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AIR NATIONAL GUARD
INSTALLATION RESTORATION PROGRAM

FINAL REMEDIAL INVESTIGATION WORK PLAN

174th FIGHTER WING
NEW YORK AIR NATIONAL GUARD
HANCOCK FIELD
SYRACUSE, NY

SAMPLING & ANALYSIS PLAN

June 1995

Hazardous Waste Remedial Action Program
Environmental Restoration and Waste Management Programs
Oak Ridge, Tennessee 37831-7606
Managed by MARTIN MARIETTA ENERGY SYSTEMS, INC.
For the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-840R21400

AIR NATIONAL GUARD
INSTALLATION RESTORATION PROGRAM

REMEDIAL INVESTIGATION
PETROLEUM, OIL, LUBRICATION (POL) AREA

for

174th Fighter Wing
New York Air National Guard
Hancock Field
Syracuse, NY

General Order No. 91B-99791C
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23 June 1995

FINAL
FIELD SAMPLING PLAN

Submitted to:

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MARTIN MARIETTA ENERGY SYSTEMS, INC.

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The objective of the remedial investigation program detailed within this and accompanying documents is to define the nature and extent of PCB and jet-propellant-related contamination of the soil and groundwater resulting from past activities at the POL Area. The RI will be conducted to obtain site data to determine necessary remedial actions. The sampling and analysis plan (SAP) consists of three site-specific parts: (1) the field sampling plan (FSP); (2) the quality assurance project plan (QAPP); and (3) the health and safety plan (HSP). Accompanying this RI SAP is the overall work plan.

The FSP is the part of the sampling and analysis plan (SAP) that provides guidance for all field work by defining in detail the sampling and data-gathering methods to be used for the RI. The QAPP describes the functional activities and other QA/QC protocols necessary to achieve data quality objectives dictated by the intended use of the data. The data which will be generated from this work are intended to be used for risk assessment and remedial design. The HSP summarizes site hazards and defines protective measures to be taken for the site.

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PREFACE

The objective of this quality assurance program is to ensure that all measurement, data gathering, and data generation activities yield data that are of adequate quality for the intended use. The key to achieving this objective is the successful implementation of a sampling and analysis plan (SAP). The SAP consists of three parts: (1) this document, the field sampling plan (FSP), which provides guidance for all field work by defining in detail the sampling and data-gathering methods to be used on a project; (2) the quality assurance project plan (QAPP), which describes the policy, organization, functional activities, and quality assurance and quality control protocols necessary to achieve data quality objectives dictated by the intended use of the data; and (3) the health and safety plan (HSP), which summarizes site hazards and defines protective measures to be taken for the site.

FIELD SAMPLING PLAN

AIR NATIONAL GUARD
INSTALLATION RESTORATION PROGRAM

FINAL REMEDIAL INVESTIGATION WORK PLAN

174th FIGHTER WING
NEW YORK AIR NATIONAL GUARD
HANCOCK FIELD
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FIELD SAMPLING PLAN

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1.0 INTRODUCTION

This field sampling plan (FSP) describes the field investigation program that is outlined in the final work plan. The FSP is the part of the sampling and analysis plan (SAP) that provides guidance for all field activities that will be conducted during the RI. The FSP defines the sampling and data acquisition protocols to be used in the field investigations and will be used by field personnel to perform the planned field work. Each member of the field team will be provided with a copy of the FSP and will become familiar with the sections that are applicable to the work in which they will be involved.

Described within this document is the field program established for the collection of field data and environmental samples that will be conducted at the POL Area. The data will be used to evaluate the nature and extent of contamination, delineate potential source areas, and to evaluate the public health and ecological risks associated with contaminants found in the areas of concern.

The purpose of the FSP is to ensure that the acquisition and analysis of samples are performed in a manner producing the highest quality data and that the results are defensible in a court of law. For this reason, field testing and sampling will be performed according to accepted and approved protocols defined by this document. The HAZWRAP Project Manager for the Hancock Field NYANG site, Mr. Thomas Cady, will be notified of any deviation from this plan by telephone or correspondence from the Contractor Project Manager, and approval for the deviation will be received where necessary. Documentation of these approved deviations will be kept in the project file.

1.1 SITE DESCRIPTION

Hancock Field, home of the 174th Fighter Wing (FW) of the New York Air National Guard (NYANG) is located approximately 5 miles north-northeast of Syracuse, in Onondaga County in central New York as shown on Figure 1-1. Hancock Field was built in 1942 as a staging

SOURCE: 1991 AAA MAP OF NEW YORK

FIGURE 1-1. LOCATION OF HANCOCK FIELD, NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK area for warplanes during World War II. Much of the airbase, including the runways, was converted to civilian use as Syracuse Hancock International Airport. The 174th FW of the NYANG is bordered to the east and south by the town of Dewitt, to the north by the town of Cicero, to the west by the town of Salina, and to the northeast by Syracuse International Airport (see Figure 1-2). The facility encompasses 765 acres (SAIC, 1986) and is situated approximately 415 feet above sea level.

Several documents have discussed in detail background information pertaining to Hancock Field. Specifically:

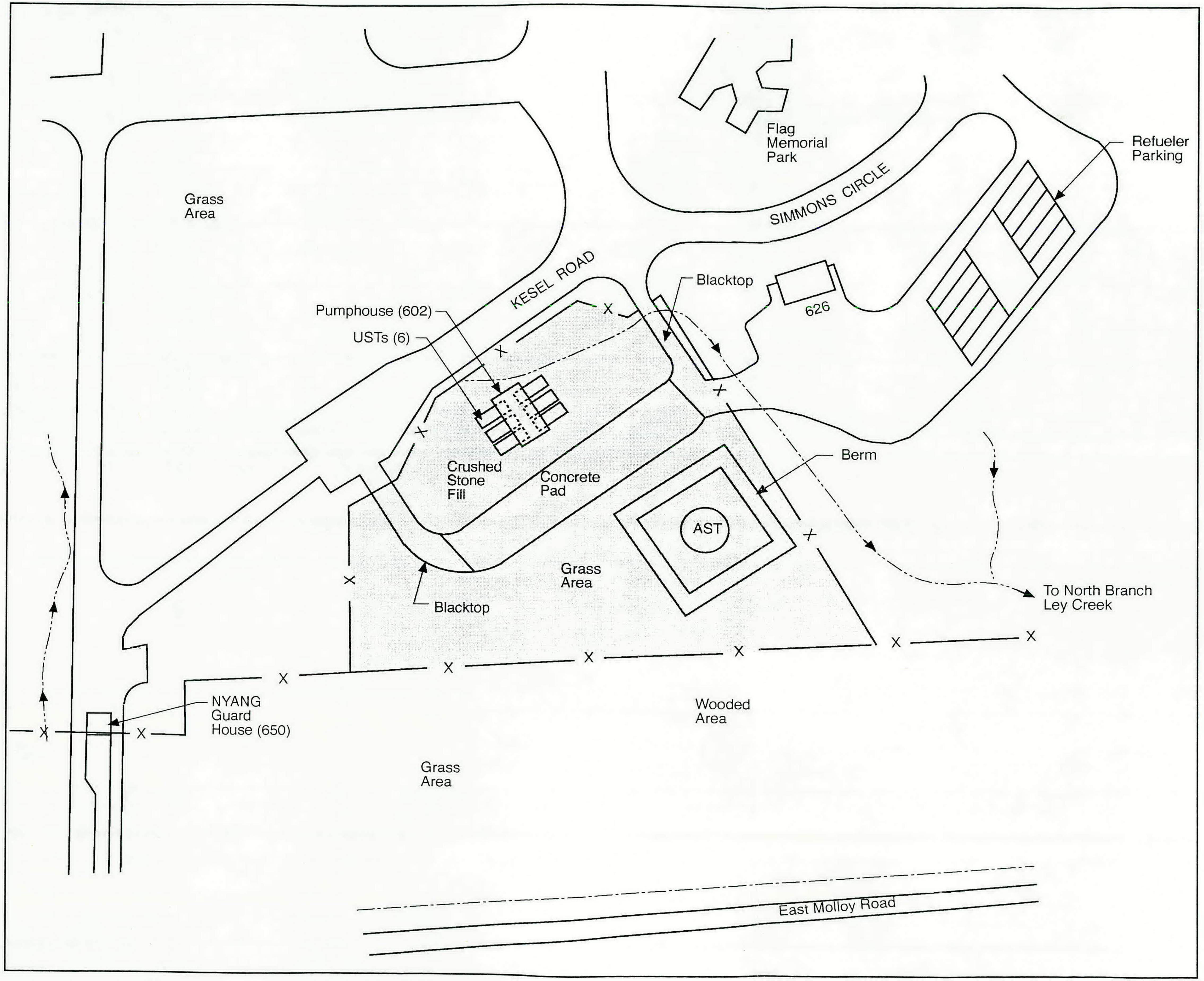
- The Site Investigation (SI) Management Work Plan (M&E, 1991), section 3.0, provides a description of the installation location and a brief description of each of the two sites under investigation, based on the information available prior to the Site Investigation.

- The SI Field Sampling Plan (M&E, 1991), section 2.0, contains a similar description as well as a summary of investigations conducted at the site prior to the M&E site investigation, and a discussion of the regional geology and hydrogeology.

- The SI Report (M&E, 1992) provides more detail as to the history of land use on both a regional and a site-specific basis. It also provides more detail as to the regional and site-specific geology and hydrogeology discussions.

- The SI Confirmatory Study Report (M&E, 1994), section 1.3.1, contains an overview of site background, similar to the one presented below, with all information available prior to the most recent study, conducted in late June and early July of 1994.

The POL Area consists of a number of tanks containing jet propellants within an area of 2.5 acres. The site includes one large above ground tank, six underground tanks which face into the fuel pumping building, a fuel pumping building, and systems for accepting fuel and delivering fuel to tanks. Figure 1-3 shows the existing above ground structures in the POL Area as well as six underground fuel storage tanks. Each of the six underground tanks are located partially under the pump building, with a pipe protruding above the ground surface outside of the building where the depth of the fuel in each tank is measured with a large dipstick.



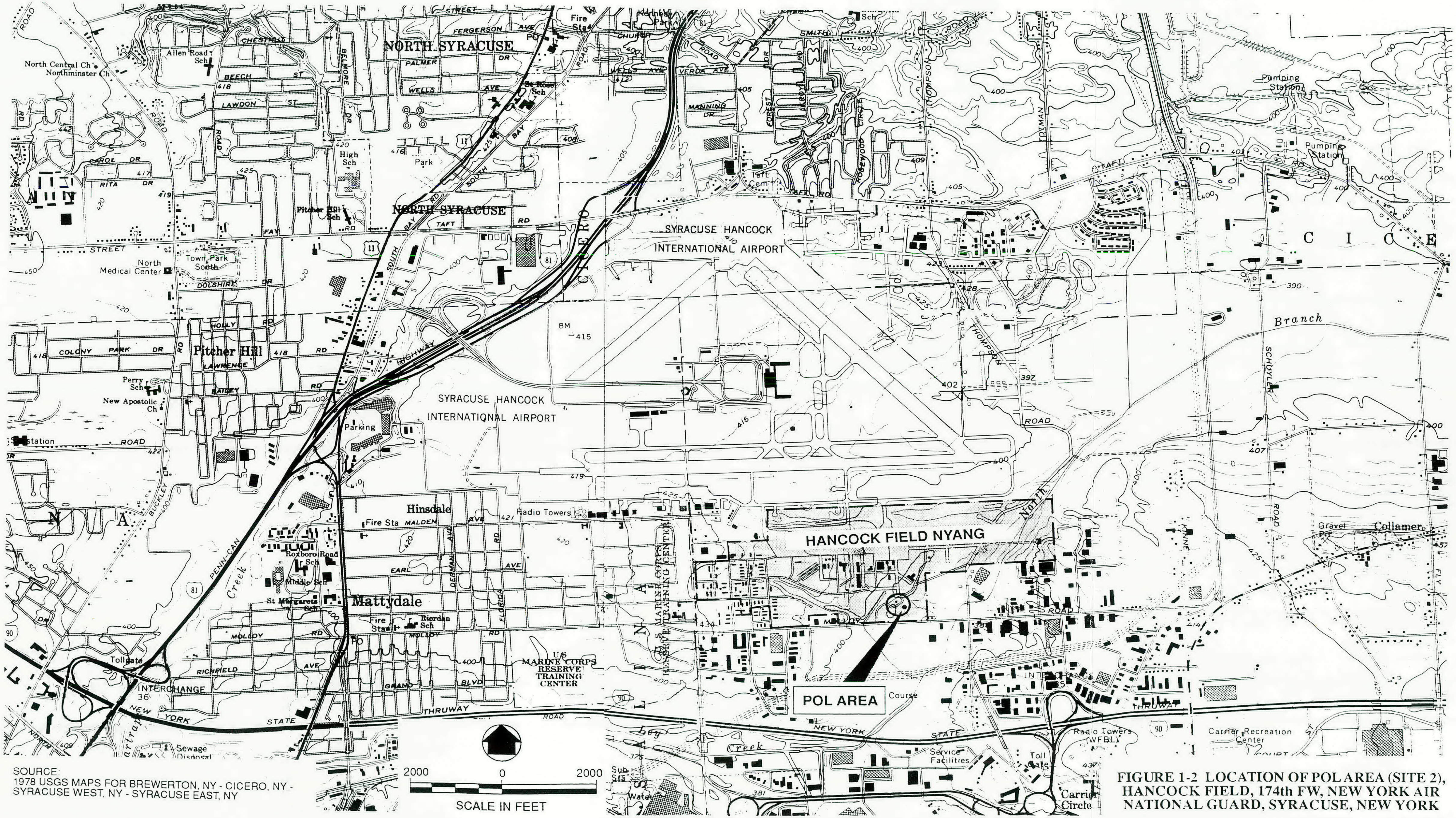
LEGEND

▨	POL Area (Site 2)
-·-·-▸-·-	Intermittent Drainage Ditch (⟶ Indicates Direction of Flow)
— X —	Fence
—·—·—	Existing Property Line
UST	25,000 Gal Underground Fuel Storage Tanks (ID # 021 Through 026)
AST	215,000 gal Aboveground Fuel Storage Tank (ID # 20001)
602	Building Number

100 0 100

SCALE IN FEET

FIGURE 1-3.
POL AREA, (SITE 2), HANCOCK FIELD, NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK



SOURCE:
1978 USGS MAPS FOR BREWERTON, NY - CICERO, NY - SYRACUSE WEST, NY - SYRACUSE EAST, NY

FIGURE 1-2 LOCATION OF POL AREA (SITE 2), HANCOCK FIELD, 174th FW, NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK

Three potentially significant spills have occurred in this area. The first was a release of PCBs, presumably from transformers at the southeast end of the fuel pump house, which occurred prior to the 1980s. The second was a release of an estimated 2,000 gallons of jet propellant inside the pump house in January 1990. Some of the released fuel reportedly flowed out of the doors of the building. The third and most recent spill occurred on June 12, 1994. Approximately 150 gallons of JP-8 was released from tanks located on the northeast side of the building.

The JP-4 spill of 1990 precipitated the installation of four monitoring wells in the area, and four sampling events, involving groundwater, pit wipes and samples from the pump house sump, and soil removed from the spill area. The results of these sampling events indicated the need for further investigation. Consequently, further investigation of the POL area, in the form of a Site Investigation (SI) was undertaken in the fall of 1990.

In November and December 1990, PCBs were detected in samples of seepage water taken from inside the pump house and in near-surface soil samples collected from soil borings in the vicinity of the pump house. In the seepage water, positive results were as high as 120 ppb for Aroclor-1260 and 15 ppb for Aroclor-1254. There were indications that PCBs were present beneath the pump house. Positive results for the subsurface soils ranged from non-detectable to 240,000 ppb for Aroclor-1260. Contamination was greatest at the area immediately south of the building and at the area to the west. The horizontal and vertical extent of the PCB contamination to the south and east of the pump house were not established, nor was the extent of the PCB-contaminated soil beneath the building determined. Dibutylphthalate was also detected in the soil sampling.

Also in 1990, samples of groundwater, seepage from a sump located in the pump house, surface water and sediment were analyzed for jet propellant contamination. Some samples of groundwater, sediment and sump water showed petroleum hydrocarbons consistent with a jet propellant source. No hydrocarbons were detected in the surface water. The results obtained from seepage water samples indicated that there were hydrocarbons beneath the pump house. Groundwater contamination was greatest (2.3 ppm total petroleum hydrocarbons (TPH) and 3,020 ppb total for benzene, toluene, ethylbenzene, and xylene (BTEX)) in MEMW-06, the monitoring well closest to, and down-gradient of the south side of the pump house. For the SI, the contemporary extent of the petroleum contamination in groundwater was defined and contamination was only detected as far south as MW-02 and MW-03.

Five discrete areas of potential residual contamination were initially identified. They are:

- Residual PCB below the depth previously excavated
- Residual jet propellant in soils in the vicinity of the pumping building
- Residual jet propellant in groundwater in the POL area
- Persistent presence of jet propellant in soil excavated from the POL area
- Residual PCB or jet propellant in the sump of the pumping building

In March of 1994, HAZWRAP directed M&E to conduct further sampling of the POL area in order to confirm the presence of contamination described in the SI report. The confirmatory study work was performed in late June and early July of 1994, and the presence of jet propellant components in the groundwater at the Petroleum, Oil, and Lubrication (POL) Area was confirmed. The presence of previously-identified PCBs in the area near the pump house was also confirmed. Although relatively insoluble, PCBs were detected in the groundwater from one monitoring well in the study area. Results from all previous studies are being used to guide this Remedial Investigation.

1.2 SCOPE OF WORK

The primary objective of the RI is to assess conditions at the POL Area and to evaluate the nature and extent of contamination at the site, in order to develop appropriate remedial actions. The data collected during the RI will be used for site characterization and human health risk assessment. The RI field investigation program has been designed to collect data to meet the RI objectives.

The field investigation program will include sampling and laboratory analysis of surface and subsurface soil, surface water, sediment, and groundwater. To summarize the scope of work for this remedial investigation, the following field activities will be conducted:

- Soil survey at forty (40) sampling points from 3 to 5 foot depth.
- Soil bore-hole sampling at 20 sampling locations. Eight (8) borings used to characterize PCB contamination will be advanced to two (2) feet above the water table. Ten (10) for characterizing jet propellant contamination, and two (2) for characterizing background concentrations will be advanced to the water table.
- Installation and development of four (4) or five (5) new monitoring wells one (1) replacement, 3 shallow, 1 deep optional)
- Collection of one round of groundwater samples
- Water level measurements
- In-situ permeability testing at all monitoring wells
- Collection of two (2) surface water and four (4) sediment samples
- Survey of all sampling locations and relevant site characteristics

A preliminary schedule for accomplishing the Remedial Investigation tasks is presented in Figure 5-1 of the Work Plan. The sampling schedule will be determined by the Contractor performing the work in consultation with HAZWRAP and NYANG.

2.0 FIELD OPERATIONS

This section presents the various field operations that will be used to collect data as part of the RI. Table 2-1 summarizes the field activities and intended objectives to be conducted during the RI. If however, data gaps arise during the RI activities, additional activities may be conducted.

2.1 SITE PREPARATION AND RESTORATION

A field office will be established to house the field sampling equipment and to operate as a field office from which field activities will be coordinated. Establishment of this field office will involve: selecting a location for staging the field office; site preparation (laying a crushed stone base and fencing, if necessary); setting up a field trailer; utility connections; and establishing areas for decon, office work, sampling preparation and equipment, and other worker-related facilities. Selection of the field office location will be chosen in coordination with HAZWRAP and the NYANG. A suggested location is presented in Figure 7-1 of the Health & Safety Plan. At the close of the RI effort, the field office and associated structures/materials will be removed and the area restored.

2.2 SOIL SURVEY

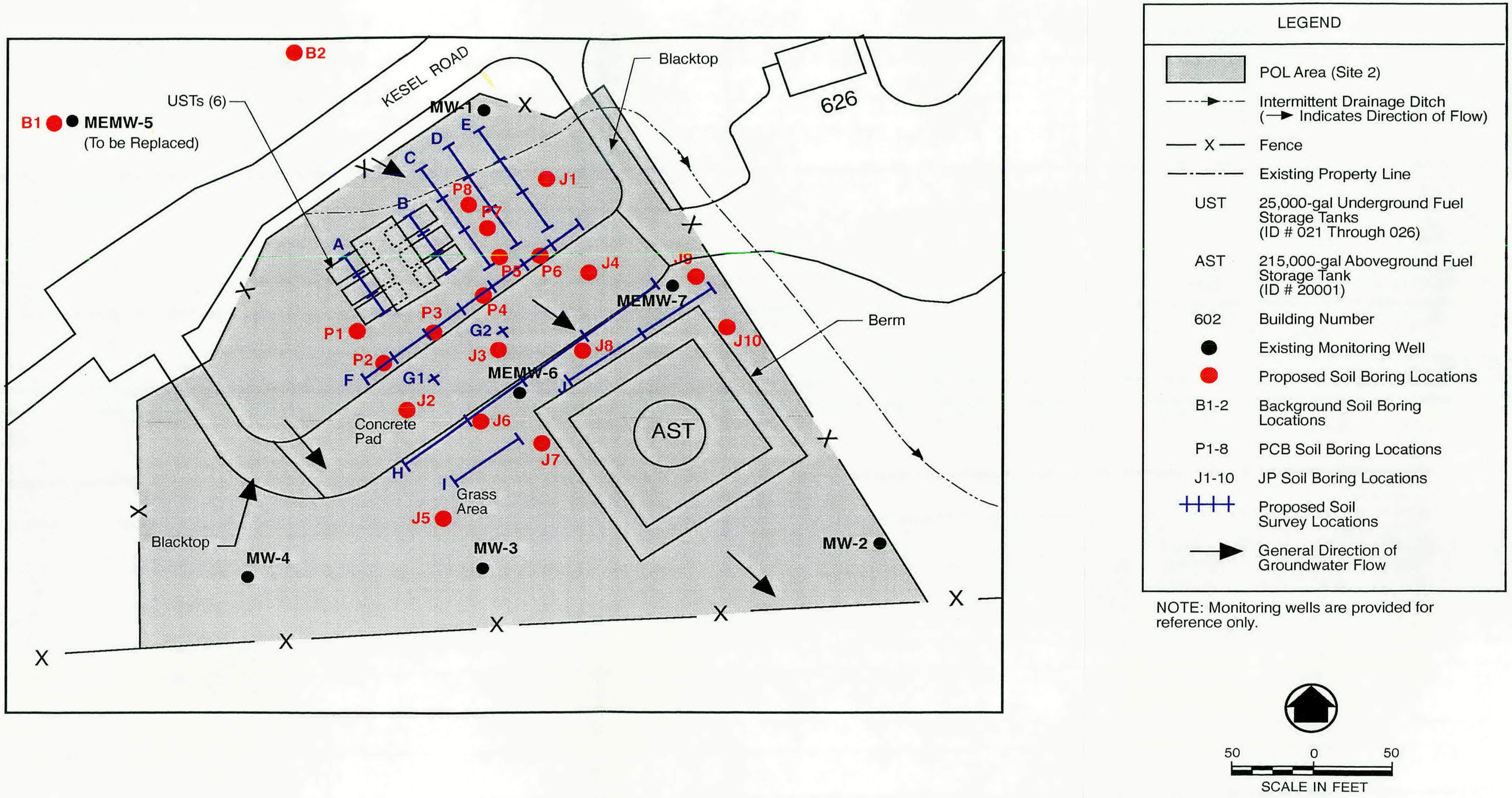
A soil survey will be conducted in the soil surrounding the pump house to aid in determining the extent of jet propellant contamination in this area. The soil survey will also aid in determining the placement of soil borings and monitoring wells to characterize the extent of contamination at the POL Area. Tentative sampling locations for the soil survey and soil borings are presented in Figure 2-1. Actual sampling locations will be dictated by the location of underground obstacles and the results obtained as the survey progresses.

