releasing Compound
Cost Estimate

OPERATION AND MAINTENANCE **$275,129**

Activity (unit)	Quantity	Unit Cost	Total Cost
Groundwater Sampling and Analysis (Years 0-5)			
Sampling Labor (events)	7	$5,120	$35,840
Per Diem (events)	7	$1,536	$10,752
Cargo Van Rental / Gas (events)	7	$450	$3,150
Sample materials (events)	7	$575	$4,025
Sample equipment (events)	7	$1,000	$7,000
Analytical Cost (events)	7	$4,000	$28,000
Sample Shipment (events)	7	$100	$700
Data Management (events)	7	$920	$6,440
IDW Disposal (events)	7	$0	$0
Reports			
Annual Monitoring Reports (events)	4	$12,800	$51,200
Final Review and Confirmation Report (ea) (year 30)	1	$12,800	$12,800
Monitoring Well Abandonment			
Abandon Monitoring Well (lot)	1	$15,000	$15,000
Subtotal O&M			$174,907
Design		10%	$17,491
Office Overhead		5%	$8,745
Field Overhead		15%	$26,236
Subtotal			$227,379
Profit		6%	$13,643
Contingency		15%	$34,107
Total			$275,129

TOTAL ALTERNATIVE CAPITAL AND O&M COST **$2,525,249**

Gabreski Air National Guard Site 7
Groundwater Alternative 1 - No Further Action with Monitoring
Key Parameters and Assumptions

Key Parameters and Assumptions:

Item	Unit	Value	Notes
Capital Cost			
Closure Monitoring	years	1	
Groundwater Sampling & Analysis	events	4	Closure monitoring will be performed quarterly for 1 year.
Sampling Labor	hrs/event	64	Includes 6 wells sampled in 2 days. Add 1 day travel for sampling
Sampling Labor	$/hr	80	and 1 days travel/labor to dispose IDW water.
Per Diem	$/event	1,536	(2 people x 4 days x $192/day)
Rental Truck and Gas	$/event	450	(1 van x 4 days x $100/day). Add $50 for gas
Sample materials	ea/event	32	Reference ECHOS 33 02 0401/0402 for disposable sampling and
Sample materials	$/ea	25.00	decon materials.
Sample equipment	$/event	1,000	Drums, water quality parameter equipment, pumps, misc tools and sampling equipment rental/purchase.
Analytical Cost	$/event	3,760	Analyze GW samples from 6 locations for VOCs (10 @ $120), SVOCs (8 @ 220), and metals (8 @ 100). Includes 10% duplicate, 5% rinsate, and trip blanks.
Sample Shipment	$/event	100	2 coolers @ $50 ea.
Data Management	hrs	16	Data validation
Data Management	$/hr	80	
IDW Disposal	$/lot	0	Dispose IDW water onsite.
Monitoring Report			
Final Review and Confirmation Report	$/event	12,800	Assume 160 hours @ $80/hr.
Monitoring Well Abandonment			
Abandon Monitoring Well	lot	1	Assume 1 monitoring well.
Abandon Monitoring Well	$/lot	1,700	

Gabreski Air National Guard Site 7
Groundwater Alternative 1 - No Further Action with Monitoring
Cost Estimate

CAPITAL COST **$107,765**

Activity (unit)	Quantity	Unit Cost	Total
Closure Monitoring			
Sampling Labor (events)	4	$5,120	$20,480
Per Diem (events)	4	$1,536	$6,144
Cargo Van Rental / Gas (events)	4	$450	$1,800
Sample materials (events)	4	$800	$3,200
Sample equipment (events)	4	$1,000	$4,000
Analytical Cost (events)	4	$3,760	$15,040
Sample Shipment (events)	4	$100	$400
Data Management (events)	4	$1,280	$5,120
IDW Disposal (events)	4	$0	$0
Reports			
Final Review and Confirmation Report (ea)	1	$12,800	$12,800
Monitoring Well Abandonment			
Abandon Monitoring Well (lot)	1	$1,700	$1,700
Subtotal			$70,684
Design		6%	$4,241
Office Overhead		5%	$3,534
Field Overhead		15%	$10,603
Subtotal			$89,062
Profit		6%	$5,344
Contingency		15%	$13,359
Total			$107,765

APPENDIX B
SUPPLEMENTAL INVESTIGATION RESULTS

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Table B1. Sites 4 and 9 DPT Point VOC Concentrations in 2006