TABLE 2-1. FIELD INVESTIGATION ACTIVITY SUMMARY

Activity	Purpose	Action
SOIL SURVEY	• to determine hot spots of jet propellant contamination to aid in selection of environmental sampling points	• conduct survey in source area
SOIL BORING SAMPLING	• to investigate subsurface PCB contamination	• collect and analyze boring soils from source area and analyze samples for PCBs using field and lab methods
	• to investigate subsurface soil jet propellant contamination	• collect and analyze boring soils from source area and analyze samples for jet propellant constituents using field and lab methods
	• to assess the potential ability of contaminants to migrate through the overburden soils	• collect and analyze selected soils for grain-size distribution, Atterburg limits (if appropriate), water content, unconfined compressive strength and organic content.
	• to investigate background levels of jet propellant contamination in subsurface soils	• collect and analyze boring soils from upgradient area and analyze samples for jet propellant constituents using lab methods
INSTALLATION OF MONITORING WELLS	• to better delineate extent of groundwater contamination	• install monitoring wells

TABLE 2-1 (Continued). FIELD INVESTIGATION ACTIVITY SUMMARY

Activity	Purpose	Action
	• to obtain information on background concentrations in GW	• replace MEMW-5
GROUNDWATER SAMPLING	• to determine background concentrations in groundwater	• collect and analyze groundwater from upgradient of source area
	• to determine extent of PCB and jet propellant contamination in groundwater	• collect and analyze groundwater from within and downgradient of the source area
	• to characterize groundwater for possible remediation	• analyze samples for metals, BOD, and TSS
	• to characterize aquifer for possible remediation	• conduct permeability tests
SURFACE WATER AND SEDIMENT SAMPLING	• to determine background concentration of surface water and sediment	• collect and analyze surface water and sediment samples upstream of the source area
	• to evaluate the type and extent of contamination in stream	• collect and analyze surface water and sediment samples downgradient from the source areas and compare to background levels



NOTE: Monitoring wells are provided for reference only.

FIGURE 2-1. RI SOIL INVESTIGATION SAMPLING LOCATIONS, POL AREA (SITE 2), 174th FW, HANCOCK FIELD, NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK

4041/jp

The Contractor will conduct a soil survey at forty (40) sampling points. Sampling equipment and sampling and decontamination procedures are addressed in the following section. The precise equipment and procedures used may vary, but must provide data of at least the quality as the procedures described.

During the last day of the planned forty (40) soil sampling points, the field crew will make a recommendation to the project manager regarding any need for additional soil sampling points. The Contractor Project Manager will then contact the HAZWRAP project manager. Additional sampling points will not be collected unless the HAZWRAP Project Manager approves their use.

2.2.1 Sampling Equipment and Procedures

The following equipment is listed as a guide for the field team, equivalent equipment may be substituted.

- Soil sampling apparatus - drill rig or geoprobe
- Photoionization detector (PID) - used in conjunction with the OVA for analysis of soil gas sampling points
- Isobutylene standard gas - used for calibrating a PID
- Other instrumentation and calibration materials - necessary for health and safety

The sampling procedure depends on the specific soil sampling apparatus used.

If a drilling rig and split spoons are used to collect the samples, then split spoons liners must be used for sample collection. If alternative sampling procedures are used their procedures must be developed by the sampling Contractor that minimize the disturbance of the samples collected for VOC analysis.

Soil Survey Sampling Procedures. The procedure described below is for the collection of subsurface soil samples from 3-5 feet to facilitate the placement of deeper soil samples.

1. Make a sketch of the sampling location.
2. Record the weather conditions and other notable site conditions. Photograph the sampling location (optional).
3. A split-spoon equipped with sand catchers (as needed) to minimize loss of sample and split-spoon liners will be used.
4. Auger or advance a pilot hole to a 3-foot depth. This is the beginning of the sampling depth.
5. Drive the split-spoon sampler 24 inches into the ground at the test site using a hammer falling approximately 30-inches. Record the blowcount required to drive the split-spoon sampler.
6. Withdraw the split-spoon from the bore hole.
7. After opening the split spoon, insert a stainless steel spatula between each liner and immediately scan the split-spoon sample for volatile organics with a PID. Record the PID measurements.
8. A sample for VOC screening should be collected from the part of the split-spoon with the highest PID readings.
9. Immediately label and log the sample into a bound field logbook. The samples should be placed on ice or into a refrigerator as soon as possible.
10. Record the physical characteristics of the unconsolidated material such as color, odor, and texture. Complete the soil boring log form presented in Section 5.
11. It will be necessary to drum all drill cuttings pending the results of the field and laboratory analysis. Each drum shall be clearly labeled with the contents and the source of the contents (e.g., soil-P1). All drill cuttings will become the property of NYANG. An attempt should be made to segregate contaminated and clean soils based on field screening results.

12. Grout each soil boring to the surface after the completion of the sampling.

13. Stake each soil boring location so that its location can be surveyed at a later time. Each location should also be measured from permanent fixed objects so that if the stake is lost the boring can be relocated prior to surveying.

Before sampling the next point, decontamination and/or quality control samples may be required as described in Sections 2.2.3 and 2.2.4.

Each of the monitoring instruments will be calibrated at least at the beginning and end of each day. Additional calibrations may be performed during the day as required. The calibration procedures will be conducted as per the operation manual included with that instrument and the procedures included in Appendix A. All calibrations and calibration checks will be recorded in the field logbooks.

Generally, the instrument calibration will be checked throughout the day to insure proper instrument response. The PID is calibrated to a isobutylene standard (100 ppm). These gases are purchased from the instrument manufacturer (HNu for the PID). Alternatively, calibration gases may be purchased from a specialty gas company such as Scott Specialty Gases or Alpha Gas.

2.2.2 Laboratory Analytical Samples

One VOC sample will be collected and submitted for laboratory analysis from a depth of 3 to 5 feet. Based on PID screening results and visual observations, one split-spoon liner segment will be capped and submitted for lab analysis. If PID screening and visual observations do not indicate one segment as being more contaminated than another, then the deepest split-spoon liner segment with full recovery should be selected.

2.2.3 Soil Survey Documentation

All soil survey results and procedures will be documented in the field either in field logbooks or on data forms. At a minimum the following information will be documented:

- weather and temperature
- refueling activities
- the time, sampling depth, results and location of every sample collected
- the time and results of all QC samples and calibrations
- any deviations from the FSP
- the type of equipment used for each sampling point
- decontamination performed on any of the sampling equipment
- any problems encountered when sampling

After completion of the soil survey, the Contractor will prepare a letter report summarizing its findings. A map of all the sampling locations and a table of all of the results will be included. The text of the report will discuss any significant deviations from the FSP and the results of quality control analysis. Recommendations for deep soil boring sampling locations will be included based on the results of the soil survey and the site history.

2.3 SOIL BORINGS

Soil borings will be performed with the intent of characterizing the extent and depth of PCB and jet propellant soil contamination over the area. With the use of a drilling rig, soil borings will be advanced by a qualified subcontractor in twenty (20) locations, with an option for six (6) additional borings. Eight (8) of the soil borings will be used for the characterization of PCB contaminated soil, ten (10) will be used to characterize jet propellant contaminated soil, and two (2) will be used to characterize background soil concentrations. The six (6) optional bore holes will only be used with the approval of the HAZWRAP project manager.

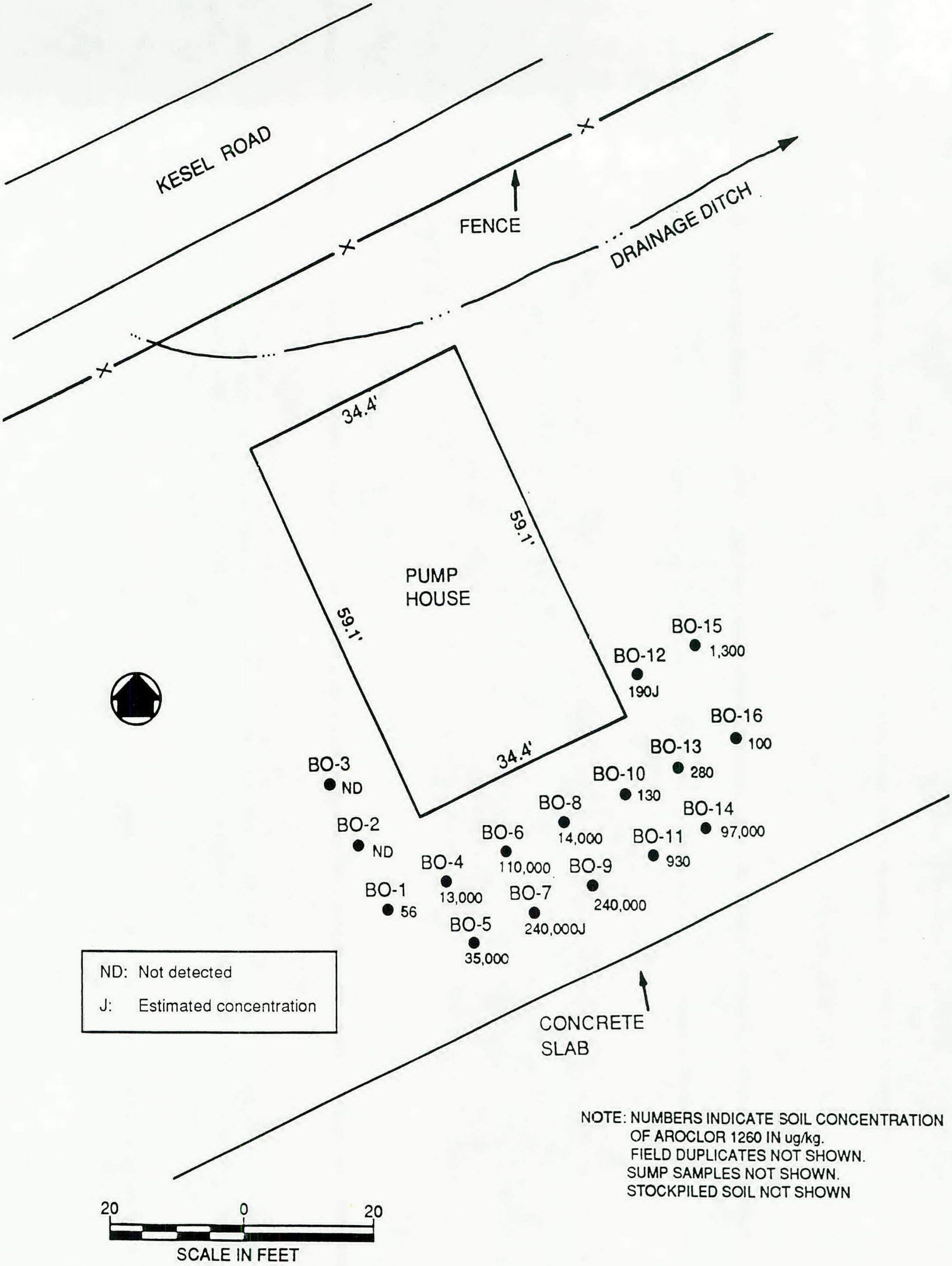
Continuous split-spoon sampling will be conducted at each location. PCB soil borings will be advanced to a depth approximately 2 feet above the water table. Jet propellant and background soil borings will be advanced to the water table at a depth of approximately twelve (12) feet.

Boring locations will be selected based on the results of the soil survey. Anticipated soil boring locations are presented in Figure 2-1 with the soil survey sampling locations. The precise locations will depend on the results of the soil survey, the results of previously sampled soil borings, and the location of aboveground and underground obstructions. Decisions about soil boring placement may be modified in the field depending on field screening results.

Prior to any invasive activities, the potential for encountering buried utilities, fuel pipelines, or other underground obstructions will be verified with DIGSAFE and the NYANG at Hancock Field. Specific boring locations will also be scanned with a metal detector. Soil borings will initially be advanced to the water table, approximately 12 feet below ground surface, using hollow stem augers. A drilling company will be subcontracted to perform the soil borings. Stainless-steel split-spoon liners will be used for the collection of all subsurface-soil samples for laboratory VOC analysis. Soil boring procedures are specified in greater detail below, for the specific objective identified.

2.3.1 PCB Soil Borings

To characterize the PCB contamination, EnSys© Immunoassay test kits for PCBs in soil will be used. Drilling will begin in an area of known PCB contamination. PCB results from the soil sampling conducted during the 1990s are presented in Figure 2-2 as a reference. As the bore hole advances, samples will be obtained and analyzed for PCB contamination with the test kits. Each boring will be advanced in depth until PCB concentrations fall below 1 ppm for two (2) consecutive depths. To ensure that PCB borings are not advanced to the depth of the groundwater table, running the risk of carrying PCB contamination from shallower depths



NOTE: NUMBERS INDICATE SOIL CONCENTRATION OF AROCLOR 1260 IN ug/kg.
FIELD DUPLICATES NOT SHOWN.
SUMP SAMPLES NOT SHOWN.
STOCKPILED SOIL NOT SHOWN

FIGURE 2-2. SOIL SAMPLING RESULTS, 1990 SI, POL AREA, (SITE 2), HANCOCK FIELD, 174th FW, NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK

into the groundwater, PCB soil borings will only be advanced to approximately 2 feet above the water table. Additional borings will be placed progressively further away from the source in every direction until the samples are below the established criteria for PCBs. Although Figure 2-1 shows the anticipated location of PCB soil borings, actual locations may be revised in the field depending on the presence of obstructions and the results of EnSys© test kit analysis.

Of the twenty (20) soil borings, eight (8) will be sampled and screened for PCBs. The depth of these bore holes is estimated to be approximately eight feet. One sample per every two feet of depth, four samples per bore hole, will be analyzed with the test kits. If the Contractor finds that the PCB contaminated soil does not extend to this depth, some of the eight (8) bore holes may be to a shallower depth.

The EnSys© Immunoassay test kits provide semi-quantitative results. Samples are compared to two concentrations, 1 ppm and 10 ppm, and results of above or below the concentration are provided. Immunoassay testing suffers from fewer interferences than other types of PCB test kits.

Up to three samples will be submitted from each PCB soil boring for laboratory analysis of PCBs. One sample will be collected from the surface interval. The two others will be selected depending on the results of the EnSys© test kits. One sample should be from a contaminated depth interval if one is found, and one should be from a depth that appears to be below the 1 ppm action limit. If no contamination is found or no clean interval is found, it is possible that only one or two samples could be submitted from a soil boring. These laboratory confirmation results will be used to verify the accuracy of the PCB test kits and to facilitate the delineation of the PCB contaminated soils.

2.3.1.1 Sampling Equipment and Procedures. The following equipment and procedures are intended as a guide for the field team. Any deviations from the following equipment and procedures must be justified and documented in the field log books. This procedure differs from the procedure presented in Section 2.3.2.1 for the collection of jet propellant soil boring in that stainless steel split-spoon liners are not required for the collection of the PCB soil samples. This is because samples from the PCB soil borings will not be analyzed for VOCs by a laboratory.

Soil Boring Sampling Equipment. This list of equipment is intended as a minimum list of equipment. Any equipment that may contact the sample must be decontaminated. Decontamination procedures are indicated in Section 2.10. Additional equipment may be useful depending on sampling conditions.

- Split-spoon sampler (3-inch diameter)
- Stainless steel trowel or spoons
- Stainless steel bowls
- Field screening sample containers. These include 40-ml vials for the volatile screening and 4-oz glass jars for the EnSys© Immunoassay PCB test kit screening. One of each container size is required per sampling depth.
- Laboratory sample containers as described in Section 3.1.1
- Field GC equipped with a photoionization detector (PID). A Photovac 10S series GC or equivalent should be used.

Soil Boring PCB-Sampling Procedures. The procedure described below is for the collection of subsurface soil samples to delineate the PCB contamination.

1. Make a sketch of the sampling location.
2. Record the weather conditions and other notable site conditions. Photograph the sampling location (optional).
3. A split-spoon equipped with sand catchers (as needed) to minimize loss of sample will be used.

4. Drive the split-spoon sampler 24 inches into the ground at the test site using a hammer falling approximately 30-inches. Record the blowcount required to drive the split-spoon sampler.

5. Withdraw the split-spoon from the bore hole.

6. Scan the split-spoon sample for volatile organics with a photoionization detector (PID).

7. A sample for VOC screening should be collected from the part of the split-spoon with the highest PID readings. Fill a 40-ml vial approximately one-half full for screening.

8. Place the remainder of the sample in a steel bowl and mix or composite the sample removing any cobble or rocks greater than 1/2 inch in diameter. Fill the appropriate sample container for laboratory analysis at least 3/4 full.

9. Immediately label and log the sample into a bound field logbook. A chain-of custody form will not be completed until after the sample is screened using the EnSys© Immunoassay test kits.

10. Record the physical characteristics of the unconsolidated material such as color, odor, and texture. Complete the soil boring log form presented in Section 5.

11. After the collection of each sampling depth it will be necessary to advance the bore hole to the beginning of the next sampling depth prior to collecting the next sample. This will be accomplished through the use of hollow-stem augers.

12. Repeat steps 4-11 as necessary to reach 2 feet above the water table, expected to be approximately 8 feet (the water table is expected to be between 10 and 12 feet). If after the completion of 2 or more borings it appears that the vertical extent of PCB contamination is less than 8 feet then samples only need to be collected to a depth that can be shown to be free (less than 1 ppm) of PCB contamination.

13. Following the collection of soil samples from each boring, screen the corresponding samples from each depth using both the field GC and the EnSys© Immunoassay test kits. Field analytical procedures are described in the next section. Samples for laboratory analysis should be selected both to confirm the results of the EnSys© Immunoassay test kits and to confirm that soil absent of PCB contamination has been

reached. The surface sample (0-2 feet) will always be submitted for laboratory analysis. If PCB contamination above the 1 ppm action level is detected, a sample should be submitted for laboratory analysis from the interval that appears to be highest. If it appears that one or more intervals below the contamination are clean (less than the 1 ppm action level), a sample should be submitted from the first clean interval below a contaminated depth interval.

14. After the sample containers are filled, make sure the appropriate sample labels are completed and the samples refrigerated or iced as necessary.

15. It will be necessary to drum all drill cuttings pending the results of the field and laboratory analysis. Each drum shall be clearly labeled with the contents and the source of the contents (e.g., soil-P1). All drill cuttings will become the property of NYANG. An attempt should be made to segregate contaminated and clean soils based on field screening results.

16. Grout each soil boring to the surface after the completion of the sampling.

17. Stake each soil boring location so that its location can be surveyed at a later time. Each location should also be measured from permanent fixed objects so that if the stake is lost the boring can be relocated prior to surveying.

2.3.1.2 Field Analytical Procedures. Field analysis, both by field GC and by EnSys© Immunoassay test kit, will be conducted on a sample from every soil boring sampling depth.

EnSys© Immunoassay Test-kit Procedure. The standard analytical methods for the analysis of EnSys© Immunoassay test kit samples are provided in Appendix C.

Field GC Analysis Procedure. Soil samples from each sampling depth will be analyzed using a field GC for jet propellant related contamination. This will consist primarily of analysis for BTEX compounds. The procedure to be used is based on the EPA Region I Volatile Field Screening Method for Aqueous Samples (see

Appendix B), and is presented in Appendix D. It has been modified to include the analysis of soil samples.

2.3.1.3 Laboratory Analytical Samples. From one to three samples will be submitted for laboratory analysis based on the results of EnSys© Immunoassay field screening. Samples for laboratory analysis should be selected both to confirm the results of the EnSys© Immunoassay test kits and to confirm that soil absent of PCB contamination has been reached. The surface sample (0-2 feet) will always be submitted for laboratory analysis. If PCB contamination above the 1 ppm action level is detected, a sample should be submitted for laboratory analysis from the interval that appears to be highest. If it appears that one or more intervals below the contamination are clean (less than the 1 ppm action level), a sample should be submitted from the first clean interval below a contaminated depth interval. The field team will document the rationale for the selection of each sample in the field logbook.

Further explanation of laboratory sampling parameters and handling procedures is provided in Section 3.

2.3.1.4 Geotechnical Testing of Soil Samples. Two soil samples total, from all of the PCB soil borings, will be tested for certain engineering properties. The samples will be selected based on lithologic character and will be spatially distributed evenly and also be representative of all stratigraphic horizons encountered in each area, whenever possible. Both of these samples will be tested to determine grain-size distribution, Atterburg limits (if appropriate), and water content. Geotechnical testing will be conducted by a qualified subcontractor.

2.3.2 Jet Propellant and Background Soil Borings

Since the procedures are similar for jet propellant and background soil borings, they are both discussed within this one section. Differences in the samples to be collected are presented in Sections 2.3.2.3 and 2.3.2.4. Screening for jet propellant contamination will be conducted by the Contractor in all borings using a gas chromatograph equipped with a photoionization detector (GC/PID) to quantitate BTEX compounds.

Subsequent to the completion of the eight (8) PCB borings, placement of ten (10) additional borings will be directed by field analysis for jet propellant contamination. Two (2) additional borings will also be used to characterize background conditions.

Samples will be collected at two-foot intervals to the water table Seven (7) sampling depths per bore hole are estimated. These samples will then be analyzed in the field by GC/PID using a head space screening technique. The GC/PID screening will provide concentrations and identification of specific BTEX compounds. Borings will be placed further away from the pump house until concentrations of BTEX are below established criteria. Borings placed to characterize background conditions will most likely be placed north of the POL area in an area not suspected to contain contamination. Figure 2-1 shows the anticipated locations of the jet propellant and background soil borings. Actual locations may be revised in the field depending on access and the results of EnSys© test kit analysis.