		Site	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
		Station	**DPT04**	**DPT04**	**DPT05**	**DPT05**	**DPT05**	**DPT06**	**DPT06**	**DPT07**
		Sample ID	G4DP-04GW30-12	G4DP-04GW40-11	G4DP-05GW30-8	G4DP-05GW40-7	G4DP-05GW50-6	G4DP-06GW30-4	G4DP-06GW40-3	G4DP-07GW30-16
		Depth Interval (ft bg)	26 - 30	36 - 40	26 - 30	36 - 40	46 - 50	26 - 30	36 - 40	30 - 34
		Sample Date	7/18/2006	7/18/2006	7/18/2006	7/18/2006	7/18/2006	7/18/2006	7/18/2006	7/19/2006
Volatile Organic Compounds (ug/L)	**NYSDEC [a]**	**MCL[b]**								
Benzene	**1**	**5**	ND	2.3	8.8	15	ND	21	2.6	14
Ethylbenzene	***5****	**700**	30	9.4	110	560	43	500	ND	400
Toluene	***5****	**1000**	14	4.0	55	240	ND	160	ND	110
Xylene, Total	***5****	**10,000**	161	32	700	2640	9.4	2970	2.2	1800
Styrene	***5****	**100**	ND	2.3	27	130	5.9	ND	ND	ND
1,2,4-Trimethylbenzene	***5****		150	56	440	990	5.4	750	ND	830
1,3,5-Trimethylbenzene	***5****		46	15	160	320	ND	260	ND	280
Isopropylbenzene	***5****		16	33	32	130	11	82	2.2	82
Naphthalene	***10***		ND	11	57	200	12	180	ND	140
n-Propylbenzene	***5****		16	11	47	150	6.8	76	ND	120
p-Isopropltoluene	***5****		ND	ND	17	20	ND	19	ND	26
n-Butylbenzene	***5****		ND	ND	ND	19	ND	ND	ND	33
sec-Butylbenzene	***5****		ND	11	9.6	15	ND	ND	ND	17

[a] - New York State Department of Environmental Conservation Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, Table 1 (cf. section 703.5) Water Quality

[b] - Environmental Protection Agency National Primary Drinking Water Standard Maximum Contaminant Level

*5** -- the principal organic contaminant standard for groundwater of 5 ug/L applies to this substance

J - detected at an estimated concentration

E - Exceeded calibration range

ND - Not detected

shaded values - represent concentrations exceeding regulatory criteria

Table B1. Sites 4 and 9 DPT Point VOC Concentrations in

		Site	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
		Station	**DPT07**	**DPT07B**	**DPT07B**	**DPT07B**	**DPT07C**	**DPT08**	**DPT08**	**DPT08**
		Sample ID	G4DP-07GW40-15	G4DP-7BDGW30-44	G4DP-7BGW40-43	G4DP-7BGW50-42	G4DP-7CGW50-48	G4DP-08GW30-19	G4DP-08GW40-18	G4DP-08GW50-17
		Depth Interval (ft bg)	40 - 44	26 - 30	36 - 40	46 - 50	46 - 50	26 - 30	36 -40	46 - 50
		Sample Date	7/19/2006	7/20/2006	7/20/2006	7/20/2006	7/21/2006	7/19/2006	7/19/2006	7/19/2006
Volatile Organic Compounds (ug/L)	**NYSDEC [a]**	**MCL[b]**								
Benzene	**1**	**5**	3.0	38	7.5	3.8	5.5	ND	12	2.0
Ethylbenzene	***5****	**700**	36	250	300	26	ND	28	10	12
Toluene	***5****	**1000**	9.0	170	150	13	ND	12	10	4.8
Xylene, Total	***5****	**10,000**	206	1200	1220	133	ND	151	52	64
Styrene	***5****	**100**	ND	41	52	8.0	ND	ND	4.0	3.7
1,2,4-Trimethylbenzene	***5****		140	770	410	61	ND	97	22	27
1,3,5-Trimethylbenzene	***5****		48	300	120	25	ND	31	8.4	10
Isopropylbenzene	***5****		12	96	74	9.4	ND	8.7	4.8	4.7
Naphthalene	***10***		18	130	98	12	ND	30	7.6	7.4
n-Propylbenzene	***5****		18	160	85	14	ND	14	5.8	6.0
p-Isopropltoluene	***5****		8.7	67	13	4.2	ND	6.2	1.8	2.2
n-Butylbenzene	***5****		11	100	20	6.5	ND	ND	2.1	3.1
sec-Butylbenzene	***5****		5.7	43	12	3.9	ND	ND	1.9	2.2

[a] - New York State Department of Environmental Conservation Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, Table 1 (cf. section 703.5) Water Quality