2.3.2.1 Sampling Equipment and Procedures. The following equipment and procedures are intended as a guide for the field team. Any deviations from the following equipment and procedures must be justified and documented in the field log books. This sampling procedure differs form the procedure presented in Section 2.3.1.1 in that stainless steel split-spoon liners are required for the collection of VOC samples for laboratory analysis.

> **Soil Boring Sampling Equipment.** This list of equipment is intended as a minimum list of equipment. Any equipment that will contact the samples must be decontaminated. Decontamination procedures are indicated in Section 2.10. Additional equipment may be useful depending on sampling conditions.

- Split-spoon sampler (3-inch diameter)
- Stainless steel split-spoon liners (four (4) 6-inch liners per sampling depth

- Stainless steel trowel, spatula or spoons

- Stainless steel bowls

- Field screening sample containers. These include 40-ml vials for the volatile screening and 4-oz glass jars for the EnSys© Immunoassay PCB test kit screening. One of each container size is required per sampling depth.

- Laboratory sample containers as described in Section 3.1.1

- Field GC equipped with a photoionization detector (PID). A Photovac 10S series GC or equivalent should be used.

Soil Boring Sampling Procedures. The procedure described below is for the collection of subsurface soil samples to delineate the jet propellant in soil contamination. It is similar to the PCB soil boring sampling procedure described previously except that a sample for laboratory VOC analysis must now be collected immediately and no sample needs to be collected for EnSys© Immunoassay PCB test-kit screening.

1. Make a sketch of the sampling location.

2. Record the weather conditions and other notable site conditions. Photograph the sampling location (optional).

3. Fit the split-spoon samplers with stainless steel split-spoon liners and sand catchers (as needed) to minimize loss of sample.

4. In accordance with ASTM D 1586 Standard Penetration Test, drive the split-spoon sampler 24 inches into the ground at the test site using a hammer falling approximately 30-inches. Record the blowcount required to drive the split-spoon sampler.

5. Withdraw the split-spoon and its contents from the bore hole.

6. After opening the ends of the split spoon, insert a stainless steel spatula between each liner and immediately scan the split-spoon sample for volatile organics with a photoionization detector (PID). Record the PID readings.

7. A sample for laboratory VOC analysis should be collected from the split-spoon liner segment with the highest PID readings. The liner

must be completely full. Immediately cap the liner segment by placing a piece of wide teflon tape over each end of the liner followed by a plastic cap. Two large rubber bands should be used to secure the plastic caps.

8. Fill a 40-ml vial approximately one-half full for field GC screening. This sample should be collected from the same area as the sample collected for laboratory VOC analysis.

9. Place the remainder of the sample in a steel bowl, cover with aluminum foil, and set aside until the samples for laboratory analysis have been determined.

10. Record the physical characteristics of the unconsolidated material such as color, odor, and texture. The soil boring log form included in Section 5 must also be completed.

11. Immediately label and log the sample into a bound field logbook. A chain-of custody form will not be completed until after the sample is screened using the field GC.

12. After the collection of each sampling depth it will be necessary to auger down to the beginning of the next sampling depth prior to collecting the next sample.

13. Repeat steps 3-12 as necessary to reach the water table expected to be approximately 10-12 feet.

14. Following the collection of soil samples from each depth, screen the corresponding samples using the field GC. Field analytical procedures are described in the next section.

15. Samples for laboratory analysis should be selected both to confirm the results of the field GC screening and to determine the extent of contamination. Mix the set-aside portion of each depth that has been selected for analysis. It may be necessary to composite two (2) or more depths to achieve enough sample volume for all of the analytical parameters. Section 3.0 indicates all of the analytical parameters and the required sampling containers. During mixing, remove any cobble or rocks greater than 1/2 inch in diameter. Fill the appropriate sample containers at least 3/4 full.

16. After the sample containers are filled, make sure the appropriate sample labels are completed and the samples refrigerated or iced as necessary.

17. It will be necessary to drum all drill cuttings pending the results of the field and laboratory analysis. Each drum shall be clearly labeled with the contents and the source of the contents (e.g., soil-P1).

2.3.2.2 Field Analytical Procedures. Soil samples from each sampling depth will be analyzed using a field GC for jet propellant related contamination. This will consist primarily of analysis for BTEX compounds. The procedure to be used is based on the EPA Region I Volatile Field Screening Method for Aqueous Samples (see Appendix B). The procedure the field team will use is presented in Appendix D. It has been modified to include the analysis of soil samples.

2.3.2.3 Laboratory Analytical Samples. Up to three (3) samples will be submitted for laboratory analysis from each of the soil borings. These include one near-surface sample, one sample just above the water table, and one optional sample. These samples will be selected on the basis of the field GC screening results, visual evidence of contamination (staining or discoloration), soil composition, and any odors that may be present. Only the surface sample and the sample at the water table will be submitted for laboratory analysis from the background soil borings. The field team will document the rationale for the selection of each sample in the field logbook.

All samples collected will be analyzed for volatile and semivolatile organics. Two PCB samples will be collected from each of the jet propellant soil borings. These will be from the surface and just above the water table. In addition, two (2) samples each from the five (5) most contaminated borings will be analyzed for total organic carbon (TOC). Further explanation of laboratory sampling parameters and handling procedures is provided in Section 3.

2.3.2.4 Geotechnical Testing of Soil Samples. One soil sample from each jet propellant bore hole will be tested for certain engineering properties. The samples will be selected based on lithologic character and will be spatially distributed evenly and also be representative of all stratigraphic horizons encountered in each area, whenever possible. Each of these samples will be tested to determine grain-size distribution, Atterburg limits (if appropriate), and water content. Geotechnical testing will be conducted by a subcontractor.

Two background soil samples will be analyzed from each of the background soil borings for volatile and semivolatile organics.

2.4 MONITORING WELL INSTALLATION

Four (4) new monitoring wells (including the replacement for MEMW-5) will be installed by a qualified subcontractor into shallow overburden. One (1) additional deep overburden well will be considered optional and will only be installed with the approval of the HAZWRAP project manager. These wells are intended to characterize the hydrogeology of the site and along with other existing wells establish the horizontal and vertical extent of the groundwater contamination.

2.4.1 Monitoring Well Locations

One shallow overburden monitoring well will be located to replace the former MEMW-5 monitoring well, to serve as the background location. Three additional shallow overburden wells will be located at or beyond the edge of the plume. The purpose of the wells is to define the edge of the plume in the upper portion of the aquifer. Previous groundwater sampling results are shown in Figure 2-3. Locations for new monitoring wells are tentatively identified in Figure 2-4. Placement of the monitoring wells will be dependent on obstacles, above and below ground, encountered in the field.

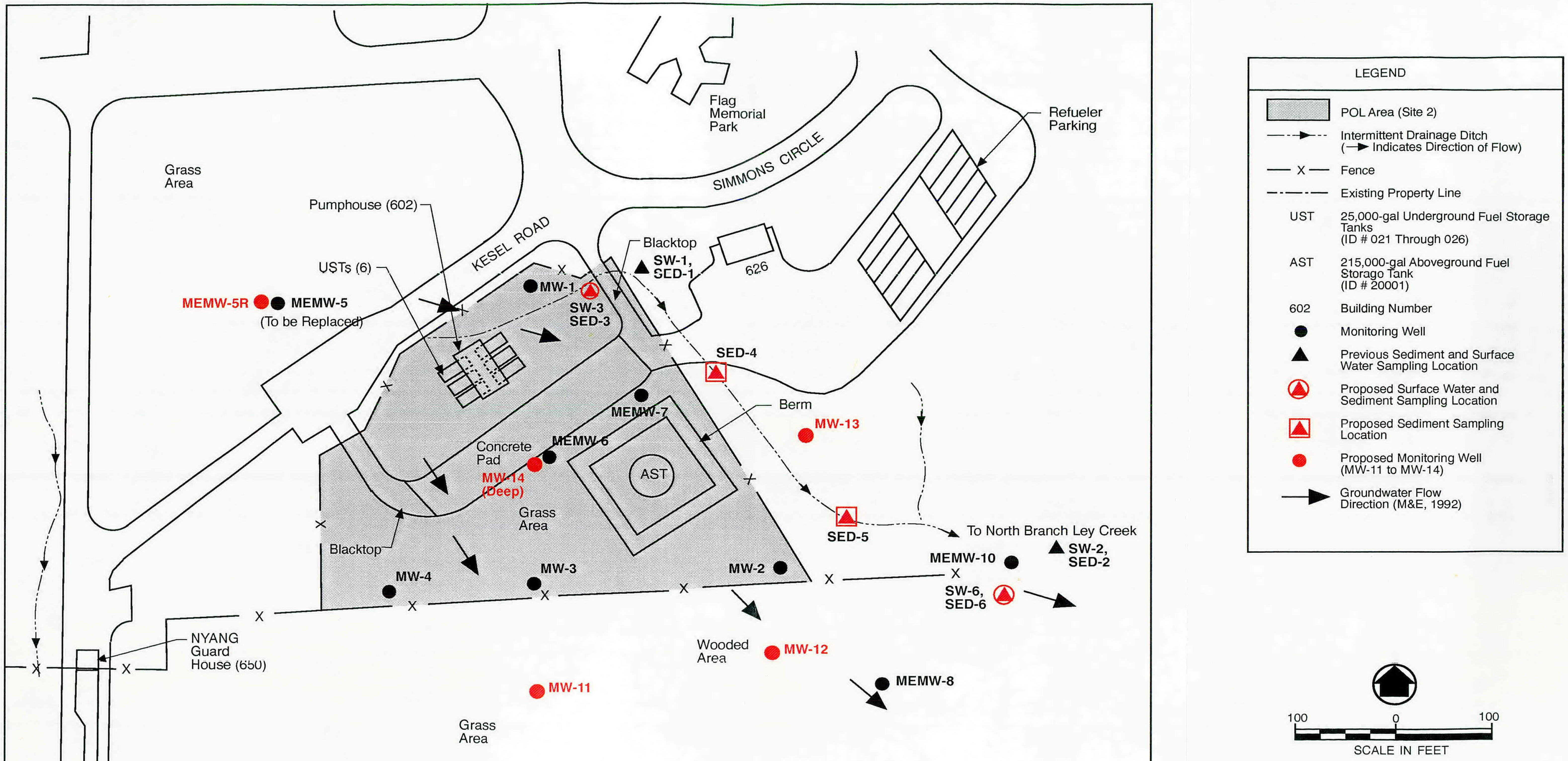


FIGURE 2-4. RI GROUNDWATER, SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS (SITE 2), POL AREA, HANCOCK FIELD, 174th FW NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK

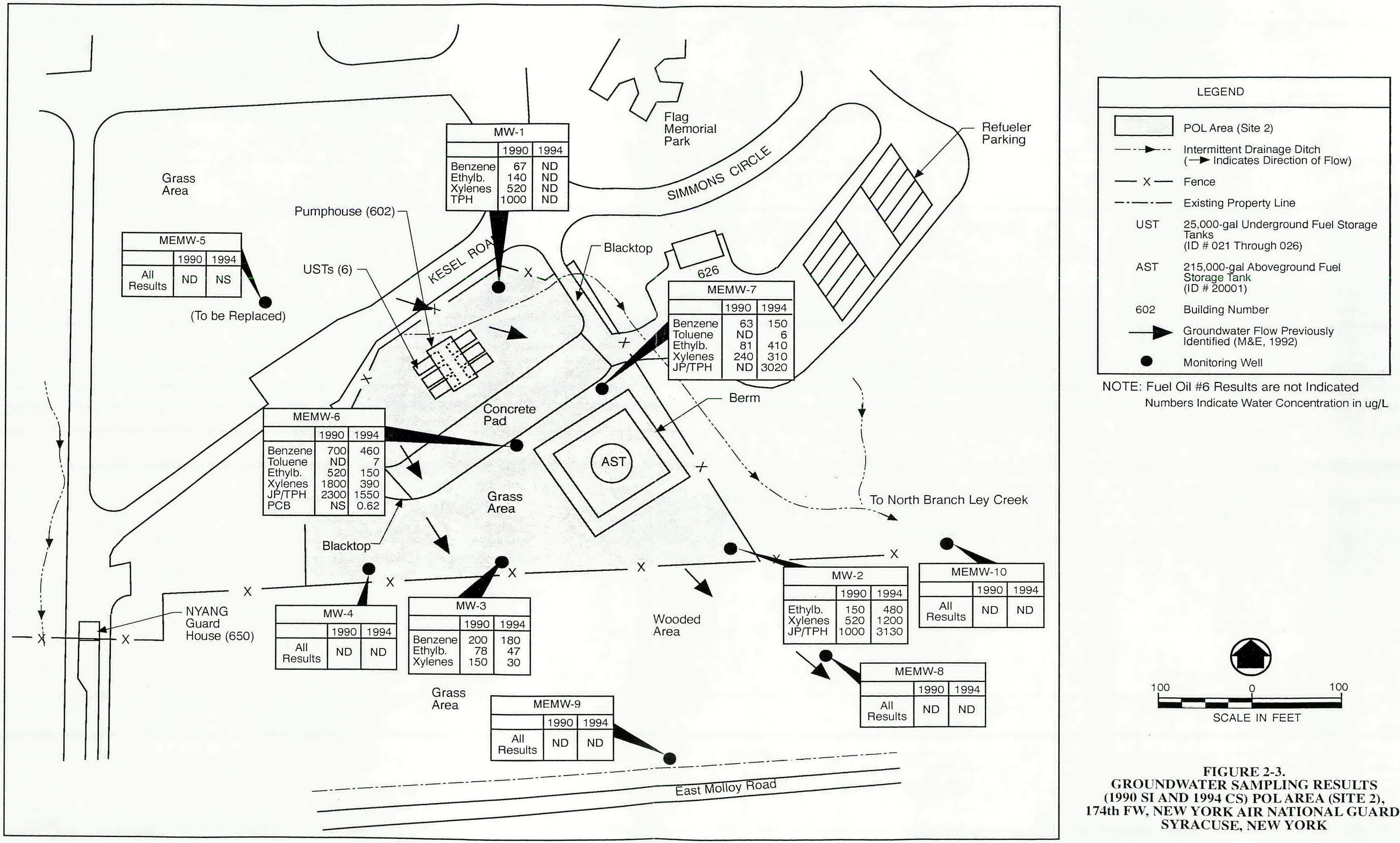


FIGURE 2-3.
GROUNDWATER SAMPLING RESULTS (1990 SI AND 1994 CS) POL AREA (SITE 2), 174th FW, NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK

2.4.1.1 Shallow Overburden Wells. Locations for the installation of three (3) new shallow overburden monitoring wells will be determined in cooperation with the HAZWRAP Project Manager. A fourth well will be used to replace the previous background well MEMW-5.

2.4.1.2 Optional Deep Overburden Wells. One (1) optional deep overburden monitoring well may be installed next to a shallow well to characterize water quality at depth and to determine vertical hydraulic gradients. The deep well would be drilled by the same methods as the shallow wells. The deep overburden monitoring well would be placed near shallow overburden wells located within the contaminant plume. The optional deep monitoring well will only be installed with the approval of the HAZWRAP project manager.

2.4.2 Well Installation

The monitoring wells will be constructed with 2-inch diameter PVC screen and casing in accordance with HAZWRAP SOP NO. 2 from DOE/HWP-100 or most recent update. The screen of each shallow well will be no longer than 10 feet. Since these wells will be constructed several hundred feet from the source of the contamination at or beyond the edge of the plume, it is possible that the plume will not occur at the water table. To determine the depth of the plume soil samples will be collected at 5-foot intervals below the water table using a split spoon sampler and screened using a field GC. The collection of these samples is discussed in Section 2.4.3 and the screening of the samples is described in Appendix D.

If the well is within the plume, the screen will be placed at the depth at which the plume is found based on the field GC screening. If the well is outside of the plume, the screen will be placed at the depth at which the plume was found in the nearest well.

Every attempt should be made to complete the drilling and sampling of the monitoring well bore holes using hollow-stem augers. However, previous drilling experience at this site has indicated that heaving sands are problematic when holes are advanced more than several feet below the water table with hollow stem augers. If heaving sands become a significant problem, the bore holes for the well installation will be drilled by driving and washing out 4-inch diameter casing. Water for the drilling will be taken from the public water system using a hydrant or spigot near the POL area. Drilling water will be recirculated to minimize waste.

The bore holes for the shallow monitoring wells will be advanced to a depth of about 15 feet below the water table, unless the results of the field screening sampling indicate that the plume is farther below the water table.

The thickness of the glaciofluvial deposits that overlie the thick till stratum is not known at this time. The deep overburden wells will be screened at the base of the glaciofluvial deposits or at a depth of 30 to 40 feet below the water table (whichever is shallower), unless screening of the soil samples during the drilling indicates that contaminants have migrated deeper into the groundwater system. The bore holes for the wells will be drilled with 4-inch diameter casing, since previous drilling at this site has shown that heaving sands are problematic when hollow stem augers are used.

The following is the general procedure that will be followed for the installation of all monitoring wells. Variations may be required by field conditions.

1. Advance the soil boring, collecting samples for field GC screening every 5 feet.
2. After the water table is encountered and the soil boring has reached a depth at which it is likely that the well screened will be placed, a tube sample must be collected for geotechnical analysis. If it is not possible to collect a sample using a sampling tube, then a sample may be collected using a split-spoon sampler.
3. Since field GC results will be used to decide the well screening depth, it is likely that the bore hole will be advanced to a depth greater that the desired bottom of the well screen. In this case, bentonite or grout will be used to fill in the bottom of the well. The exact procedure will depend on conditions encountered in the field. The procedure used will be documented by the field crew.

encountered in the field. The procedure used will be documented by the field crew.

4. Verify the bottom bore hole depth by measuring with a weighted fiberglass tape through the auger flights.

5. Monitoring well casing will consist of new, 2-inch diameter, Schedule 40 polyvinyl chloride (PVC). The well will be flush-threaded riser, screen and end cap; individual screen lengths of monitoring wells will not exceed 10 feet. The machined screen slots will be sized to retain at least 90 percent of the sand pack.

6. PVC casing will be suspended inside the augers and clean well-rounded silica sand added slowly as the auger flights are removed. Estimates of the volume of sand needed to raise the sand pack to 2 feet above the top of the screen and frequent tape checks will be made to avoid bridging and assure proper sand placement. The screen will be placed depending on the results of the field GC screening and conditions encountered in the field. The screen will be placed at the depth most suspected of containing contaminated groundwater.

7. Bentonite pellets will be added slowly after the sand pack has been placed. The bentonite pellet seal will form a barrier to keep the bentonite/cement grout from penetrating the sand pack. The pellet seal will be manually checked with a weighted tape to assure that a minimum two-feet seal exists. If the bentonite pellet seal is above the existing water table, clean potable water will be added to allow proper hydration. The bentonite pellet seal will be allowed to hydrate for 1-2 hours.

8. The bentonite/cement grout will consist of Portland Type I or II cement mixed with clean potable water and 2-5% by weight powdered bentonite. If the water table is above the top of the bentonite seal, the grout mixture will be pumped with a tremie pipe at the bottom. The grout mixture will be allowed to hydrate for a minimum of 24 hours before development to effectively seal the well.

9. A locking watertight cap and a traffic box or steel casing to prevent tampering by unauthorized personnel will be installed over the well immediately after well installation. All locking well caps will be supplied with keyed-alike locks. A minimum 6-inch thick concrete pad will be installed around the well head and raised slightly to drain surface runoff away from the wellhead.

10. Each well will be identified with a brass plate on the traffic box or steel casing. The individual well caps will also be marked.

11. If a steel casing is used in an area that is accessible to vehicular traffic guard posts will be installed to prevent damage by vehicles. As the wells with a traffic box will be mounted at or near ground surface, guard posts are not necessary.

12. A well completion log will be completed for each monitoring well installed (see Documentation, section 5.1.4, Figure 5-6 for a sample well completion log).

2.4.3 Sample Collection (Screening)

Soil samples will be collected at intervals of five (5) feet with split-spoon samplers. The samples will be taken from undisturbed soil below the auger or casing. The soil samples will be screened for the presence of jet propellant contamination with a field GC. The procedure for sample collection from the split-spoon is described in Section 2.3.1.1 and the screening of the soil samples is described in Appendix D. The sampling procedure should incorporate the following modifications:

- With the exception of geotechnical parameters, laboratory samples will not be submitted, thus it will not be necessary to collect samples for laboratory analysis.
- One geotechnical sample will be collected per monitoring well. If possible this sample will be selected from a depth that will include the well screened interval.
- Samples will be collected at 5-foot intervals to a depth of 25 feet which is below the water table.
- Because samples will not be collected for laboratory analysis of VOC samples it will not be necessary to use split-spoon liners.

2.4.4 Geotechnical Testing of Soil Samples

One soil sample from each bore hole will be tested for certain engineering properties. The samples will be selected based on lithologic character and will be spatially distributed evenly and also be representative of all stratigraphic horizons encountered in each area, whenever possible. Each of these samples will be tested to determine grain-size distribution, Atterburg limits (if appropriate), and water content. Geotechnical testing will be conducted by a subcontractor.

2.5 MONITORING WELL DEVELOPMENT

Following installation of each monitoring well, either the Contractor or the drilling subcontractor will develop the wells. The wells will be allowed to sit a minimum of 48 hours after hydration of the bentonite prior to well development. Well development water will be drummed and staged on-site at the Hancock Field NYANG Base until receipt of analytical data from the well(s). Treatment and discharge of the development and purge water is discussed in Section 2.11.2.

Well development will be continuously supervised by the Contractor field team. Development protocols are as follows:

1. Measure the static water level and total well depth.
2. Surge the well with a decontaminated surge block and/or bailer followed by removal of well water with a bailer or pump. Decontamination procedures are described in Section 2.10.2.
3. Well development should continue until 3 bore hole volumes (as required by NYSDEC) have been removed or until temperature, pH, and conductivity measurements have stabilized to within 10%.
4. Well development water will be contained. Refer to Section 2.11.2.3 regarding waste storage and disposal.
5. Physical characteristics such as color, odor, turbidity, the presence of separate phases, odors, etc. will be noted throughout well development operations. Also noted in the field notebook will be duration of different development methods (time spent bailing, pumping) and estimated quantities of water removed.

Slowly recharging wells will be developed as follows:

1. If possible, water will be removed from the well at a rate equal to or less than the recharge rate of the aquifer by use of a peristaltic pump, bailer or a bladder pump.
2. If the above technique is not possible, the well will be surged and pumped using a surging block or bailer in an effort to dislodge fine materials from the screen and sand pack.
3. If the slowly recharging well does not recover after being pumped or bailed to dryness to ninety percent of its static water level within six to eight hours, then the well should be bailed or pumped to dryness a second time at the end of eight (8) hours.
4. If the slowly recharging well recovers in less than six hours, the well should be purged until the pH, conductivity and temperature have stabilized to with 10%. The well may be repurged after the water level has recovered to 50% of its static water level. In this case an attempt will be made to remove at least one bore hole volume.

2.6 MONITORING WELL SAMPLING

Following the installation of the new monitoring wells, the Contractor will collect one (1) round of groundwater samples from all of the monitoring wells for laboratory analysis. This includes the nine (9) existing wells and all of the newly installed monitoring wells. Refer to Figure 2-4 for monitoring well locations. Any optional wells will also be sampled at this time if installed.

Groundwater samples will be collected a minimum of 48 hours after the development of the new monitoring wells. A summary of samples and analyses is presented in Section 3.3.1. Samples will be analyzed by a laboratory familiar with all of the analytical methods, HAZWRAP requirements, and approved by the State of New York.

Monitoring well purge water will be drummed and staged on-site at the Hancock Field NYANG Base until the completion of the in-situ permeability tests. At that time it will be treated, along with other purge and development water, and discharged.

2.6.1 Groundwater Sampling Equipment and Procedures

The equipment and procedures that follow are for the purging and sampling of each of the monitoring wells. Monitoring well development is covered in Section 2.6.

2.6.1.1 Sampling Equipment. The following equipment list is intended as a guide for the field team. All equipment that will contact the sample must be decontaminated as indicated in section 2.10. Additional equipment may be required depending on field conditions:

- Electronic water level indicator
- Oil-water interface probe
- Submersible pump that can be controlled to a low flow rate less than 1 L/minute.
- Generator or other AC power source for submersible pump.
- Calibrated bucket to measure purge water volume
- Sample containers as described in Section 3.1.1
- Required sample preservatives as described in Section 3.1.1
- Disposable cups for collection of field monitoring aliquots (i.e., pH, temperature, conductivity and turbidity)
- Thermometer, non-mercury
- pH meter
- Conductivity meter
- Turbidimeter

- Standard pH buffer solutions (pH 4.0, 7.0 and 10.0)
- Single use KCl conductivity calibration solutions
- Gelex secondary calibration standard solution for turbidimeter
- Photoionization Detector
- Calibration gas for photoionization detector

2.6.1.2 Sampling Procedure. The procedure described below is for purging and sampling of monitoring wells. Once three bore hole volumes have been purged and the turbidity, conductivity, temperature, and pH measurements have stabilized, then samples may be collected for all parameters directly from the pump outlet. The following describes the sampling procedure in greater detail.

1. Unlock the protective casing on the well or remove cap from road box.
2. Sample the air in the well head for organic vapors using a PID and record the measurements.
3. Using a decontaminated oil-water interface probe, check the well for the existence of any non-aqueous phase liquid (NAPL). Record the thickness of any layer. If a NAPL is encountered than the well should not be purged prior to sampling. A sample containing both the NAPL and the aqueous phase should be collected for VOC analysis. HAZWRAP should be contacted to authorize the analysis of additional samples.
4. Using a decontaminated electronic water level indicator, measure and record the static groundwater level in the well and the depth to the bottom of the well. Record the measurement from the water surface to the top of the well casing.
5. From the well diameter and the measured depth of the standing water, calculate (or use a well volume table to determine) the volume of standing water in the well. Note and record the volume on the well sampling worksheet. A well sampling worksheet is contained in Section 5, Documentation, as Figure 5-7.

6. Begin purging the well with a submersible pump. The pump should be placed approximately two feet above the bottom of the well. The purging rate should be adjusted to be the highest flow rate possible without purging the well dry.

   The water level should be monitored to insure that the water level does not drop below the pump level, as this may cause damage to the pump.

   When the purging rate has been modified so that the maximum flow rate is achieved without dropping the water level below the pump level then the length of time required to purge 3 bore hole volumes should be calculated. If the length of time required to purge 3 bore hole volumes is greater than 4 hours, then the well may be purged to the level of the pump, by increasing the flow rate. When the well has been allowed to recover to within 80% of its static water level, the well may be sampled.

   If the calculated purge time is less than 4 hours for 3 bore hole volumes, then continue purging until three bore-hole volumes have been withdrawn and instrument measurements have stabilized or purging has been performed continuously for 4 hours, which ever occurs first.

   Conductivity, temperature, pH and turbidity measurements should be made initially and after each 1/2 bore hole volume. After 3 bore hole volumes a sample may be collected provided that conductivity and temperature have stabilized to within 10%, pH to within 0.2 units and turbidity is less than 50 NTUs. If after 4 hours of purging measurements have not stabilized, then a sample can be collected.

7. To collect the sample the pump flow rate should be turned down to about 0.5 liters per minute. Slower flow rates may be used to collect VOC samples. If slow well recharge limits the amount of sample that can be collected, the order of sampling priority should be VOCs, PCBs, SVOCs, metals, TSS, TOC and BOD.

8. Fill the VOA vials completely so that there is no headspace or bubbles in the container. Immediately add 4 drops of HCl to the vial. If the sample bubbles or effervesces then discard the sample, recollect it and do not preserve. This must be noted on the chain-of-custody (COC) form and the sample must be analyzed within 7 days.

9. Collect a final groundwater aliquot and immediately transfer it to a disposable container for analysis of temperature, pH, conductivity, and turbidity. Record the results in the field logbook.

10. Immediately label and tag (as required); preserve if necessary; refrigerate/ice; and log the samples into a bound field logbook and complete the chain of custody form. Metals, TRPH and VOC samples must be preserved at the time of sample collection. Check the pH of the metals and TRPH samples to insure that the pH is less than 2.
11. Remeasure and record the standing water level in the well after sampling.
12. Replace the protective cap on the well and lock.

All purge water must be contained pending the results of laboratory analysis.

2.6.2 Laboratory Analytical Procedures

All groundwater samples will be analyzed for the following parameters: VOCs, SVOCs, and Pest/PCBs. In addition, samples from four (4) monitoring wells will also be analyzed for TAL metals, total suspended solids (TSS), and biological oxygen demand (BOD). This data will provide information necessary as to water quality for the selection and design of an effective groundwater treatment system. Therefore, samples analyzed for TAL metals, TSS, and BOD will be selected from wells that are expected to exhibit jet propellant contamination. Further explanation of laboratory sampling parameters and handling procedures is provided in Section 3.0 of this FSP.

2.7 SURFACE WATER AND SEDIMENT SAMPLING

Surface water and sediments will be sampled to support an assessment of human health risk and for comparison to ecological criteria. Refer to Figure 2-3 for proposed sampling locations. Two (2) surface water and four (4) sediment samples will be collected from the drainage ditch located to the east of the pump house. One sediment sample will be collected at each of the two surface water locations. One upstream and one downstream location will be selected for the surface water sampling. The other two (2) sediment samples will be collected in apparent areas of sedimentation. Surface water samples will only be collected if surface water is present during one of the two groundwater sampling events. Sediment samples will be collected even if no surface water is present. Surface water and sediment samples will be analyzed for VOCs, SVOCs and pest/PCBs.

2.7.1 Surface Water and Sediment Sampling Equipment and Procedures

Surface water samples should be collected prior to collection of sediment samples. The following equipment list is intended as a guide for the field team. Additional equipment may be required depending on field conditions:

Surface Water Sampling Equipment:

- Sample containers (see Section 3.1.1)
- Required sample preservatives (if sample containers do not contain preservatives, Section 3.1.1)
- Disposable polystyrene cups for collection of field monitoring aliquot
- pH meter
- Conductivity meter
- Thermometer
- Standard pH buffer solutions of pH 4.0, 7.0 and 10.0
- Single-use KCl conductivity calibration standard solutions
- Camera

Sediment Sampling Equipment:

- Stainless steel trowel, scoop, or hand auger
- Stainless steel spoons

- Sample containers (see Section 3.1.1)
- Stainless steel bowls

2.7.1.1 Surface Water Sampling Procedures. Two (2) samples shall be collected from the drainage ditch adjacent to the above ground storage tank in the POL Area. It is not anticipated that there will be any water flowing in the drainage ditch to be sampled. There may, however, be some standing water which, if present, should be sampled. To avoid sampling from stations downstream of disturbed stations, sample collection should start at the most downstream location and continue upstream. Samples should be collected while standing downstream of each sample collection point according to the following procedures:

1. Estimate the depth of water. (If a pole is to be used, wait to perform this task until after actual sampling to avoid water turbulence.)
2. Record the weather conditions and other on-site particulars.
3. Record the physical characteristics of the water body such as odor, color, temperature, pH, conductivity, presence of any dead vegetation and surface sheens, etc.
4. Make a sketch of the surface water boundaries and sampling location.
5. Photograph the sampling location and conditions.
6. Collect a sample by immersing the sample container in the water. Do not collect samples at the surface; instead, the sample container should be inverted, lowered to the approximately sampling depth, and held at about a 45-degree angle. If the surface water is a flowing stream, river, or brook, hold the sample container at about a 45-degree angle with the mouth of the bottle facing upstream.

   Samples collected for volatile organic analysis must contain no air bubbles in the VOA vial after it has been capped; ensure this by turning the vial upside down and tapping it lightly. Fill all other sample containers to the shoulder.

   If the water depth is not sufficient for the collection of the samples by submerging the sample bottles, a decontaminated stainless-steel ladle should be used for the collection of the sample. Decontamination procedures are listed in Section 2.10.2.

7. Collect a final sample aliquot in a disposable container and immediately measure and record the pH, temperature, and conductivity of that sample.

8. Immediately label and tag (as required); preserve if necessary; refrigerate/ice; and log the samples into the bound field logbook and complete the chain of custody form.

9. Calculate an estimate of the surface water flow (if any) from a measurement of the linear cross-section flow velocity (using a bobber and a stop watch) and an estimate of the flow volume's cross-sectional area.

2.7.1.2 Sediment Sampling Procedures. Four (4) sediment samples shall be collected from the drainage ditch adjacent to the above ground storage tank in the POL area beginning with the most downstream location. One (1) sediment sample will be collected at each of two (2) surface water sampling locations. In these locations, collect the surface water sample before the sediment sample. Two (2) other sediment samples will be collected in apparent areas of sedimentation. Sediment samples shall be collected according to the following procedure:

1. Record the physical characteristics of the drainage ditch and sediment such as color, odor, and texture.

2. Make a sketch of the drainage ditch water boundaries and sampling location.

3. Photograph the sampling location and conditions.

4. Wearing a new pair of PVC gloves, collect portions of sediment with a trowel, scoop or a hand auger. Transfer the samples into a decontaminated stainless-steel bowl. Decontamination procedures are indicated in Section 2.10.2.

5. VOC samples should be collected first. For sample volume being collected for VOC analysis, minimize any disturbance or mixing of the soil. Fill the container as completely as possible to minimize the air space.

   After VOC sample volume has been collected, the remaining sample volume may be mixed. Rock or pebbles greater than 1/2-inch diameter, roots, and vegetative material should be excluded from the sample. Fill the containers at least 3/4 full for all other analyses.

6. Record the physical characteristics of the sediment material such as color, odor, and texture. Complete the Soil/Sediment Sampling Data Form presented in Section 5 as Figure 5-4.

7. Immediately label and tag (as required), refrigerate/ice, and log the samples into the bound field logbook and complete the sample chain of custody form.

2.7.2 Laboratory Analytical Procedures

Sediment and surface water samples will be analyzed for VOCs, SVOCs and Pest/PCBs. A summary of the surface water and sediment samples to be collected for laboratory analysis, including QA/QC samples, appears in Section 3.3.

2.7.3 Documentation

A description of the documentation necessary during surface water and sediment sampling is presented in Section 5.0 of this document.

2.8 IN-SITU PERMEABILITY TESTING

Determination of in-situ permeability of the screened formation of all of the monitoring wells will be accomplished by the conductance of slug tests. The slug tests will be performed after the conclusion of the well sampling.

The slug test will be performed in accordance with the following protocol:

1. The static water level will be measured.

2. A solid slug of known volume will be instantaneously introduced into each well. This slug should be decontaminated like sampling equipment prior to use as indicated in Section 2.10.2.

3. Using an in-situ data logger and downhole pressure transducer, the recovery of the water level in each well will be measured and recorded with time until the water level reaches the previous static level (falling head)

4. The slug will be instantaneously removed and the recovery of the well recorded as described above (rising head)

5. If the water table is below the top of the screen, only slug removal will be performed (rising head)

6. The slug tests will be duplicated, if warranted by reviewing recovery data

7. If the volume of water displaced by the solid slug is insufficient in providing a recovered time acceptable for analysis, a larger volume of water may be withdrawn by the use of a bailer or pump (rising head)

The data will then be plotted on semi-logarithmic paper and analyzed using two of the following methods: Bouwer and Rice (1989); Cooper, Bredehoeft and Papadopalos (1967); or Hvorslev (1951).

2.9 SURVEY OF SAMPLING POINTS

A qualified surveyor under subcontract to the Contractor will survey sampling locations. This includes selected soil gas locations, all of the soil boring locations, new monitoring wells, and the surface water and sediment sampling locations, and additional points necessary for accurate representation of the site. Existing monitoring wells have been previously surveyed. Surveyed locations will be tied to existing control locations. All surveyed locations will have vertical and horizontal accuracies of 0.01 and 0.1 feet, respectively. All sampling and monitoring locations will be plotted on a base map. A Contractor team member will be on site while the subcontractor is on site.

2.10 EQUIPMENT DECONTAMINATION PROCEDURES

Proper decontamination is essential in minimizing the transfer of harmful materials into clean areas, in the prevention of cross-contamination between samples due to the use of improperly decontaminated field and sampling equipment, and in protecting workers from hazardous substances.

2.10.1 Non-Sampling Field Equipment

Non-sampling field equipment is any equipment that may potentially contact a sample area. All equipment and power tools used as non-sampling equipment (i.e., drilling equipment, well casings and screens, backhoes, dredges, augers, etc.) shall be decontaminated if necessary following usage, as well as prior to removal from the site. Large and heavy drilling equipment shall be steam cleaned. Light or small equipment such as hand tools shall be rinsed with tap water, scrubbed with a water/mild soap solution, and rinsed again with tap water, or shall be steam cleaned. All equipment decontamination shall be performed at a decontamination station specified in the site specific Health and Safety Plan. This type of decontamination is only necessary if the equipment becomes contaminated during use.

2.10.2 Sampling Equipment

Prior to field use, the cleaning procedures outlined in this section shall be used by the Contractor personnel for the cleaning of all sampling equipment that shall come in direct contact with the sample being collected. A sufficient amount of clean equipment and sample containers should, whenever possible, be transported to the project site to minimize the need for excessive cleaning of equipment in the field. Since off-site decontamination is not always possible, field cleaning procedures are outlined in the following sections. Table 2-2 can be used as a guide for typical items used during field decontamination. The effectiveness of the decontamination procedures is measured by the collection of equipment blanks. The collection and analysis of equipment blanks are described in Section 3.3.2.

2.10.2.1 Cleaning Materials. The equipment used throughout the cleaning procedures outlined in this plan may be dangerous if improperly handled. Caution must be exercised by all personnel and all applicable safety procedures must be followed. At a minimum, the following precautions shall be taken in the field during these cleaning operations:

- Safety glasses with splash shields or goggles, chemical-resistant gloves, and appropriate clothing must be worn during all cleaning operations.
- All solvent rinsing operations must be conducted under a fume hood or in the open - never in a closed room.
- No eating, smoking, drinking, chewing, or any other hand-to-mouth contact is permitted during cleaning operations.

The organic solvents, nitric acid solutions, laboratory detergent solutions, and rinse waters used to clean equipment shall not be reused. The cleaning materials are defined in the following paragraphs.

Phosphate-Free Laboratory Detergent: A standard brand of phosphate-free detergent such as Sparkleen®, Liquinox®, or Alconox® is used as the standard laboratory detergent for decontaminating field equipment. The use of any other detergent must be justified and documented in the field logbooks.

Nitric Acid Solution: When trace metal analysis is to be performed on a sample, a nitric acid solution is used for decontamination of sampling equipment involved in collection of this sample. The standard solution is made as a 1:10 dilution of ACS reagent-grade nitric acid in deionized water.

Pesticide-Grade Solvent: Pesticide-grade methanol is used as a standard cleaning solvent. Each lot of this reagent that is purchased must be analyzed to ensure that the methanol is free of contaminants that could interfere with site samples.

Tap Water: Tap water from any municipal potable water supply system may be used for initial rinsing of field equipment. An untreated or non-potable water supply is not an acceptable substitute for tap water.

TABLE 2-2. TYPICAL MATERIALS REQUIRED FOR EQUIPMENT DECONTAMINATION

Item	Usage Rate	Unit
Aluminum Foil	1/10 samples	100 sq ft
Bottle Brushes	2/crew	each
Equipment Decontamination Basin	2/site	each
Equipment Decontamination Brush	2/site	each
2.5 - 5 Gallon Carboy, Glass (DI Water)	1/20 samples	each
2.5 - 5 Gallon Carboy (Tap Water)	2/day	each
Non-Phosphate Laboratory Detergent, Liquid	1/crew/week	2 1/2 gal
Non-Phosphate Laboratory Detergent, Solid	1/crew/week	4 lbs
Organic Solvent (Pesticide Grade)	1/25 samples	1 gallon
Nitric Acid (Reagent Grade)	1/25 aqueous samples	1 pint
Personnel Decontamination Basin (for hands and face)	3/site	each
Personnel Decontamination Brush	3/site	each
Plastic Sheeting (250 sq ft/roll)	1/crew/week	1 roll
Polyethylene Wash Bottles	5/crew	1 pint
Tap Water	1/20 samples	5 gallons
Teflon Wash Bottles	6/crew	1 pint
Trash Bags (20/box)	1/crew	box
Trash Barrels	3/site	each
Type II Quality Deionized Water	1/20 samples	5 gallons

DIUF: Deionized ultra-filtered water shall be used for the final water rinsing of all field equipment. Other grades of reagent water may be used as required by the site-specific project plans. (Distilled water purchased from local supply stores or supermarkets is not considered adequate.) The field team shall retain the analytical data or manufacturer's certification which verifies the quality of the reagent water used by the field team.

Laboratory Pure Water: This water supplied by the subcontracted laboratory is deionized water that is then passed through a Millipore© filtration system to remove organic constituents. Laboratory pure water should contain no detectable amounts of pesticides, herbicides, and extractable organic compounds, and less than 20 μg/L of commonly used laboratory solvents. All other compounds should be below the detection limits as measured by a low level GC/MS analysis (typically 0.5 μg/L).

Brushes: The use of brushes with wire-wrapped bristle should be avoided due to contamination from the wire. Totally plastic brushes should be used, if possible. However, plastic brushes with wooden handles are acceptable.

2.10.2.2 Cleaning Procedures. Guidelines for routine decontamination of equipment used in the collection of samples at hazardous waste sites are outlined in the following sections. (Note: Rinse the sampling equipment thoroughly with tap water in the field as soon as possible after use to aid in the ease of future decontamination). Paint or coatings (e.g., rust) must be removed from any part of the equipment that may contact the sample.

Teflon, Polyethylene, and Glass Equipment:

1. Wash the equipment thoroughly with phosphate-free laboratory detergent and tap water. Use a brush to remove any particulate matter or surface film.[1]
2. Rinse the equipment thoroughly with tap water.
3. If the sampling equipment is being used to collect samples for trace metals analysis, rinse the equipment with a nitric acid solution.[2]

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[1] If the sampling equipment was used to collect samples that contained oil, grease, or other hard-to-remove materials, it may be necessary to rinse the equipment several times with pesticide-grade isopropanol to remove the materials and to steam clean the equipment prior to washing with the laboratory detergent solution. If the field equipment cannot be cleaned using these procedures, it should be properly discarded.

[2] Small and awkward equipment such as bottle-lid inserts and well bailers may be soaked in rather than rinsed with the nitric acid solution. Fresh nitric acid solution should be prepared for each cleaning session.

4. Rinse the equipment thoroughly with deionized water.
5. Rinse the equipment with pesticide-grade methanol and allow it to air dry.
6. Wrap the equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.

Stainless Steel Equipment:

1. Wash the equipment thoroughly with phosphate-free laboratory detergent and tap water. Use a brush to remove any particulate matter or surface film.
2. Rinse the equipment thoroughly with tap water.
3. Rinse the equipment thoroughly with deionized water.
4. Rinse the equipment with pesticide-grade methanol and allow it to air dry.
5. Wrap the equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.

Electronic Well Sounding Tapes and Measuring Tapes Used to Measure Groundwater Levels:

1. Wash the electronic well sounding tapes and/or measuring tapes with phosphate-free laboratory detergent and tap water.
2. Rinse the equipment thoroughly with tap water.
3. Rinse the equipment thoroughly with deionized water.
4. Place the equipment in a polyethylene bag or wrap it with aluminum foil to prevent contamination during storage and/or transport to the field.

2.10.3 Ice Chests and Shipping Containers

All ice chests and reusable shipping containers shall be washed on-site (interior and exterior) with phosphate-free laboratory detergent, rinsed with tap water, and air dried before storage. In the event that an ice chest or shipping container becomes severely contaminated with waste or other toxic material, it shall be cleaned as thoroughly as possible and disposed of properly.

2.10.4 Final Decontamination

Equipment that has been used to collect samples shall be decontaminated before it is returned from the field. At a minimum, this decontamination procedure shall consist of washing the equipment with a phosphate-free laboratory detergent solution and rinsing it with tap water.

Field or sampling equipment that requires repair shall be identified with a tag. Any problems encountered with the equipment during use as well as recommendations as to the needed repairs shall be noted on this tag. Field equipment or reusable sample containers requiring cleaning or repairs shall not be stored with decontaminated equipment, sample tubing, or sample containers.

2.10.5 Personnel Decontamination

Decontamination of personnel is described in Section 5.9 of the Hancock Field Health and Safety Plan.

2.10.6 Documentation of Decontamination

All decontamination procedures performed during the course of a field investigation must be documented in the site-specific field logbook. Any deviations from the standard decontamination protocols must be noted.

2.11 INVESTIGATION-DERIVED WASTE HANDLING PROCEDURES

Wastes derived from the RI field tasks are expected to include: soil cuttings from soil borings; water produced from equipment decontamination and monitoring well development and purging; and field clothes and assorted trash. Wastes generated during the RI will become the property of NYANG, who will be responsible for its proper disposal. The Contractor will supply NYANG with a description of the contents of drummed waste to facilitate NYANGs evaluation of disposal options. When an IDW is determined to be regulated as RCRA-hazardous, M&E will provide all information required to complete a manifest document.

2.11.1 Solid Waste

Soil cuttings, used PPE, field clothes, and trash are considered solid waste materials. The disposal of these materials is discussed below.

2.11.1.1 Soil Cuttings. Soil cuttings generated from soil borings and monitoring well installations will be containerized in DOT 17H drums pending determination of appropriate disposal methods. Containers used to collect the drill cuttings will be labeled as to the source of the cuttings and will become the property of NYANG.

2.11.1.2 Protective Clothing and General Trash. All solid waste such as discarded protective clothing and general trash will be handled as routine "non-hazardous waste" through the existing waste disposal mechanism at the base.