[b] - Environmental Protection Agency National Primary Drinking Water Standard Maximum Contaminant Level

*5** -- the principal organic contaminant standard for groundwater o

J - detected at an estimated concentration

E - Exceeded calibration range

ND - Not detected

shaded values - represent concentrations exceeding regulatory criteri

Table B1. Sites 4 and 9 DPT Point VOC Concentrations in

		Site	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
		Station	**DPT08A**	**DPT08A**	**DPT08A**	**DPT09**	**DPT09**	**DPT09**	**DPT09B**	**DPT09B**
		Sample ID	G4DP-8AGW30-25	G4DP-8AGW40-24	G4DP-8AGW50-23	G4DP-09GW30-22	G4DP-09GW40-21	G4DP-09GW50-20	G4DP-9BGW40-52	G4DP-9BGW50-51
		Depth Interval (ft bg)	26 - 30	36 - 40	46 - 50	26 -30	36 - 40	46 - 50	36 - 40	46 -50
		Sample Date	7/19/2006	7/19/2006	7/19/2006	7/19/2006	7/19/2006	7/19/2006	7/21/2006	7/21/2006
Volatile Organic Compounds (ug/L)	**NYSDEC [a]**	**MCL[b]**								
Benzene	**1**	**5**	19	16	ND	18	2.6	2.3	5.2	ND
Ethylbenzene	***5****	**700**	25	300	3.2	230	100	2.6	32	ND
Toluene	***5****	**1000**	11	74	2.0	390	18	2.4	15	1.5
Xylene, Total	***5****	**10,000**	116	1490	18.7	1950	146	15.2	185	2.5
Styrene	***5****	**100**	5.6	95	2.2	ND	16	2.7	14	1.6
1,2,4-Trimethylbenzene	***5****		87	460E	15	860	120	24	180	7.0
1,3,5-Trimethylbenzene	***5****		23	130	4.9	280	33	10	75	3.8
Isopropylbenzene	***5****		8.8J	84	1.9	49	28	4.1	33	ND
Naphthalene	***10***		15J	160	ND	130	38	5.9	39	ND
n-Propylbenzene	***5****		12	95	3.3	62	35	6.3	36	1.9
p-Isopropltoluene	***5****		5.5J	11	1.4	33	7.2	1.9	9.6	ND
n-Butylbenzene	***5****		ND	11	ND	ND	7.6	2.5	8.2	ND
sec-Butylbenzene	***5****		ND	13	ND	15	7.5	2.0	8.0	ND

[a] - New York State Department of Environmental Conservation Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, Table 1 (cf. section 703.5) Water Quality

[b] - Environmental Protection Agency National Primary Drinking Water Standard Maximum Contaminant Level

*5** -- the principal organic contaminant standard for groundwater o

J - detected at an estimated concentration

E - Exceeded calibration range

ND - Not detected

shaded values - represent concentrations exceeding regulatory criteri

Table B1. Sites 4 and 9 DPT Point VOC Concentrations in

		Site	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**
		Station	**DPT01**	**DPT01**	**DPT01**	**DPT01B**	**DPT03**	**DPT03**	**DPT03**	**DPT03**
		Sample ID	G4DP-01GW30-38	G4DP-01GW40-37	G4DP-01GW50-36	G4DP-1BGW23-45	G4DP-03GW30-29	G4DP-03GW40-28	G4DP-03GW50-27	G4DP-03GW60-26
		Depth Interval (ft bg)	24 - 28	34 - 38	44 - 48	19 - 23	26 - 30	36 - 40	46 - 50	56 - 60
		Sample Date	7/20/2006	7/20/2006	7/20/2006	7/20/2006	7/19/2006	7/19/2006	7/19/2006	7/19/2006
Volatile Organic Compounds (ug/L)	**NYSDEC [a]**	**MCL[b]**								
Benzene	**1**	**5**	8.4	46	18	ND	ND	20	28	ND
Ethylbenzene	***5****	**700**	27	960	550	8.8	25	940	660	1.5
Toluene	***5****	**1000**	8.9	180	86	14	6.4	120	130	ND
Xylene, Total	***5****	**10,000**	100	2939	1617	171	100	2437	1736	5.6
Styrene	***5****	**100**	5.1	160	59	ND	ND	110	120	ND
1,2,4-Trimethylbenzene	***5****		35	730	590	62	45	870	530	3.4
1,3,5-Trimethylbenzene	***5****		8.6J	220	170	16	12	280	140	ND
Isopropylbenzene	***5****		3.1	92	68	ND	ND	100	81	ND
Naphthalene	***10***		12J	390	170	32	ND	270	230	ND
n-Propylbenzene	***5****		4.9	97	90	ND	5.2	130	73	ND
p-Isopropltoluene	***5****		ND	15J	14	ND	ND	16	8.8J	ND
n-Butylbenzene	***5****		ND	15J	16	ND	ND	23	13	ND
sec-Butylbenzene	***5****		ND	8.4J	9.4J	ND	ND	12	ND	ND