2.11.2 Liquid Wastes

Water generated on-site during equipment decontamination, monitoring well development water, and solvents used for equipment decontamination are considered liquid waste materials. The disposal of these materials is discussed below.

2.11.2.1 Decontamination Solvent Waste. All decontamination solvent wastes and acids such as isopropanol and nitric acid will be collected on-site. Containers used to collect waste solvents will be labeled by waste contents and become the property of NYANG.

2.11.2.2 Decontamination Rinse Water. All decontamination rinse water will be drummed pending receipt and subsequent review of laboratory data of environmental samples. Rinse water will only contain a small amount of soap such as ALCONOX and is not a regulated hazardous waste nor harmful to the environment. Drummed decontamination rinse waters will become the property of the NYANG.

2.11.2.3 Well Development Water. All well development and purge water will be allowed to recharge back into the aquifer from which it was drawn or, in the event the groundwater contains free product or exhibits a sheen, contained in DOT 17H drums. Any well development and purge water contained in drums will become the property of NYANG. Depending upon the results of field sampling, NYANG may either treat the waters as a hazardous waste or allow it to recharge back into the aquifer from which is came.

3.0 ENVIRONMENTAL SAMPLING FOR LABORATORY ANALYSIS

This section of the FSP provides detailed descriptions of the procedures to be used for environmental sample handling at the Hancock Field POL Area.

3.1 SAMPLE HANDLING

Sampling handling is an important part of the field investigation program since samples that are incorrectly handled can affect the quality of data. Sample handling begins at the collection of the samples and continues until the sample has been analyzed. Described in this section are sample preservation requirements for the samples, sample custody, and documentation protocols.

3.1.1 Sample Container, Preservation, and Holding Time Requirements

All samples shall be preserved immediately following collection. Table 3-1 summarizes the sampling parameters, containers, and preservation requirements for the aqueous and soil samples to be collected under the RI, based on the analytical methods being performed. Sample preservation for soil/sediment samples consists of refrigeration. Since various field conditions and components can affect the integrity of aqueous samples, the addition of chemical preservatives to achieve a specific pH, along with refrigeration, is necessary. The following procedures will be used for testing and preserving aqueous samples for volatile organics, metals, and TOC analyses. These procedures will also be applied to all aqueous QC samples that are generated in the field.

- **Volatile Organic Analyses.** To each sample vial, add 4 drops of 1:1 hydrochloric acid (HCl). If the sample bubbles or effervesces, discard the sample, draw a new sample and do not add any HCl preservative. This must be noted on the appropriate chain-of-custody form(s), and the sample(s) must be analyzed within 7 days.

TABLE 3-1. SAMPLING PARAMETERS, CONTAINERS, PRESERVATION AND HOLDING TIME FOR SAMPLES COLLECTED AT HANCOCK FIELD POL AREA

Parameter	Container	Preservative	Holding Time
SOILS/SEDIMENT			
Volatile Organic Compounds (VOCs)	Split-spoon liner (soil) 4 oz. glass with TEFLON®-lined lid (sediment)	Cool, 4°C	14 days TEFLON®-lined lid
Semivolatile Organic Compounds (SVOCs)	8 oz. glass with TEFLON®-lined lid(1)	Cool, 4°C	Extract within 14 days of sampling; analyze within 40 days
Pesticides and PCBs (P/PCBs)	8 oz. glass with TEFLON®-lined lid(1)	Cool, 4°C	Extract within 14 days of sampling; analyze within 40 days
Target Analyte List (TAL Metals)	8 oz. glass with TEFLON®-lined lid	Cool, 4°C	180 days for all metals but mercury; 28 days for mercury
Total Organic Carbon (TOC)	4 oz. glass with TEFLON®-lined lid	Cool, 4°C	28 days
Geotechnical Parameters	6-inch segment of split-spoon liner	Cool, 4°C	Not established by methods
Field PCB Analysis	4 oz. glass with TEFLON®-lined lid	Cool, 4°C	48 hours
Field GC Analysis	2 x 40 ml glass vial with TEFLON-lined lid(2)	Cool, 4°C	24 hours
Total Combustible Organics (TCO)	4 oz. glass with	Cool, 4°C	28 days TEFLON®-lined lid
AQUEOUS			
Volatile Organic Compounds (VOCs)	2 x 40 ml glass vial with TEFLON-lined lid	HCl to pH <2 Cool, 4°C	14 days
Semivolatile Organic Compounds (SVOCs)	2 x 1 liter amber glass with TEFLON-lined lid	Cool, 4°C	Extract within 7 days of sampling; analyze within 40 days
Pesticides and PCBs (P/PCBs)	2 x 1 liter amber glass with TEFLON-lined lid	Cool, 4°C	Extract within 7 days of sampling; analyze within 40 days
Target Analyte List (TAL) Metals	1 liter plastic with TEFLON-lined lid	HNO_3 to pH <2 Cool, 4°C	180 days for all metals but mercury; 28 days for mercury
Total Suspended Solids (TSS)	500 ml plastic with TEFLON-lined lid	Cool, 4°C	7 days
Biological Oxygen Demand (BOD)	1 liter plastic with TEFLON-lined lid	Cool, 4°C	48 hours
Total Organic Carbon (TOC)	125 ml glass with TEFLON-lined lid	H_2SO_4 or HCl to pH <2, Cool, 4°C	28 days

(1) Soil samples for these parameters can be collected into the same container for samples being analyzed for both parameters.

(2) Soil samples for field GC screening should only be filled half full.

- **Metal Analyses.** Aqueous samples for metals analyses are preserved to a pH of less than 2 with the addition of concentrated nitric acid (HNO_3). Preservation is performed following collection of the sample into the container. A few drops of acid (start with approximately 1 ml) are added into the sample container, the container is gently closed and gently agitated. To check the pH, a few drops of preserved sample are removed from the container and checked with pH test paper to ensure that pH is less than 2. This procedure is repeated until the sample reaches a pH of less than 2.

- **TOC Analyses.** Aqueous samples for TOC analysis are gradually preserved to a pH of less than 2 with the addition of sulfuric acid (H_2SO_4) or hydrochloric acid (HCl). Preservation is performed following collection of the sample into the container. A few drops of acid (start with approximately 1 ml) are added into the sample container, the container is gently closed and gently agitated. To check the pH, a few drops of preserved sample are removed from the container and checked with pH test paper to ensure that pH is less than 2. This procedure is repeated until the sample reaches a pH of less than 2.

3.1.2 Sample Custody Procedures

An overriding consideration essential for the validation of environmental measurement data is the necessity to demonstrate that samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Evidence of the sample traceability from collection to shipment, laboratory receipt, and laboratory custody (until proper sample disposal and the introduction of field investigation results as evidence in legal proceedings when pertinent) must be documented. A sample is considered to be in a person's custody if the sample is:

- In a person's actual possession
- In view after being in a person's possession
- Locked so that no one can tamper with it after having been in physical custody
- In a secured area, restricted to authorized personnel.

All sample bottles shall be maintained on-site in a locked storage area prior to use.

The field team leader is responsible for overseeing and supervising the implementation of proper sample custody procedures in the field. The field team leader is also designated as the field sample custodian and as such is responsible for ensuring sample custody until the samples have been transferred to a courier or directly to the laboratory.

Once the samples have been received by the laboratory, a designated person is responsible for maintaining a file of all the original documents (e.g., sample labels, chain of custody forms, custody seals, traffic reports. etc.) pertinent to sample custody and sample analysis protocol.

Sample chain of custody procedures are initiated in the field following sample collection. The procedures consist of: 1) preparing and attaching a unique sample label to each sample collected. 2) completing the chain of custody form, and 3) preparing and packing the samples for shipment. These procedures are further described in the following sections.

3.1.2.1 Sample Labels. Field personnel are responsible for uniquely identifying and labeling all samples collected during a field investigation. All labeling and tagging must be done in indelible/waterproof ink. Any errors are crossed out with a single line, dated, and initialled. Each sample label securely affixed to the appropriate sample container and sample tag attached to the neck of each sample container must contain the following information:

- Client/site name
- Unique project-specific sample identification number (i.e., station number)
- Sample location/description number
- Type of analysis to be performed and the name of the laboratory to whom the samples are being sent
- Sample volume, container type, and the type of chemical preservation used
- Sampling date and time

- Initials of the person obtaining the sample

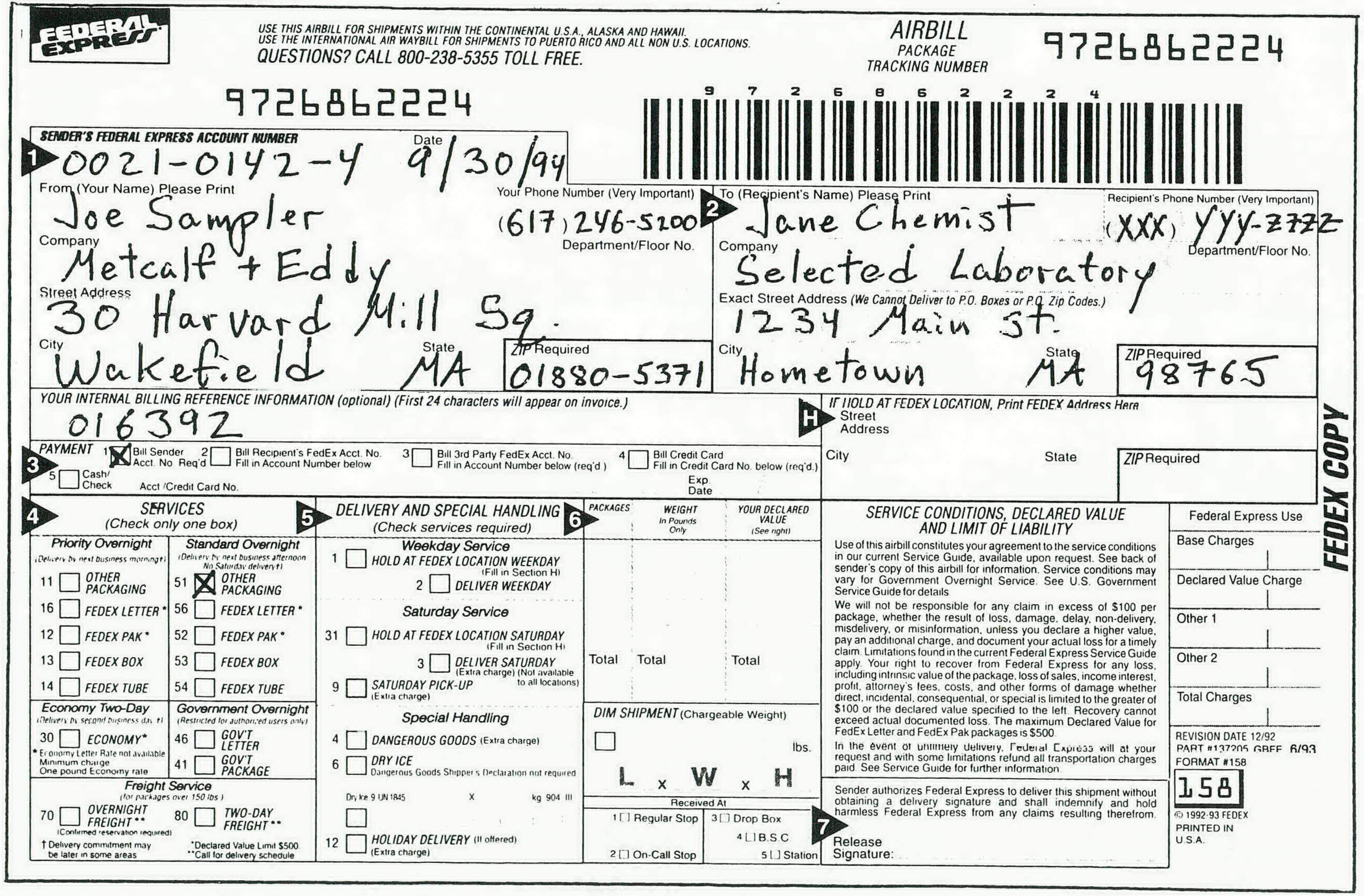
3.1.2.2 Chain-of-Custody Record. A chain-of-custody form (see section 5.1.5, Figure 5-8) must be completed for each sample set collected at a sampling location. The form is maintained as a record of sample collection, transfer, shipment, and receipt by the laboratory. The forms must also contain pertinent information concerning sampling location, date, and times; signatures of the sampling team members; types of samples collected along with a unique sample identification number; the number of samples collected and shipped for analysis in each lot; the project name and number; and the name of the laboratory to which the samples are being sent.

3.1.2.3 Sample Shipment/Transfer of Custody. Samples shall be accompanied by an approved and completed chain of custody form during each step of custody, transfer, and shipment. When physical possession of samples is transferred, both the individual relinquishing the samples and the individual receiving them shall sign, date, and record the time on the chain of custody form. In the case of sample shipment by an overnight courier, a properly prepared airbill (see Figure 3-1 for sample airbill) shall serve as an extension of the chain of custody form while the samples are in transit.

3.1.3 Sample Packaging and Preparation for Shipping

Following sample collection, all samples shall be brought to an on-site location for batching and paperwork checks. At this central location, like sample types are matched (i.e., solids, liquids, etc.) with similar sample types from all sample locations. Labels, tags (as required), and log information are checked to be sure there is no error in sample identification. The samples are packaged to prevent breakage and/or leakage, and the shipping containers are labeled in accordance with the DOT regulations for transport.

As soon as field personnel are ready to transport samples from the field to the laboratory, the laboratory shall be notified by telephone of the shipment along with the estimated time of



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Date: 9/30/94

From (Your Name) Please Print: Joe Sampler
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Company: Metcalf + Eddy
Department/Floor No.:
Street Address: 30 Harvard Mill Sq.
City: Wakefield
State: MA
ZIP Required: 01880-5371

2 To (Recipient's Name) Please Print: Jane Chemist
Recipient's Phone Number (Very Important): (XXX) YYY-ZZZZ
Company: Selected Laboratory
Department/Floor No.:
Exact Street Address (We Cannot Deliver to P.O. Boxes or P.O. Zip Codes.): 1234 Main St.
City: Hometown
State: MA
ZIP Required: 98765

YOUR INTERNAL BILLING REFERENCE INFORMATION (optional) (First 24 characters will appear on invoice.): 016392

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3 PAYMENT
1 ☒ Bill Sender Acct. No. Req'd
2 ☐ Bill Recipient's FedEx Acct. No. Fill in Account Number below
3 ☐ Bill 3rd Party FedEx Acct. No. Fill in Account Number below (req'd.)
4 ☐ Bill Credit Card Fill in Credit Card No. below (req'd.)
5 ☐ Cash/Check
Acct./Credit Card No.:
Exp. Date:

4 SERVICES (Check only one box)

Priority Overnight (Delivery by next business morning†)
11 ☐ OTHER PACKAGING
16 ☐ FEDEX LETTER*
12 ☐ FEDEX PAK*
13 ☐ FEDEX BOX
14 ☐ FEDEX TUBE

Standard Overnight (Delivery by next business afternoon No Saturday delivery†)
51 ☒ OTHER PACKAGING
56 ☐ FEDEX LETTER*
52 ☐ FEDEX PAK*
53 ☐ FEDEX BOX
54 ☐ FEDEX TUBE

Economy Two-Day (Delivery by second business day†)
30 ☐ ECONOMY*
* Economy Letter Rate not available
Minimum charge
One pound Economy rate

Government Overnight (Restricted for authorized users only)
46 ☐ GOV'T LETTER
41 ☐ GOV'T PACKAGE

Freight Service (for packages over 150 lbs.)
70 ☐ OVERNIGHT FREIGHT** (Confirmed reservation required)
80 ☐ TWO-DAY FREIGHT**

† Delivery commitment may be later in some areas
*Declared Value Limit $500
**Call for delivery schedule

5 DELIVERY AND SPECIAL HANDLING (Check services required)

Weekday Service
1 ☐ HOLD AT FEDEX LOCATION WEEKDAY (Fill in Section H)
2 ☐ DELIVER WEEKDAY

Saturday Service
31 ☐ HOLD AT FEDEX LOCATION SATURDAY (Fill in Section H)
3 ☐ DELIVER SATURDAY (Extra charge) (Not available to all locations)
9 ☐ SATURDAY PICK-UP (Extra charge)

Special Handling
4 ☐ DANGEROUS GOODS (Extra charge)
6 ☐ DRY ICE Dangerous Goods Shipper's Declaration not required
Dry Ice 9 UN 1845 X kg 904 III
☐
12 ☐ HOLIDAY DELIVERY (If offered) (Extra charge)

6

PACKAGES	WEIGHT In Pounds Only	YOUR DECLARED VALUE (See right)
Total	Total	Total

DIM SHIPMENT (Chargeable Weight)
☐ lbs.
L x W x H

Received At
1 ☐ Regular Stop
2 ☐ On-Call Stop
3 ☐ Drop Box
4 ☐ B.S.C.
5 ☐ Station

SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY

Use of this airbill constitutes your agreement to the service conditions in our current Service Guide, available upon request. See back of sender's copy of this airbill for information. Service conditions may vary for Government Overnight Service. See U.S. Government Service Guide for details.

We will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, non-delivery, misdelivery, or misinformation, unless you declare a higher value, pay an additional charge, and document your actual loss for a timely claim. Limitations found in the current Federal Express Service Guide apply. Your right to recover from Federal Express for any loss, including intrinsic value of the package, loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental, consequential, or special is limited to the greater of $100 or the declared value specified to the left. Recovery cannot exceed actual documented loss. The maximum Declared Value for FedEx Letter and FedEx Pak packages is $500.

In the event of untimely delivery, Federal Express will at your request and with some limitations refund all transportation charges paid. See Service Guide for further information.

Sender authorizes Federal Express to deliver this shipment without obtaining a delivery signature and shall indemnify and hold harmless Federal Express from any claims resulting therefrom.

7 Release Signature:

Federal Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 12/92
PART #137205 GBFE 6/93
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FIGURE 3-1. SAMPLE AIRBILL

arrival. All samples shall be shipped directly to the laboratory via overnight carrier. The field team shall determine whether it is best to directly transport the packages to the shipping office or to arrange for on-site pick-up. For each sample shipment to a specific subcontracting laboratory, an overnight airbill must be properly completed (see Figure 3-1, for a sample airbill). Unless field collected information indicates otherwise, all environmental samples collected shall be treated as non-hazardous aqueous liquids and non-hazardous soil.

Because of the expected non-hazardous nature of the collected samples, packaging and shipping criteria have been designed only to maintain chain of custody protocol as well as to prevent breakage of the sample containers. If the nature of the samples indicates that they may be hazardous, then additional packaging and labeling requirements will be necessary to comply with federal shipping regulations. The packaging and shipping procedures shall be as follows:

1. Place a layer of cushioning material (e.g., vermiculite) in the bottom of the watertight insulated metal or equivalent strength plastic shipping containers.
2. Wrap the properly labeled and secured glass sample bottles and purgeable vials with plastic bubble wrap. Place the wrapped containers into watertight zip lock bags and seal the bags closed.
3. Place sample bottles (top side up) into the shipping container arranging the bottles so that the glass bottles are surrounded by plastic bottles.
4. Using the necessary packing material, pack the sample bottles to ensure that they do not shift during transport.
5. Fill any void spaces of the shipping container, around and on top of the sample bottles, with ice cubes or chips sealed in plastic bags or with blue ice.
6. Seal the appropriate chain of custody form(s) in a zip-lock plastic bag, and tape it securely to the inside of the shipping container lid.
7. Close and lock/latch the shipping container. Seal the space between the container body and lid with waterproof tape. (If the shipping container used is

a picnic cooler, tape the drain plug closed to prevent any leakage of water as the ice packs melt during transport.)

8. Apply several wraps of chain of custody tape around the shipping containers perpendicular to the seal to ensure that the lid remains closed if the latch is accidentally released or damaged during shipment. Do not obscure any stickers or labels on the shipping container with the chain of custody tape.

9. Place a completed overnight carrier airbill on the lid of the shipping container. Include the name, address, and telephone number of the receiving laboratory and the return address and telephone number of the shipper on the airbill.

10. Place a "This End Up" label on the lid and on all four sides of the shipping container.

11. Each shipping container must not weigh more than 150 pounds if it is to be shipped overnight by Federal Express.

3.2 SAMPLE IDENTIFICATION

The establishment of a standard sample designation/labeling protocol is essential to ensure adequate quality assurance/quality control (QA/QC) in regards to the traceability of samples and their associated analytical data. Proper labeling allows for the tracking of samples beginning from the time of sample collection, through analysis, and following project completion should future data correlation be deemed necessary. The proper labeling of samples is also critical in ensuring that samples are analyzed within the required sample holding times.

All samples will be identified using a unique sample identification scheme suitable to the project and the sampling protocol. The numbering scheme will be devised by the field sampling team and approved by the project manager prior to sampling activities. The sample identification number will be recorded on the COC form accompanying each sample shipment submitted to the laboratory for analysis.

3.3 SUMMARY OF LABORATORY ANALYSES

The numbers and types of samples being collected for laboratory analysis are summarized in this section.

3.3.1 Field Samples by Matrix

The number of samples expected and the parameters being analyzed are summarized by media in Table 3-2. The associated QC samples that will also be collected are presented as well.

3.3.2 Field-Generated QA/QC Samples

During each sampling episode, a number of quality control (QC) samples must be collected and submitted for laboratory analysis. The number and frequency of the QC sample collection is determined by the individual project requirements and is detailed in the Quality Assurance Project Plan (QAPP) specific to this investigation. A list of the types of QC samples that shall be collected along with a brief description of each sample type is outlined in the following sections.

3.3.2.1 Trip Blanks. Trip blanks are collected for chemical analysis of volatile organics. The analytical results serve as a baseline measurement of volatile organic contamination that samples may be exposed to during transport and laboratory storage prior to analysis.

Trip blanks originate in the laboratory. They are comprised of organic-free ASTM Type II reagent water which is placed in sample containers by the subcontracting laboratory, transported to the sample collection site, handled along with the samples, and returned to the laboratory along with samples of water and/or soil collected for volatile organic analysis. The trip blank containers are <u>not</u> to be opened in the field.

TABLE 3–2A. FIELD SAMPLES GENERATED BY MATRIX: SOIL INVESTIGATION

22–Jun–95

PARAMETER	METHOD	NUMBER OF BOREHOLES	SAMPLES PER BOREHOLE(7)	NUMBER OF SAMPLES	QUALITY CONTROL SAMPLES					TOTAL SAMPLES(6)
					MS/MSD(1)	FIELD DUP(2)	TRIP BLANK(3)	EQUIP. BL.(2)	FIELD BL.(4)	
SOIL SURVEY										
Soil Samples										
VOCs	CLP	40	1	40	6	2	4	2	2	56
Optional Soil Samples (8)										
VOCs	CLP	20	1	20	4	1	2	1		28
PCB BORINGS										
Soil Samples										
Pest/PCBs	CLP	8	2–3	22	4	2		2	2	32
Geotechnical Parameters(5)	ASTM	2	1	2						2
JP–RELATED BORINGS										
Soil Samples										
Pest/PCBs	CLP	10	2	20	4	3		3		30
VOCs	CLP	10	2–3	28	4	3	4	3	2	44
SVOCs	CLP	10	2–3	28	4	3		3	2	40
TOC	EPA 415.1	5	2–3	10	2	1		1	2	16
Geotechnical Parameters(5)	ASTM	5	1	5						5
BACKGROUND BORINGS										
Soil Samples										
VOCs	CLP	2	2	4		1	1	1		7
SVOCs	CLP	2	2	4		1		1		6
OPTIONAL BORINGS (8)										
Soil Samples										
Pest/PCBs	CLP	6	2	12	2	2		2		18
VOCs	CLP	6	2–3	17	2	1	2	1		23
SVOCs	CLP	6	2–3	17	2	1		1		21
Geotechnical Parameters(5)	ASTM	6	0	0						0
TOTAL ANALYTICAL (7)				156	24	16	9	16	10	231
OPT. ANALYTICAL				66	10	5	4	5	0	90
TOTAL GEOTECH. (7)				7	0	0	0	0	0	7
OPT. GEOTECHNICAL				0	0	0	0	0	0	0

NOTES:

(1) – Each MS/MSD is indicated as two samples. Additional volume is not required for soil MS/MSD analysis.
(2) – Equipment blanks and field duplicates must be collected at a 10% frequency for each matrix sampled. Equip. blanks are aqueous samples.
(3) – Aqueous samples. A trip blank must be included for each cooler containing volatile samples shipped to the laboratory.
(4) – Aqueous samples. A field blank must be collected for each source of decontamination water used. Both tap water and the DIUF water will be analyzed.
(5) – Geotechnical parameters will include: grain size (D422), moisture content (D2216), and Atterburg limits (D4318).
(6) – Sample total includes soil and aqueous samples.
(7) – In some cases, 3 samples will be taken, rather than 2, based on field screening results (it is assumed that this will happen 75% of the time).
(8) – Optional samples will only be analyzed with the approval of HAZWRAP. If the optional samples are collected during a different field mobilization, additional QC samples may be necessary.

TABLE 3–2B. FIELD SAMPLES GENERATED BY MATRIX: GROUNDWATER INVESTIGATION

22–Jun–95

PARAMETER	METHOD	NO. OF WELLS SAMPLED	SAMPLE FREQUENCY	NO. OF SAMPLES	QUALITY CONTROL SAMPLES MS/MSD(1)	FIELD DUP(2)	TRIP BLANK(3)	EQUIP. BL.(2)	FIELD BL.(4)	TOTAL SAMPLES
GROUNDWATER INVESTIGATION										
Aqueous Samples										
VOCs	low level CLP	13	each well	13	4	2	5	2	2	28
SVOCs	low level CLP	13	each well	13	2	2		2	2	21
Pest/PCBs	CLP(8)	13	each well	13	2	2		2	2	21
TAL Metals (total)	CLP	4	contam. wells(6)	4	2	1		1	2	10
TSS	EPA 160.2	4	contam. wells(6)	4	2	1		1	2	10
BOD	EPA 405.1	4	contam. wells(6)	4	2	1		1	2	10
Soil Samples										
Geotechnical Testing	ASTM	4	each new well	4						5
Optional Aqueous Samples(5)										
VOCs	low level CLP	1	each well	1			1			2
SVOCs	low level CLP	1	each well	1						1
Pest/PCBs	CLP(8)	1	each well	1						1
TAL Metals (total)	CLP	1	each well	1						1
TSS	EPA 160.2	1	each well	1						1
BOD	EPA 405.1	1	each well	1						1
Optional Soil Samples										
Geotechnical Testing	ASTM	1	each new well	1						1
TOTAL ANALYTICAL(7)				51	14	9	5	9	12	100
OPT. ANALYTICAL				6	0	0	1	0	0	7
TOTAL GEOTECHNICAL				4	0	0	0	0	0	5
OPT. GEOTECHNICAL(7)				1	0	0	0	0	0	1

NOTES:

(1) – Each MS/MSD is indicated as two samples. One additional sample volume is required for each of the MS and MSD analysis of aqueous samples. Thus, aqueous samples for MS/MSD analysis must be collected in triple volume.

(2) – Equipment blanks and field duplicates must be collected at a 10% frequency. Equipment blanks must also be collected for each type of sampling equipment.

(3) – A trip blank must be included for each cooler containing volatile samples shipped to the laboratory. (Assume 1 cooler/day, 10–day sampling period.)

(4) – A field blank must be collected for each source of decontamination water used. Both tap water and the DIUF water will be analyzed.

(5) –The optional samples will only be collected if the optional well is approved by HAZRAP for installation and installed. QC samples for this optional well are included with those for the other definate wells.

(6) – Contaminated wells scheduled for sampling for these parameters are: MW–2; MW–3; MW–4; MEMW–6; and MEMW–7.

(7) – Optional items not included.

(8) – The CLP method will be modified so that the sample extract is concentrated to a final extract of 1 ml rather than 10 ml as specified by the method.

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TABLE 3–2C. FIELD SAMPLES GENERATED BY MATRIX: SURFACE WATER / SOIL

22–Jun–95

PARAMETER	METHOD	NUMBER OF SAMPLES	QUALITY CONTROL SAMPLES					TOTAL SAMPLES(6)
			MS/MSD(1)	FIELD DUP(2)	TRIP BLANK(3)	EQUIP. BL.(2)	FIELD BL.(4)	
SEDIMENT								
Soil Samples								
VOCs	CLP	4	2	1	1(5)	1(5)	2(5)	11
Pest/PCBs	CLP	4	2	1		1(5)	2(5)	10
TAL Metals (total)	CLP	4	2	1		1(5)	2(5)	10
SURFACE WATER								
Aqueous Samples								
VOCs	low level CLP	2	2	1	1	1	2	9
Pest/PCBs	CLP	2	2	1		1	2	8
TAL Metals (total)	CLP	2	2	1		1	2	8
TOTAL SEDIMENT		12	6	3	1	3	6	31
TOTAL SW		6	6	3	1	3	6	25

NOTES:

(1) – Each MS/MSD is indicated as two samples. Additional sample volume is not required of the sediment samples. One additional sample volume is required for both the MS and MSD analysis of aqueous samples. Thus, aqueous MS/MSD analysis requires the submittal of triple sample volume.

(2) – Equipment blanks and field duplicates must be collected at a 10% frequency. Equipment blanks must also be collected for each type of sampling equipment.

(3) – A trip blank must be included for each cooler containing volatile samples shipped to the laboratory. (assume 1 cooler/day & 10 days.)

(4) – A field blank must be collected for each source of decontamination water used. Both tap water and the DIUF water will be analyzed.

(5) – These QC samples are aqueous.

(6) – Sample total includes soil and aqueous samples.

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Typically, one trip blank is included in each shipping container for volatile organics analysis, is stored in the laboratory with the samples, and is analyzed by the laboratory (for volatile organics only).

3.3.2.2 Equipment Blanks. Equipment blanks are collected for each piece of sampling equipment used in the collection of samples when devices other than the sample bottle itself are required. The analysis of these blanks serves to verify the cleanliness of the sampling equipment.

Equipment blanks are comprised of deionized water used to decontaminate the drilling and sampling equipment. This water is transferred to the sample bottle, and returned to the laboratory for analysis. The equipment blanks are analyzed for the same parameters as the associated samples.

One equipment blank shall be collected per ten field samples taken with each set of sampling equipment.

3.3.2.3 Source Blanks. Source blanks are collected for each type of water used to decontaminate drilling and sampling equipment. A minimum of two samples (one tap and one deionized water sample) shall be submitted for complete analysis of project-specified analytes.

3.3.2.4 Field Duplicates. Field duplicates are defined as two samples collected independently of each other at a sampling location during a single episode of sampling. Analysis of these duplicates provides statistical information relating to sample variability and serves as a check on the precision of any sample collection method as it pertains to the sampled area.

Ten percent of all samples will be collected in duplicate and submitted for laboratory analysis. Field duplicates shall be labeled in such a manner so that persons performing laboratory analyses are not able to distinguish duplicates from other collected samples.

3.3.2.5 Matrix Spike and Matrix Spike Duplicate. One matrix spike (MS) and matrix spike duplicate (MSD) shall be submitted for each group of twenty samples submitted to the laboratory for organic analysis per matrix. Aqueous MS/MSD analysis requires that the sample be submitted with triple volume. Soil MS/MSD analysis does not require additional volume but must be indicated on the chain-of-custody form.

Inorganic analysis uses a matrix spike sample and a laboratory duplicate. No MSD analysis is conducted. The same additional volume requirement applies to the inorganic matrix spike sample. These must also be specified on the COC form.

The sample selected for MS/MSD or MS and duplicate analysis should be generally representative of the group of samples with which it is submitted. It should not be a sample that is likely to be highly contaminated, a field duplicate, or a blank.

4.0 FIELD MEASUREMENTS

Table 4-1 summarizes parameters to be measures in the field; equipment that will be used for the measurements; equipment calibration; equipment maintenance procedures and schedules; and equipment decontamination.

TABLE 4-1. FIELD INSTRUMENTATION - PREVENTATIVE MAINTENANCE, CALIBRATION AND DOCUMENTATION.

Instrument	Preventative Maintenance	Maintenance Frequency	Calibration Frequency	Documentation	Reference
pH Meter	Electrolytes Checked Electronics checked Check Batteries	Daily Daily Daily	Twice per day (minimum)	Field Logbook	Manufacturers' Manual and SOP presented in Appendix A
Conductivity Meter	Check Probe Check Batteries	Daily Daily	Twice per Day (minimum)	Field Logbook	Manufacturers' Manual and SOP presented in Appendix A
Thermometer	Inspect for cracks or damage	Daily	Not Performed	Field Logbook	None
Turbidity Meter	Check light source Clean sample tubes Check batteries	Daily With each use Daily	Daily	Field logbook	Manufacturers' Manual
Photoionization Detector	Clean UV Lamp and ion Chamber Replace Lamp Check Batteries	Weekly As necessary Daily	Twice per Day (minimum)	Field logbook	Manufacturers' Manual and SOP presented in Appendix A
Organic Vapor Analyzer	Check Hydrogen Tank Check Instrument Response	Throughout the day Throughout the day	Twice per Day (minimum)	Field Logbook	Manufacturers' Manual and SOP presented in Appendix A
Field Gas Chromatograph	Clean UV Lamp and ion Chamber Replace Lamp Check Batteries Check Calibration Responses, Retention Times and Peak Shapes	Weekly As necessary Daily With each Calibration	Twice per day or every ten samples.	Field Logbook	Manufacturers' Manual and SOP presented in Appendix A

5.0 DOCUMENTATION

All sampling procedures, instrument calibration, and information pertinent to sampling conditions, progress, and field data collection must be documented following a prescribed set of guidelines. The documentation serves as a permanent and traceable record of all activities related to a specific field investigation project. The record must be legible and accessible to allow ease in verifying sampling activities and addressing future questions which may arise concerning such issues as sample integrity, sample traceability, etc.

The following section serves as a guideline for the types of documentation that are required for the remedial investigation at the 174th FW, Hancock Field NYANG.

5.1 RECORD KEEPING

All documentation must be recorded in permanent ink. Corrections to errors in documentation or recorded calculations will be made by first striking out the error with a single line so as not to obliterate the original entry. Then the replacement entry or value will be inserted where appropriate. The person originating the change will initial each separate change. All revisions, deletions, and changes must be made in indelible ink. The use of white-out is not permissible.

The field team leader has the responsibility to maintain the daily field documents pertaining to sample identification and control. Special emphasis is placed on the logbook completeness and accuracy. Field logbooks, field data forms, CLP tracking forms, and chain of custody forms must contain entries made with indelible ink and that are dated, signed, and contain statements that are legible, accurate, and inclusive documentation of project activities. The daily log will contain a diary of all pertinent project activities. Entries into the log typically include weather conditions, samples collected, and difficulties encountered and how such difficulties were resolved. Because the logbook, field data forms, and chain of custody forms provide the basis for future reports, they must contain accurate facts and observations. Language must be objective, factual, and free of personal interpretations or other terminology that may prove inappropriate. Objectives to ensure valid data collection are listed in Table 5-1.

5.1.1 Field Logbooks

A field logbooks shall be maintained by the field investigation team. Logbooks shall be comprised of bound books with consecutively numbered pages; no pages must be skipped when filling in the logbooks. The integrity of field documentation is further ensured by the use of field logbooks containing paper treated to repel the rain or any other aqueous splashings experienced during field documentation. Should more than one field logbook be required, they shall be numbered sequentially.

The front of each field logbook shall contain the following information:

- Project name and number
- Name of the contract under which the investigation is being conducted
- Date(s) of use

The field logbook shall contain a diary of all pertinent project activities. Standard information recorded in the field logbook includes: general observations made in the field, identification and calibration of instruments used, and field data. See Figure 5-1 for an example of typical information that may be included at the beginning of each field logbook. Figures 5-2, 5-3, and 5-4 serve as guidelines for field logbook data entries for various sample collection procedures.

One master site log book will be maintained that will keep track of the activities performed on site each day. This will include general information for the entire site. Additional field logbooks will be used as required for individual tasks. Some tasks such as the soil borings will require the use of more than one logbook. A geologist will document the progress of the soil boring and drilling activities while a chemist will document the field screening of samples in a

TABLE 5-1. FIELD SAMPLING TEAM DOCUMENTATION OBJECTIVES TO ENSURE VALID DATA COLLECTION

Objective	Action	Responsible Person
Verify sample and location information conforms to conditions and requirements specified	Review labeled samples and in-process samples using daily sample inventory	Field sampling team
Verify incoming field data and sample completeness	Maintain daily count of incomplete items	Field sampling team
Verify completeness of field log books	Review daily	Field team leader (or designee)
Review field calibration criteria and record test calibration acceptance	Perform as necessary	Field team leader (or designee)
Ensure all data forms are properly completed	Review and check off during each sample collection	Field team leader (or designee)
Verify all field generated QC samples were collected as required	Review requirements and confirm sample collection	Field team leader (or designee)

separate logbook. The use of all logbooks will be documented in the master logbook for the site.

Daily documentation in field logs shall include at a minimum:

- Date and time of personnel entries on-site, weather conditions, temperature
- List of start and stop times of all subcontractors hired for activities such as drilling, steam cleaning, well development

FIGURE 5-1. FIELD LOGBOOK INITIAL FIELD INFORMATION

Instrument Calibration

Include a brief description of the calibration procedures used for each instrument utilized in the field and the designated pages on which daily calibration entries are made. The field instruments may include:

- HNu photoionization detector
- pH meter
- Conductivity meter
- MX 241 Combustible gas indicator

Decontamination Procedures

Include a brief description of the decontamination procedures used to clean all sampling equipment that may come in direct contact with the sample and designated pages on which daily decontamination procedure entries are made. The equipment may include:

- Pump
- Bailer
- Filtration apparatus
- Split-spoon sampler
- Hand trowel
- Measurement tape (used to measure static water level)

Quality Control Sample Preparation

Include a brief description of all QC samples prepared in the field for both aqueous and soil/sediment sampling and the designated pages on which daily QC samples preparation entries are made. The QC samples may include:

- Trip blank
- Ambient conditions blank
- Equipment blank
- Field duplicates

Field Water

Include a brief description of the field water sources for tap, deionized, and organic-free deionized water. Outline the daily water usages, the applications of when each water type is used, and the designated pages on which daily use entries are made.

FIGURE 5-2. FIELD LOGBOOK GROUNDWATER MONITORING WELL SAMPLING DATA

Date ____________________ Location ______________________

Samplers, Pumps, Bailers, Used ____
____
____

Description of sampling location ____
____

Weather____
____

Purging method/well method and purging data, if available:
____
____

Water parameters/measurements:
pH ____________________
Conductivity ____________________
Temperature ____________________
Depth of well ____________________
Static groundwater level collection ____________________
Well water volume ____________________
Time of bailing: start ______________ finish ________________
Final groundwater water level ____________________

Air monitoring (list equipment used as well as the measured reading):
In well ____
In personnel breathing area ____

Sample description (physical characteristics, odor, color, appearance) ______________
____
____

Field preservation ____

Decontamination (page number reference):
Bailer ____________________ Pump ____________________
Measurement tape ________________ Sampler ____________________
Filtration apparatus ______________

____ ____________________
Signature (field team personnel making data entry) Date

FIGURE 5-3. FIELD LOGBOOK SURFACE WATER SAMPLING DATA

Date ____________________ Location ____________________

Samplers Used ____
____
____

Drawing of sampling location (including location description as well as the presence of debris, surface sheens, current, vegetation, etc.)

Weather ____
____

Description of water body, odor, color, appearance ____________________
____
____

Water sampling parameters:

pH	____________________
Conductivity	____________________
Temperature	____________________
Depth of water body	____________________
Depth of sample collection	____________________
Time of sample collection	____________________
Qualitative velocity	____________________

Field preservation ____

Decontamination (page number reference):
Filtration apparatus ____________________________________
Sampler ____

Photograph frame numbers ____

____ ____________________
Signature (field team personnel making data entry) Date

FIGURE 5-4. FIELD LOGBOOK SOIL/SEDIMENT SAMPLING DATA

Date ____________________ Location ____________________

Samplers Used ____
____
____

Drawing of sampling location (including location description as well as the presence of debris, surface sheens, recent excavations, vegetation, etc.)

Weather ____
____

Soil/sediment sample description:

Color, odor, texture, soil features, organic vapor levels, etc: __________
____

Time of sample collection ______________________________
Depth of sample collection ______________________________

Note on analyses: ______________________________

Decontamination (page number reference) ______________________

Spoons or spatulas ______________________________
Trowel ______________________________
Hand corer ______________________________
Hand auger ______________________________
Bowls ______________________________
Split-spoons ______________________________

Photograph frame numbers ______________________________

______________________________ ____________
Signature (field team personnel making data entry) Date

- List of the personnel present on-site during each sampling day to include all Contractor personnel, subcontractors, and visitors
- List of the equipment decontaminated along with a reference to the procedures used
- Description of the sampling locations in reference to permanent landmarks
- List of any changes from standard operating procedures, decisions made in the field, and other pertinent information
- QA/QC samples associated with the samples collected
- Equipment and/or instrument identification numbers (if available) for those used
- Sample preservation techniques performed
- Air monitoring information gathered (e.g., HNu, OVA readings)
- Level of personnel protection mandated (e.g., Level B, C, D) and record of pertinent time intervals spent by each field team member at each level (e.g., time spent in Level C developing a well, time spent in Level C sampling soil from a backhoe, etc.)
- Other logs/paperwork used to document activities
- Instrument calibration information including the instruments calibrated during the day and the individual who performed the calibration (Note: Instrument calibration information should be documented in the field logbook as well as on the instrument calibration log kept with each instrument and serving to document instrument response over time.)
- List of the samples collected by media (i.e., soil, water, etc.)
- Information on whether samples collected were grabs or composites
- Comments relative to any problem areas that occurred during the day's activities, their final resolution, and any anticipated impact on the outcome of the field investigation

The last item to be entered at the bottom of each page of the field logbook shall be the signature of the person responsible for completing the data entry.

5.1.2 Project Logbook

A unique project-specific logbook shall be maintained for each hazardous waste field investigation project, as required by the client. The logbook shall be comprised of a bound book with consecutively numbered pages. Should more than one project logbook be required, they shall be numbered sequentially.

The primary purpose of this logbook is to contain all the data specific to a particular project in one central location. In general, the project logbook shall contain essentially the same information as the field logbook. However, the project logbook need not list all the actual field data and instrument calibration information generated during a sampling episode. References to other documents that contain specific field activity descriptions, outlines of any administrative occurrences that have affected the field work for any given sampling activity, as well as a summary of the field activities, must be documented in the project logbook and kept up-to-date on a daily basis.

5.1.3 Field Equipment Logbook

A unique field equipment logbook is required for each piece of field measurement equipment (i.e., the HNu photoionization detector, pH meter, conductivity meter, etc.). This logbook is used for the documentation of the proper use, maintenance, and calibration of the field equipment as well as for any information concerning the conformance and decontamination status of each piece of equipment.

The field equipment logbook is maintained and kept up-to-date following the return of equipment from the field. Entries into the logbook should contain the following information:

- Signature of the person making the entry
- Date of entry

- Status of equipment in terms of its operational and decontamination standing
- Reference to the procedures used for calibration or maintenance as well as the procedural results and/or description
- Name of person(s) using the equipment and a brief description of the nature of the work
- Transcriptions of information recorded from all on-site calibrations

The field equipment logbook is comprised of a 3-ring notebook. Every page in the logbook must be signed by the field equipment maintenance person responsible for keeping each piece of equipment in proper repair and maintained for field use as a reflection of their review and approval of each entry.

5.1.4 Field Data Forms

Along with the completion of data entry in each of the above-mentioned logbooks, field data forms may be completed and filed separately in a 3-ring notebook maintained at the sampling site for all field activities. The forms may include the following:

- Site Health and Safety Log - to maintain accurate health and safety records for each field team member
- Geologic Boring Log - to document soil boring operations (Figure 5-5)
- Monitoring Well/Piezometer Completion Log Form (Figure 5-6)
- Monitoring Well Sampling Worksheet (Figure 5-7)

Alternatively, this information may be kept in the project logbook(s).