[a] - New York State Department of Environmental Conservation Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, Table 1 (cf. section 703.5) Water Quality

[b] - Environmental Protection Agency National Primary Drinking Water Standard Maximum Contaminant Level

*5** -- the principal organic contaminant standard for groundwater o

J - detected at an estimated concentration

E - Exceeded calibration range

ND - Not detected

shaded values - represent concentrations exceeding regulatory criteri

Table B1. Sites 4 and 9 DPT Point VOC Concentrations in

		Site	**9**	**9**	**9**	**9**	**9**	**9**
		Station	**DPT03B**	**DPT03B**	**DPT03B**	**DPT03C**	**DPT03C**	**DPT03C**
		Sample ID	G4DP-3BGW30-35	G4DP-3BGW40-34	G4DP-3BGW50-33	G4DP-3CGW30-41	G4DP-3CGW40-40	G4DP-3CGW50-39
		Depth Interval (ft bg)	26 - 30	36 - 40	46 - 50	26 - 30	36 - 40	46 - 50
		Sample Date	7/20/2006	7/20/2006	7/20/2006	7/20/2006	7/20/2006	7/20/2006
Volatile Organic Compounds (ug/L)	**NYSDEC [a]**	**MCL[b]**						
Benzene	**1**	**5**	7.1	14	15	80	12	3.8
Ethylbenzene	***5****	**700**	30	620	430	21	380	41
Toluene	***5****	**1000**	7.1	71	67	33	69	4.7
Xylene, Total	***5****	**10,000**	100.7	1424	1315	62	1350	54.6
Styrene	***5****	**100**	5.0	91	46	15	85	5.2
1,2,4-Trimethylbenzene	***5****		42	560	410	33	470	67
1,3,5-Trimethylbenzene	***5****		9.6	140	120	6.2J	110	9.0
Isopropylbenzene	***5****		3.8	93	56	4.1	61	17
Naphthalene	***10***		18	96	120	43	98	16
n-Propylbenzene	***5****		5.2	76	56	4.0	54	9.7
p-Isopropltoluene	***5****		ND	11	9.6J	ND	14	ND
n-Butylbenzene	***5****		ND	8.9J	9.8J	ND	9.3	ND
sec-Butylbenzene	***5****		ND	7.3J	ND	ND	7.7J	2.8

[a] - New York State Department of Environmental Conservation Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, Table 1 (cf. section 703.5) Water Quality

[b] - Environmental Protection Agency National Primary Drinking Water Standard Maximum Contaminant Level

*5** -- the principal organic contaminant standard for groundwater o

J - detected at an estimated concentration

E - Exceeded calibration range

ND - Not detected

shaded values - represent concentrations exceeding regulatory criteri

Table B2. Sites 4 and 9 New MW VOC Concentrations in 2006

		Site	**4**	**9**	**9**	**9**
		Station	**06MW01**	**06MW02**	**06MW03**	**06MW04**
		Sample ID	G4MW-01GW-54	G4MW-02GW-53	G4MW-03GW-56	G4MW-04GW-55
		Depth (ft bg)	20.99	25.47	11.04	20.65
		Sample Date	7/24/2006	7/24/2006	7/24/2006	7/24/2006
Volatile Organic Compounds (ug/L)	**NYSDEC [a]**	**MCL[b]**				
Benzene	**1**	**5**	ND	ND	ND	ND
Ethylbenzene	***5****	**700**	0.22	440	11	ND
Toluene	***5****	**1000**	ND	470	ND	ND
Xylene, Total	***5****	**10,000**	0.71	2000	20	ND
Naphthalene	***10***		ND	44	ND	ND
2-Methyl Naphthalene			ND	25	ND	ND
Acetone			0.8	10	0.95	0.066

[a] - New York State Department of Environmental Conservation Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations,

Table 1 (cf. section 703.5) Water Quality Standards Surface Waters and Groundwaters, Class GA waters, Amended August 1999

[b] - Environmental Protection Agency National Primary Drinking Water Standard Maximum Contaminant Level

*5** -- the principal organic contaminant standard for groundwater of 5 ug/L applies to this substance

ND = not detected

shaded values - represent concentrations exceeding regulatory criteria