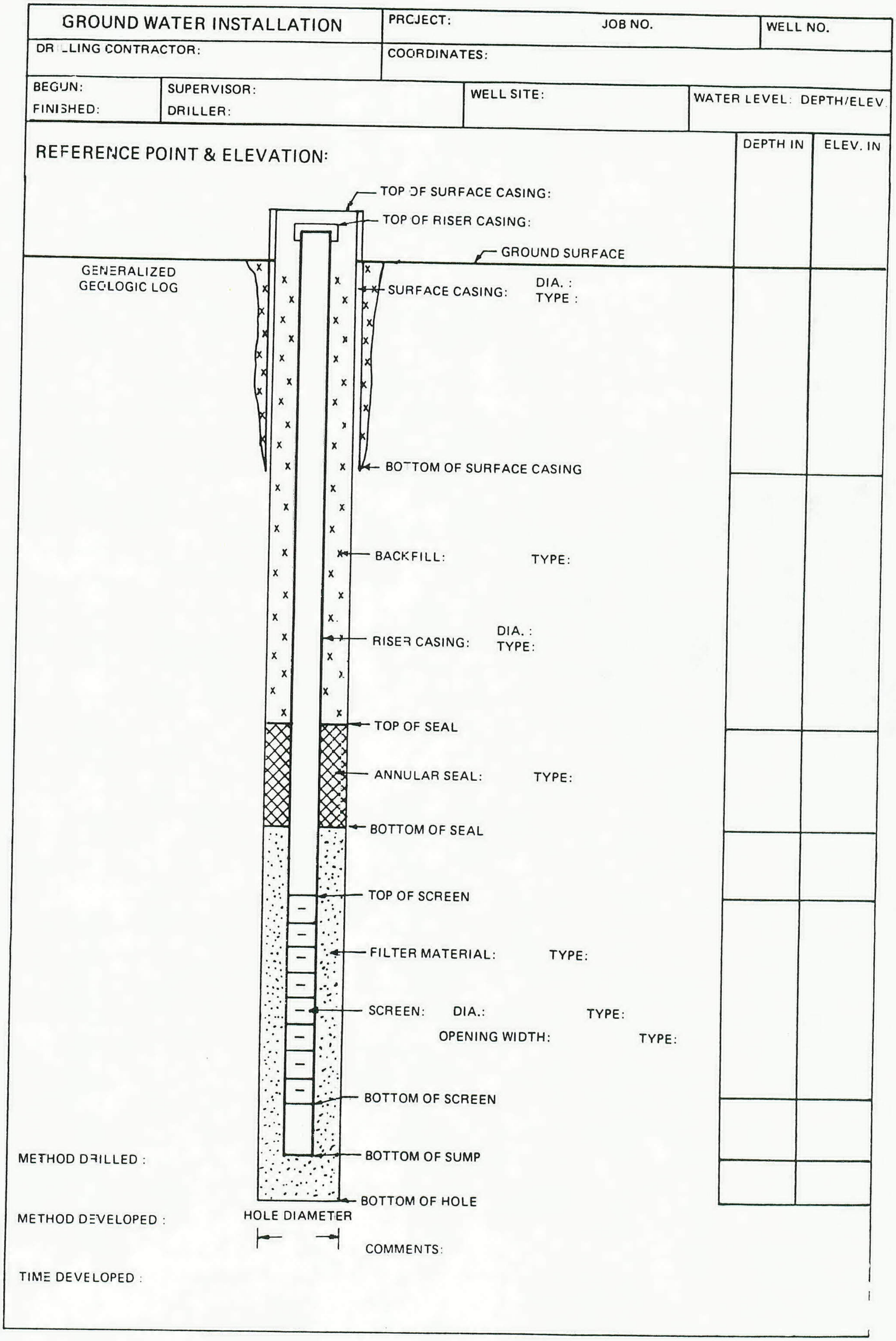
GEOLOGIC LOG

PROJECT :		SHEET	BORING NO.
SITE LOCATION:	JOB NO.:		
	LOCATION: N: E:	Elevation:	Total Depth
DRILL CONTRACTOR:	ENG/GEO:	BEGUN :	
DRILL RIG:	DRILLER:	FINISHED:	
Hole Size:	Weather:	Ground Water (Depth/Elev.):	
Drilling Method:	Drilling Fluid:	Top of Rock (Depth/Elev.):	

Depth	Sample Type/No.	SPT N Value	Blow Counts (per 6 in.) or Drilling Rate (min/ft)	Sample Recovery or REC and RQD	SAMPLE DESCRIPTION	Elev.	STRATIGRAPHIC DESCRIPTION

SAMPLE TYPES: SS = SPLIT SPOON, ST = SHELBY TUBE R = ROCK CORE, O = OTHER	NOTES:	Approved\Date

FIGURE 5-5. GEOLOGIC BORING LOG



GROUND WATER INSTALLATION

PROJECT:

JOB NO.

WELL NO.

DRILLING CONTRACTOR:

COORDINATES:

BEGUN:

FINISHED:

SUPERVISOR:

DRILLER:

WELL SITE:

WATER LEVEL: DEPTH/ELEV.

REFERENCE POINT & ELEVATION:

DEPTH IN	ELEV. IN

GENERALIZED GEOLOGIC LOG

TOP OF SURFACE CASING:

TOP OF RISER CASING:

GROUND SURFACE

SURFACE CASING: DIA. :
TYPE :

BOTTOM OF SURFACE CASING

BACKFILL: TYPE:

RISER CASING: DIA. :
TYPE:

TOP OF SEAL

ANNULAR SEAL: TYPE:

BOTTOM OF SEAL

TOP OF SCREEN

FILTER MATERIAL: TYPE:

SCREEN: DIA.: TYPE:
OPENING WIDTH: TYPE:

BOTTOM OF SCREEN

BOTTOM OF SUMP

BOTTOM OF HOLE

HOLE DIAMETER

METHOD DRILLED :

METHOD DEVELOPED :

TIME DEVELOPED :

COMMENTS:

FIGURE 5-6. MONITORING WELL/PIEZOMETER COMPLETION LOG FORM

Job Name ______________ Job No. _____ Samplers ______________

Well ID ______________ Date Sampled _______ Time: Start ____ End ____

Location Description ____

Weather ____

Measuring tape marking (circle one) inches 10ths of a foot
Casing Diameter ___ inches ÷ 12 = ___ (d)ft. Well secured upon arrival? Y/N
Depth of well from T.O.C. ____ ft. Standing water (gal.) = ________________
Depth of water from T.O.C ____ ft. x __________ well volumes
Feet of standing water _______ (h)ft. = __________ gallons to purge

Standing
Water $= \pi[(d)^2 \div 4](h)$
Volume

$= 3.14[(\_\_\_\ ft)^2 \div 4]\ (\_\_\_\ ft) \times 7.48\ gal/ft^3 =$ ______ gals.

PID Readings (ppm)
Breathing _________ Well ___________ Bailer _________
Purging method __________ Purge: Time Start __________ End ___________

pH Conductivity Temperature,(C) Turbidity
1 well volume = ______ gal. ___ ____________ ____________ ____________
2 well volume = ______ gal. ___ ____________ ____________ ____________
3 well volume = ______ gal. ___ ____________ ____________ ____________
4 well volume = ______ gal. ___ ____________ ____________ ____________
5 well volume = ______ gal. ___ ____________ ____________ ____________
Final volume = ______ gal. ___ ____________ ____________ ____________

Sample Collection: Time Start ______________ End ___________ Bailer ID# _____

Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum ______
Describe color: colorless black brown orange red ______
Describe appearance: turbid silty sand clay floaters sheen ______
clear multiphased foaming slimy algae ______

Organic Layer? _______ Length? ________ Samples preserved? ________

Comments ____
____

FIGURE 5-7. MONITORING WELL SAMPLING WORKSHEET

5.1.5 Chain-of-Custody Forms

Possession of samples shall be traceable from the time a sample is collected until it is used as evidence in legal proceedings, if applicable. To adequately track sample possession, a documented chain of custody must be maintained. See Section 3.1.2 for more detailed guidelines concerning sample custody. A Chain-of Custody Form is provided as Figure 5-8.

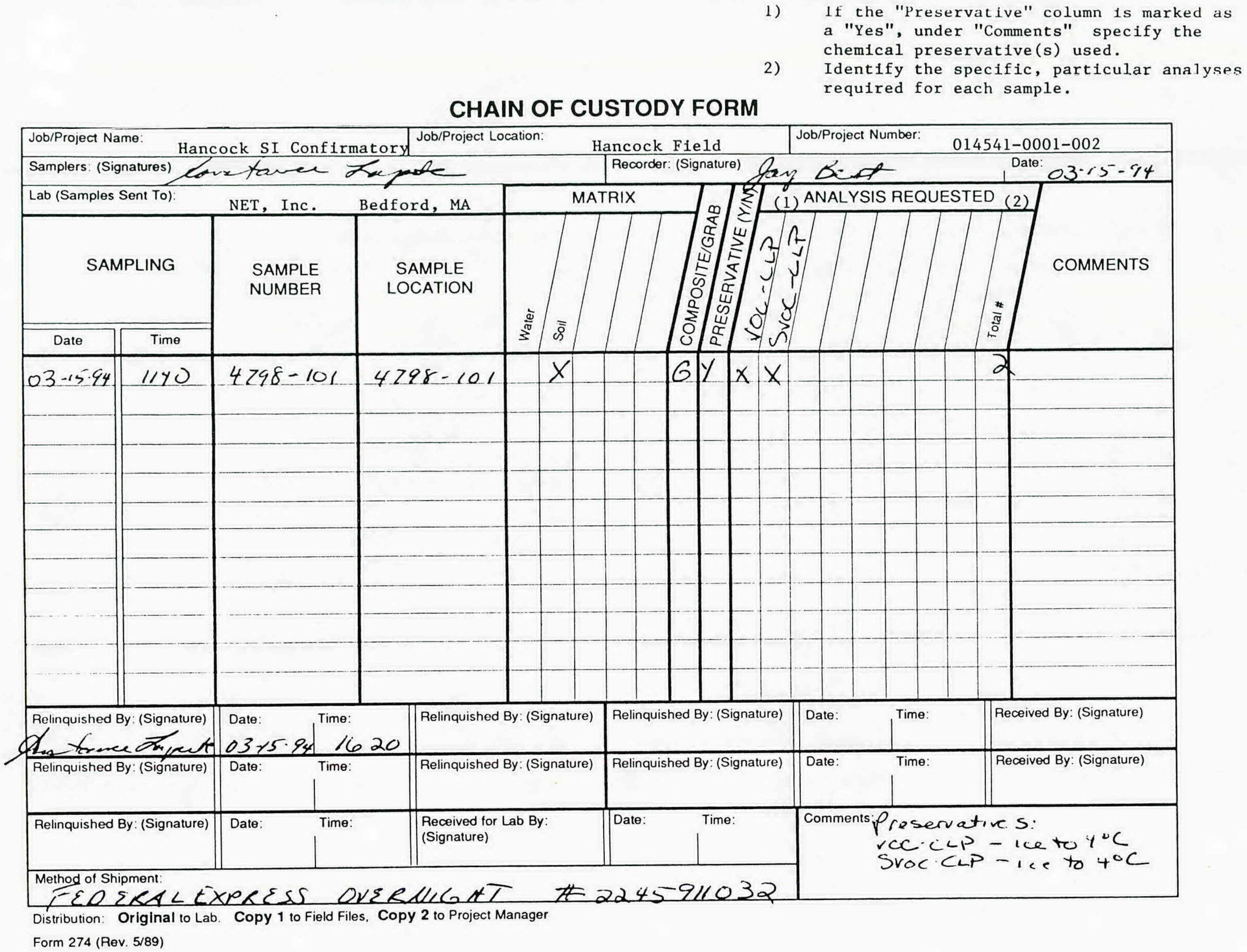
5.1.6 Materials Certification

Documentation (or copies) concerning the quality of all materials used on-site shall be retained on-site for the duration of the site investigation. The following list of materials certification documentation serves as an example of the documentation that will be maintained:

- Analysis of all decontamination rinse water (i.e., both tap water and ASTM Type II water)
- Sieve analysis of filter pack material
- Manufacturer and lot number for calibration standards
- Material certificates for all construction materials
- Certificates of analysis for materials used in decontamination
- Certificates of cleaning or decontamination furnished by the equipment manufacturer (The certificate shall detail the cleaning procedure.)

5.1.7 Variances

A variance is a deviation from project requirements. All variances from procedural and planning/design documents and other project requirements shall be documented on the Field Change Request Form. The HAZWRAP project manager for Hancock Field shall approve field changes that have a major impact on cost, schedule, and/or technical performance prior to incorporation. The requirements for documentation and the approval authority for field changes



1) If the "Preservative" column is marked as a "Yes", under "Comments" specify the chemical preservative(s) used.
2) Identify the specific, particular analyses required for each sample.

CHAIN OF CUSTODY FORM

Job/Project Name: Hancock SI Confirmatory
Job/Project Location: Hancock Field
Job/Project Number: 014541-0001-002
Samplers: (Signatures)
Recorder: (Signature)
Date: 03-15-94
Lab (Samples Sent To): NET, Inc. Bedford, MA

SAMPLING Date	SAMPLING Time	SAMPLE NUMBER	SAMPLE LOCATION	MATRIX Water	MATRIX Soil				COMPOSITE/GRAB	PRESERVATIVE (Y/N)	(1) ANALYSIS REQUESTED (2) VOC-CLP	SVOC-CLP							Total #	COMMENTS
03-15-94	1140	4798-101	4798-101		X				G	Y	X	X							2	

Relinquished By: (Signature)	Date: 03-15-94	Time: 1620	Relinquished By: (Signature)	Relinquished By: (Signature)	Date: Time:	Received By: (Signature)
Relinquished By: (Signature)	Date:	Time:	Relinquished By: (Signature)	Relinquished By: (Signature)	Date: Time:	Received By: (Signature)
Relinquished By: (Signature)	Date:	Time:	Received for Lab By: (Signature)	Date: Time:	Comments: Preservatives: VOC-CLP – ice to 4°C SVOC CLP – ice to 4°C	

Method of Shipment: FEDERAL EXPRESS OVERNIGHT #2245911032

Distribution: **Original** to Lab. **Copy 1** to Field Files, **Copy 2** to Project Manager

Form 274 (Rev. 5/89)

FIGURE 5-8. CHAIN-OF-CUSTODY FORM

are presented in Table 2.14 of the HAZWRAP document entitled "Quality Control Requirements for Field Methods," February 1989 (DOE/HWP-69). This table is reproduced as Figure 5-9.

Field changes and deviations from project planning documents shall be reviewed and approved by the Project Manager. All deviations from procedural and planning documents shall be recorded in the site logbook. Project reports shall detail all field changes and deviations.

5.2 PHOTOGRAPHS

The field team leader will document, through the use of color photographs where possible, various on-site activities and sampling specifics as deemed necessary for the project. Examples of items that may require photographic documentation include:

- General site topography
- Geophysical survey locations
- Sampling locations
- Physical appearance of environmental samples

7. FIELD CHANGE REQUEST FORM

Field Change No.:______
Page______ of _______

Project: 174th TFW / Hancock Field, NYANG

Project No.: 91B-99791C / K-06

Applicable Document: Final Site Investigation Confirmatory Study Sampling and Analysis Plan

Description:

Reason for Change:

Recommended Disposition:

Impact on Present and Completed Work:

Final Disposition:

Request by:
Field/Project Manager:____

Approvals:
HAZWRAP Project Manager:____

Note: The HAZWRAP Project Manager is notified of the need for change in project cost, schedule direction, or scope. This form does not satisfy Sect. 3, "Changes," of contract Terms and Conditions.

FIGURE 5-9. FIELD CHANGE REQUEST FORM

6.0 REFERENCES

AFCEE ESR, 1991. *Handbook to Support the Installation Restoration Program (IRP) Statements of Work: Volume I - Remedial Investigation/Feasibility Study,* Environmental Restoration Division (ESR) Environmental Services Office, Air Force Center for Environmental Excellence (AFCEE), Brooks Air Force Base, Texas, May 1991.

Bouwer, H. 1989. The Bouwer and Rice slug test - an Update. *Groundwater.* 27:304-309.

Cooper, H.H.; Bredehoeft, J.; and Papadopolos, I. 1967. Response of a finite-diameter well to an instantaneous charge of water. *Water Resources Research.* 1:263-269.

ES, 1982. *Installation Restoration Program; Phase I - Records Search; Hancock Field, New York.* Prepared by Engineering-Science, Inc. for United States Air Force and HQ TAC/DEE, July 1982.

HAZWRAP, 1990a. Amendment 1 to the Statement of Work for Site Investigation, Remedial Investigation and Feasibility Study, and Remedial Design at 174th Tactical Fighter Group; Hancock Field, Syracuse, New York. Prepared by HAZWRAP Support Contractor Office for the U.S. Department of Energy, July 27, 1990 and August 20, 1990.

HAZWRAP, 1990b. Amendment 2 to the Statement of Work. September 26, 1990.

Hvorslev, J.M. 1951. *Time lag and soil permeability in groundwater observations.* U.S. Army Corps of Engineers. Waterways Experiment Station. Bulletin No. 36.

JRB, 1984. *Installation Restoration Program; Phase IIB - Confirmation/ Quantification; Hancock Field, New York.* Prepared by JRB Associates for Department of the Air Force (USAFOEHL), April 1984.

M&E, 1991. *Final Site Investigation Sampling and Analysis Plan - 174 TFW/Hancock Field, New York Air National Guard*, Metcalf & Eddy, Inc., Wakefield, Massachusetts, February 1991.

M&E, 1992. *Base POL Area Site Investigation Report and Pesticide Storage Area Supplementary Site Investigation Report - 174 TFW/Hancock Field, New York Air National Guard*, Metcalf & Eddy, Inc., Wakefield, Massachusetts, June 1992.

NGB, 1990a. *Generic Community Relations Plan.* Prepared for the National Guard Bureau by CH2M Hill Southeast, April, 1990.

NGB, 1990b. *Draft Preliminary Risk Evaluation.* Working paper of the National Guard Bureau, August 29, 1990.

NYANG, 1990. New York Air National Guard, Spill Report Number 90-01019, Jet propellant and PCB Contamination Sample Analysis and Site Information. Memo to Ms. Helen L. Capone, NYSDEC, June 25, 1990. with attachments.

NYSDEC, 1994. *Division Technical and Administrative Guidance Memorandum (TAGM): Determination of Soil Cleanup Objectives and Cleanup Levels.* New York State Department of Environmental Conservation (NYSDEC), January 24, 1994.

SAIC, 1986. *Installation Restoration Program; Phase II - Confirmational Quantification; Stage 2 - Technical Operation Plan; Hancock Field, New York.* Prepared by Science Applications International Corporation for Headquarters ANGSC and USAFOEHL, September 1986.

SAIC, 1989. *Installation Restoration Program; Phase II - Confirmational/ Quantification; Stage 2.* Final Report prepared by Science Applications International Corporation for National Guard Bureau and United States Air Force (USAFOEHL), June 1989.

U.S. DOE, 1990a. *HAZWRAP Quality Control Requirements for Field Methods,* DOE/HWP-69/R1, July 1990.

U.S. DOE, 1990b. *HAZWRAP Standard Operating Procedures for Site Characterizations,* DOE/HWP-100, July 1990

U.S. DOE, 1990c. *HAZWRAP Requirements for Quality Control of Analytical Data,* DOE/HWP-65/R1, July 1990

U.S. EPA, 1993. *Contract Laboratory Program, Statement of Work for Organics Analysis: Multi-Media, Multi-Concentration, Revisions through OLM01.9*, July, 1993.

U S Environmental Protection Agency (EPA), 1990. *EPA Region I Volatile Organic Screening for Aqueous Samples.*

APPENDICES

APPENDIX A

FIELD INSTRUMENTATION CALIBRATION PROCEDURES

PHOTOIONIZATION DETECTOR

A photoionization detector shall be used in the field to monitor volatile organic compound (VOC) vapors in both soil and water according to the jar head space procedure. The PID that shall be used in this investigation is an HNu Model PI 101 Analyzer.

When calibrating the PI 101, the gas standards used for calibration should be at ambient temperature and pressure and at the proper flow rate. The frequency of calibration is dictated by the frequency of use and the toxicity of the species measured. After the analyzer has been serviced or repaired, it should be calibrated to verify proper operation and performance. It is recommended that calibration be checked frequently at first (daily or every other day) and then regularly as the confidence in the instrument increases.

Calibration of the PID by the Analyzed Gas Cylinder Method

The analyzed gas cylinder is a compressed gas cylinder containing the species of interest at known concentrations in the air matrix at or near the concentrations expected in the field. If the species of interest are unstable in air, another gaseous matrix shall be used. If the expected concentrations are wholly unknown, then a concentration should be chosen that causes a scale displacement of 50 to 80 percent on the 0 to 20 ppm range. Calibration on the 0-20 ppm range provides accurate values on the 0-2 ppm range as well.

A two-standard calibration is preferred when using the 0 to 2000 ppm range; one standard that causes a scale displacement of at 70 to 85 percent of the linear range and the other at 25 to 35 percent of the linear range. With a linear range of approximately 600 ppm for most compounds, these points would lie between 420 to 510 ppm and 150 to 210 ppm, respectively.

The calibration gas must be stable within the cylinder during the period of use. If the calibration is required in the field, a small cylinder is recommended. The cylinder material must be compatible with the calibration gas. The cylinder must be equipped with a regulator which fits properly and is also compatible with the calibration gas (i.e., the orifice must be of a size to deliver the proper flow of gas to the instrument). The operator should contact the suppliers in the event of uncertainties. Extreme care must be taken in the handling of gas cylinders; the contents are under high pressure and, in some cases, the contents may be hazardous. Material Safety Data Sheets (MSDSs) for all of the calibration gases are included in the Site Safety and Health Plan (SSHP; M&E, 1993a).

One method of sampling the calibration gas is illustrated in Figure C-1. The cylinder is connected to the probe by flexible tubing. All connections, as well as the main cylinder valve, must be leak-tested to prevent toxic or hazardous materials from leaking into the work area. This method can also be used to check instrument calibration.

A gas calibration cylinder should not be used below a pressure of 200 to 300 psi, because the loss of pressure could cause the concentration to vary. The cylinder should not be used past the recommended shelf-life of its contents.

The PID probe must be set up properly prior to the overall instrument calibration. The required steps to follow in this procedure are outlined below.

1. Identify the probe by the lamp label.
2. Connect the probe to the readout assembly, making sure the red interlock switch is depressed by the ring on the connector.
3. Set the SPAN potentiometer to the proper value for the probe being calibrated (refer to the calibration memo accompanying the probe).
4. Check the Ionization Potential (IP) of the calibration gas to be used and verify that the IP of the calibration gas is at or below the IP of the lamp. (The energy of the lamp is etched into the glass envelope.)
5. Proceed with the calibration as described below.

FIGURE C-1 PID (HNu PI 101 ANALYZER) CALIBRATION TEST SET UP

Calibration Method

The HNu will be prepared for use each day according to the following procedure:

1. WARM-UP: 5-10 minutes.

2. BATTERY CHECK: Turn the function switch to the battery check position. The needle should reach within or above the green area on the scaleplate. If the needle is in the lower portion of the battery arc, the instrument must be recharged prior to making any measurements. If the red LED comes on, the battery must be recharged.

3. CHECK UV LIGHT SOURCE: Turn the function switch to the "on" position. In this position, the UV light source should be on. Check this by looking quickly into the end of the probe to see the purple glow of the lamp.

4. ZERO INSTRUMENT: Turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. (Clockwise rotation of the zero potentiometer produces an upscale deflection while counterclockwise rotation yields a downscale deflection).

   0-2000 Range:

   The instrument is first calibrated with the higher concentration standard using the span potentiometer, then the instrument is calibrated at the lower concentrations using the zero potentiometer. These steps should be repeated several times to ensure that a good calibration is obtained. If the analyzer is to be used subsequently on the 0-20 or 0-200 range, it must be recalibrated as described above.

5. RECHARGING INSTRUMENT: The PI 101 must be recharged overnight after each day's use. To charge the battery, place the mini phone plug into the jack on the left side of the bezel and plug the charger into a 120 VAC source. (NOTE: When disconnecting the charger, remove it from the 120 VAC source before removing the mini phone plug.) The battery completely recharges in 14 hours. To ensure that the charger is functioning properly, turn the function switch to the battery check position, place the phone plug into the jack, and plug the charger into an AC outlet. The needle should go upscale if the charger is working properly and is correctly inserted into the jack.

Calibration Check

A short-cut method may be used to quickly check the calibration of the PID in the field. Immediately after the calibration has been completed, a reading is taken on an isobutylene standard. The reading obtained is used as a benchmark throughout the day. Readings of the isobutylene standard may be taken and adjustments to the PID may be made as required. This is an indirect method of calibration, one that maintains the calibration on the isobutylene standard to indicate the fidelity of the calibration using the original gas mixture.

PH METER

A field pH meter shall be used throughout this investigation in order to determine the acidity of various water samples prior to, during, and upon final sample collection. Calibration of the pH meter shall proceed as described below.

All pH buffer solutions used to calibrate field pH meters are typically purchased from Fisher Scientific Company. These buffer solutions, manufactured in Fairlawn, New Jersey, are traceable to the National Institute of Standards and Technology (NIST).

Two-Buffer Calibration

This procedure is recommended for precise measurements and is as follows:

1. Choose two buffer solutions which bracket the expected sample pH. The first should be pH 7 and the second appropriate for the expected sample pH (pH 4 of PH 10).

2. The buffer solutions should be at room temperature. If the samples are at varying temperatures, the appropriate temperature compensation, as described in the instrument instruction manual, is recommended.

3. Rinse the electrode with distilled water and blot dry.

4. Place the electrode in the pH 7 buffer solution. Wait for a stable display. Set the meter to the pH value of the buffer at its measured temperature. (A table of pH values at various temperatures is supplied with the buffer solution.)

5. Rinse the electrode with distilled water and blot dry.

6. Place the electrode in a second buffer solution. When the display reading is stable, set the meter to the actual pH value of the buffer as described in the meter instruction manual.

7. Rinse the electrode with distilled water and blot dry.

8. Place the electrode in the sample solution. When display reading is stabilized, record the displayed pH.

CONDUCTIVITY METER

A field conductivity meter shall be used throughout this investigation in order to determine the specific conductivity of groundwater and surface water samples prior to, during, and upon final sample collection. Initial calibration checks are performed on the conductivity meter by the Contractor prior to use at the project site. Continuing calibration is performed in the field at regular intervals during the course of the investigation. (Typically, calibration is checked at each test site or every 4 hours, whichever is more frequent.) Final calibration checks shall be performed following use at the project site. If the initial and final calibration checks differ by more than 15 to 20 percent, reanalysis of the field samples is required.

All standard conductivity solutions used to calibrate field conductivity meters shall be traceable to the NIST.

Initial (and Final) Calibration

A full range of calibration checks are performed on the conductivity meter prior to and following each field investigation. Typically, four standard conductivity solutions ranging from 10 to 10,000 μmhos/cm, one for each instrumental analytical range, are analyzed. One standard, generally the 10 μmhos/cm concentration, is analyzed and the meter is adjusted to read 10 μmhos/cm on the lowest range setting. Then 100, 1000, and 10,000 μmhos/cm standards are analyzed on their appropriate range settings and the results are reported. The instrument is presumed to be operating correctly if the initial and final calibration difference is less than 20 percent. (Note: 1.) Care must be taken to rinse the probe with deionized water and blot it dry between readings and 2.) if the conductivity meter does not compensate for temperature, a temperature reading will be obtained and the conductivity reading adjusted to reflect the conductivity reading adjusted to reflect the corresponding reading at 25°C.)

Continuing Calibration

Continuing calibration is performed in the field at a frequency depending on the sample concentration range. Typically, a sample is analyzed to determine the appropriate instrumental range setting. Then, while at this setting, the appropriate calibration standard is analyzed, the instrumental range is fine-tuned, and the sample is reanalyzed. (Note: 1.) Care must be taken to rinse the probe with deionized water and blot it dry between analyses and 2.) if the conductivity meter does not compensate for temperature, a temperature reading will be obtained and the conductivity reading adjusted to reflect the corresponding reading at 25°C.)

TEMPERATURE

A hand-held, non-mercury thermometer shall be used throughout this investigation in order to determine the temperature of pH buffer (calibration) solutions, conductivity calibration standards, and various water samples. Non-mercury thermometers and equipment with thermistors shall be cross checked against a precision thermometer traceable to the NIST.

TURBIDIMETER

A field turbidimeter shall be used throughout this investigation when collecting groundwater and surface water samples. In order to ensure consistently accurate results, the standardization procedure identified in steps 1-8 will be performed before each set of tests.

1. Turn the instrument off and check the mechanical zero setting. Adjust the screwdriver adjustment control in the meter face if necessary to obtain a zero-nephelometer turbidity unit (NTU) reading.

2. Press the power switch to on and perform a battery check by pressing the BATTERY CHECK switch and verifying that the meter indicates in the BATTERY CHECK area. If not, charge the battery pack.

3. Place the focusing template into the cell holder. The focusing template will block all light from reaching the detector and allow the instrument to be zeroed electronically in steps 4 and 5.

4. Press the 1.0 range switch and adjust the zero control for a reading of zero NTU.

5. Press the 10 range switch and verify the meter still indicates zero NTU. Readjust the zero control is necessary.

6. Remove the focusing template and place the appropriate Gelex secondary standard for the turbidity range to be used into the cell holder. Use the index mark on the standard to orient the vial in the same position each time, thereby eliminating variation due to rotation.

7. Place the light shield over the turbidity standard and allow the meter to stabilize.

8. Adjust the SPAN control for a meter reading equal to the value of the Gelex standard in the cell holder. Remove the light shield and turbidity standard. The instrument is now ready for use.

APPENDIX B

EPA REGION I VOLATILE ORGANIC FIELD SCREENING METHOD FOR AQUEOUS SAMPLES

1. Scope and Application

This method is applicable for the screening of various volatile organic compounds in water. The following compounds can be screened by this method:

Table I - Target Compound List

Analyte	MDL(ug/l)	CAS* Registry No.
Benzene	1	71-43-2
Chlorobenzene	1	108-90-7
1,1-Dichloroethene	1	75-35-4
cis-1,2-Dichloroethene	1	156-59-4
trans-1,2-Dichloroethene	1	156-60-5
Ethylbenzene	1	100-41-4
Tetrachloroethene	1	127-18-4
Trichloroethene	1	79-01-6
1,1,1 Trichloroethane	50	71-55-6
Toluene	1	108-88-3
m/p - Xylene	2	108-38-3/106-42-3
o - Xylene	2	95-47-6

* Chemical Abstract Services

Achievable Method Detection limits (MDL's) are presented in Table I.

This method may be used when the quality assurance objectives are either QA1 or QA2 as defined in Interim Final Guidance for the Quality Assurance/Quality Control Guidance for Removal Activities, April 1990.[1] Briefly, QA1 is a screening objective to afford a quick preliminary assessment of site contamination. QA2 is a verification objective used to verify analytical (field or lab) results. A minimum of 10% of samples screened must be analyzed by a full protocol method for qualitative and quantitative confirmation.

[1] Quality Assurance/Quality Control Guidance for Removal Activities, OSWER Directive 9360.4-01; US EPA, Washington, D.C. April 1990.

2. Summary of Method

2.1 An aqueous sample is collected in a 40 ml VOA vial and allowed to equilibrate to ambient temperature. A sample of the headspace gas is withdrawn with a gas-tight syringe and analyzed on a gas chromatograph (GC) equipped with a photoionization detector (PID).

2.2 Tentative identifications and quantitations are made by analyzing samples under the same conditions used for standards and comparing resultant GC retention times and peak areas or peak heights.

2.3 This method can be used to provide analytical data in a timely manner for guidance of ongoing work in the field. This field screening method is not equivalent to and is not a replacement for full protocol laboratory methods (ie. Contract Laboratory Program analysis).

3. Interferences

3.1 Contamination by carry-over can occur whenever high level and low level samples are sequentially analyzed. To reduce carry-over, a sample syringe blank should be analyzed following an unusually concentrated sample to assure that the syringe is clean.

4. Apparatus and Equipment

4.1 Sample containers - 40 ml screw cap VOA vials each equipped with a polytetrafluoroethylene (PTFE) - faced silicon septum.

4.2 Micro Syringes - 25 ul and larger (up to 1,000 ul) with chromatographic needles. Take an adequate supply into the field.

4.3 Gas chromatograph equipped with a photoionization detector and all required accessories, including GC column, recorder and carrier gas.

4.3.1 GC columns:
1. 4' 1/8" SE-30 packed column
2. 10 meter CP sil 5CB megabore capillary
3. equivalent column

5. Reagents

5.1 Methanol - demonstrated to be free of analytes.

5.2 Reagent water - tap water demonstrated to be free of analytes.

5.3 Standard Stock Solutions - Solutions are either prepared from pure standard materials or purchased by the Region I Chemistry Laboratory and are used to prepare secondary dilution standards.

5.4 Secondary dilution standards - Secondary standards are available thru the Region I Laboratory and should be diluted to prepare aqueous calibration solutions (standards). Store secondary dilution standards in crimp vials at 0 deg C. Check frequently for signs of deterioration or evaporation, especially just prior to preparing calibration standard.

5.5 Performance Evaluation Sample - To be obtained from Region I ESD Laboratory.

6. Sample Collection and Preparation

6.1 Sample Collection - Fill the 40 ml sample bottle to 3/4 full, leaving a 10 ml headspace and seal the bottle with septa and cap. If samples are to be transported to a fixed lab for screening analysis, fill sample bottle completely and withdraw 10 mls of headspace immediately prior to sample analysis.

6.2 Sample Preparation - Let sample stand septa side down and equilibrate to ambient temperature.

7. Calibration

7.1 Prepare calibration standard from an EPA Region I Laboratory secondary dilution standard and place in a 40 ml VOA vial. The traceability of the standard must be documented.

To prepare a calibration standard, add an appropriate volume of the secondary dilution standard solution to a known volume of reagent water in a volumetric flask. Using a micro-syringe, rapidly inject the methanol/VOA standard into the expanded area of the filled volumetric flask. Remove the needle as quickly as possible after injection. Mix by inverting the flask three times only. Aqueous standards may be stored up to 7 days, if held in sealed VOA vials with zero headspace at 4 deg C ± 2 deg.

7.2 In a clean atmosphere, withdraw 10 mls from the aqueous standard vial using a 10 ml graduated syringe and vent needle. Let standard stand septa side down until it equilibrates to ambient temperature.

7.3 Allow gas chromatograph detector and carrier gas flow to equilibrate. Run a two point standard calibration by running a reagent blank and a calibration standard. The reagent blanks must show no chromatographic peaks at the 1 ppb level. If other than target compound peaks are found, they should be accounted for in calibration and when reagent water is used for dilutions. The calibration standard should not exceed the linearity of the instrument. A 10-20 ppb range is ideal. Carrier flow should be such that acceptable peak resolution is obtained. If flow is changed, repeat the standard calibration before analysis of samples.

7.4 The GC must be recalibrated at a minimum of once every 10 samples, by running the calibration standard. If the GC has no temperature controls, calibration may need to be performed more frequently, especially if ambiant temperatures changes cause retention times to shift significantly. Technical judgement must be used to determine the actual frequency of instrument calibration. Analysts must feel confident when making tentative compound identifications and quantitations.

8. Sample Analysis

8.1 All samples are to be allowed to equilibrate to ambient temperature before analysis.

8.2 Samples should be analyzed between calibrations. A standard must be run at the end of final sample analysis.

8.3 If the initial analysis of a sample or a dilution of a sample has a target compound response 100% greater than the standard response, the sample must be re-analyzed at a higher dilution, at a higher instrument gain setting, or using a smaller sample injection volume. Analyte peaks should be kept on the recorder scale if measured peak heights are used for quantitation. If an integrator is used, area counts of sample must not exceed 150% counts of the calibration standard.

9. Qualitative Analysis

9.1 The compounds listed in the target compound list (TCL) in Table I, shall be tentatively identified by comparing the sample peak retention times to the standard peak retention times. Retention time of a sample peak must match that of a standard peak before tentative identification can be made. For accurate qualitation, samples must be compared to calibration standards run closest in time to the sample. This accounts for any possible column degradation and flow or temperature changes which could cause retention time shifts. Occasionally, late eluting peaks from previous samples may elute with a sample and false positives can mistakenly be reported in the sample. To avoid this, peak shapes should be examined to verify the presence of target compounds. For tentative compound identifications, peak shapes in the samples must match the peak shapes in the standard.

10. Quantitative Analysis

10.1 **After a tentative identification has been made, TCL compounds shall be quantitated by the external standard method. Peak height or area counts of the samples can be directly compared to the corresponding calibration standard peak height or area count. For accurate quantitation, samples must be compared to calibration standards run closest in time to the sample. This accounts for any possible column degradation and loss or gain of detector sensitivity.**

10.2 Example calculation: If a 10 ppb benzene calibration standard has a peak area of 150 units, a tentatively identified benzene peak in a sample analyzed using the same sample volume and gain as the calibration standard, with an area of 60 units, will represent a concentration of 4 ppb.

$$\begin{array}{ccc} \underline{\text{Standard}} & & \underline{\text{Unknown}} \\ \frac{10 \text{ ppb}}{150 \text{ units}} & = & \frac{x \text{ ppb}}{60 \text{ units}} \end{array}$$

$$x = 4 \text{ ppb}$$

11. Quality Control

11.1 Each day, the analyst must analyze a syringe blank at the same volume and instrument gain of calibration standards to demonstrate that interferences from the analytical system are under control. Syringe blanks must also be analyzed following an unusually concentrated sample to assure that syringe is clean. If the syringe is found to be contaminated, another syringe must be used and checked.

11.2 Field duplicates must be collected and analyzed once each survey to validate the precision of the sampling technique. Calculate relative percent difference (RPD).

11.3 Laboratory duplicates must be analyzed non-sequentially once each survey or once each 20 samples (whichever is greater), to validate the precision of analysis. Calculate RPDs.

11.4 A Performance Evaluation Sample, containing target compounds, must be analyzed once a day to validate the accuracy of the analysis. Calculate percent recoveries.

11.5 All quality control must be documented on the QA/QC checklist form. All data generated must be reviewed and validated by qualified personnel other that the analyst.

12. Data to be Submitted

12.1 Completed QA/QC Form

12.2 Chromatograms

12.2.1 Site name, analyst name, and date at the start of the chromatogram strip chart.

12.2.2 Every chromatogram/every sample/standard

Numbered Sequentially
Sample ID number
Sample Volume Injected
Instrument Gain Setting
Concentration of STD

12.2.3 Attached calculation sheets - Legible calculations and other information (ie: dilutions) required to reproduce the screening results must be provided.

12.3 Data summary forms - Sample results for all positive and non-detected results along with detection limits. See example on page 8.

Calculations

1. Precision as Relative percent difference (RPD)

$$\frac{\text{Sample - Sample Dup}}{\text{(Sample + Sample Dup)/2}} \times 100 = \text{Relative percent difference (RPD)}$$

2. Accuracy as Percent recovery

$$\frac{\text{Sample Found Value}}{\text{True Value}} \times 100 = \text{Percent Recovery}$$

VOA Daily Field QA/QC Form

Date:
Site Name:
Site No.:

Analyst:
Affiliation:

Purpose of sampling:

QA Level:	QA1 - No confirmation analysis done	Yes	No
	QA2 - Confirmation lab analysis done	Yes	No

Instrument used for screening (model, detector, column):

Is a list of compounds and their detection limits included? Yes No

CALIBRATION

1. Calibration Standard Identification data (for traceability):
2. Was calibration performed at minimum once every 10 samples? Yes No

BLANKS

1. Was initial syringe blank analyzed? Yes No
2. Was reagent blank analyzed? Yes No
3. Were syringe blanks run appropriately after high level samples to check for carry-over contamination? Yes No

PRECISION

1. Were field duplicates analyzed at least once? Yes No

Compounds	Sample Conc.	Duplicate Conc.	RPD

2. Were lab duplicates analyzed at least once each 20 samples and non-sequentially? Yes No

Compounds	Sample Conc.	Duplicate Conc.	RPD

ACCURACY

1. Was Performance Evaluation Sample analyzed once a day? Yes No

Compound	Concentration	True Value	% Recovery (Acceptable Limits 70-130%)

COMMENTS ON USEABILITY OF DATA

____
____
____

Reviewer ______________ Date ________

Volatile Organics Screening Summary (Example)
Results in ug/l

Site Name : Doe Property

Analysis Date: 7/07/90

Sample Number	A01	A02	A03	A04	A05
Compound					
Benzene	1UF	1UF	1UF	1UF	14F
Chlorobenzene	1UF	1UF	1UF	1UF	1UF
1,1-Dichloroethene	1UF	1UF	1UF	1UF	1UF
cis-1,2-Dichloroethene	1UF	1UF	1UF	1UF	1UF
trans-1,2-Dichloroethene	1UF	1UF	1UF	1UF	1UF
Ethylbenzene	7F	1UF	1UF	1UF	1UF
Tetrachloroethene	1UF	27F	1UF	1UF	1UF
Trichloroethene	1UF	12F	1UF	1UF	1UF
1,1,1-Trichloroethane	50UF	50UF	50UF	50UF	50UF
Toluene	1UF	1UF	1UF	95F	1UF
m/p Xylene	2UF	2UF	2UF	20F	2UF
o-Xylene	2UF	2UF	2UF	20F	2UF

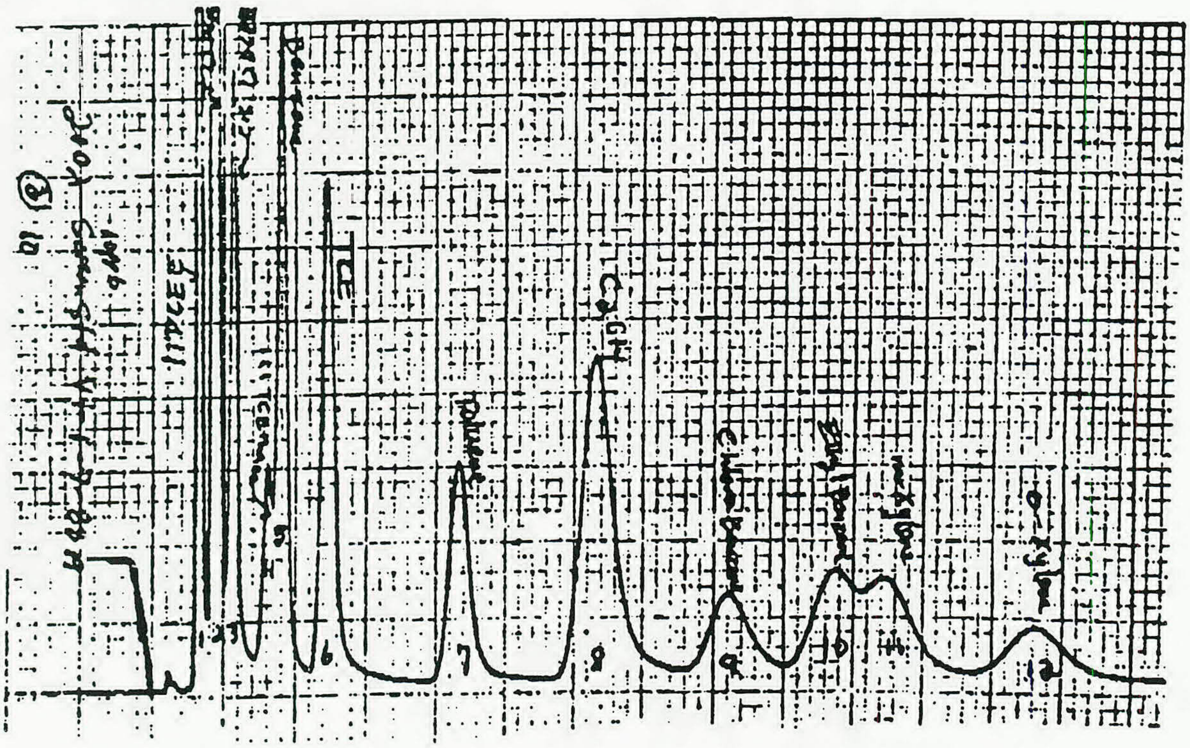
U - The material was analyzed for but was not detected. The associated numerical value is the field screening method quantitation limit.

F - Data has been generated using a field screening method. Analytes are tentatively identified and concentrations are quantitative estimates.

Figure I

Volatile Organic Screening Method
Target Compound Chromatogram

1. 1,1-Dichloroethylene
2. t-1,2-Dichloroethylene
3. c-1,2-Dichloroethylene
4. 1,1,1-Trichloroethane
5. Benzene
6. Trichloroethylene
7. Toluene
8. Tetrachloroethylene
9. Chlorobenzene
10. Ethyl Benzene
11. m/p-Xylene
12. O-Xylene



Instrument: Photovac 10A10
Detector: Photoionization Detector (PID) with 10.6 eV lamp
Column: 4' x 1/8" SE-30
Temperature: ambient, 22° C
Carrier Gas: Ultra-zero grade air
Flow Rate: 20 cc/min
Chart Speed: 1 cm/min

APPENDIX C

ENSYS© IMMUNOASSAY TEST KIT PROCEDURES FOR THE ANALYSIS OF PCBs IN SOIL SAMPLES

Rev. 5 9/1/93

ENSYS INC.
ENVIRONMENTAL PRODUCTS

PCB RISc®
SOIL TEST SYSTEM

RAPID IMMUNOASSAY SCREEN

User's Guide

IMPORTANT NOTICE

This method correctly identifies 95% of samples that are PCB-free and those containing 1 ppm or greater of PCBs. A sample that develops less color than the standard is interpreted as positive. It contains PCBs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of polychlorinated biphenyls. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

WORKSTATION SET-UP

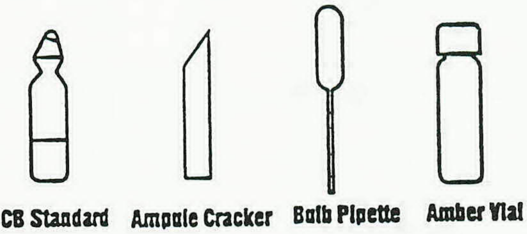
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Follow diagram below to setup workstation.
- Items that you will need that are not provided in the test kit include: a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, disposable gloves.
- Do not expose reagents to direct sunlight.
- Do not attempt to run more that 12 tubes, two of which must be Standard tubes.
- Operate test at temperatures greater than 4°C / 40°F and less than 32°C / 90°F.
- See table on page 9 for sensitivity to various aroclors.

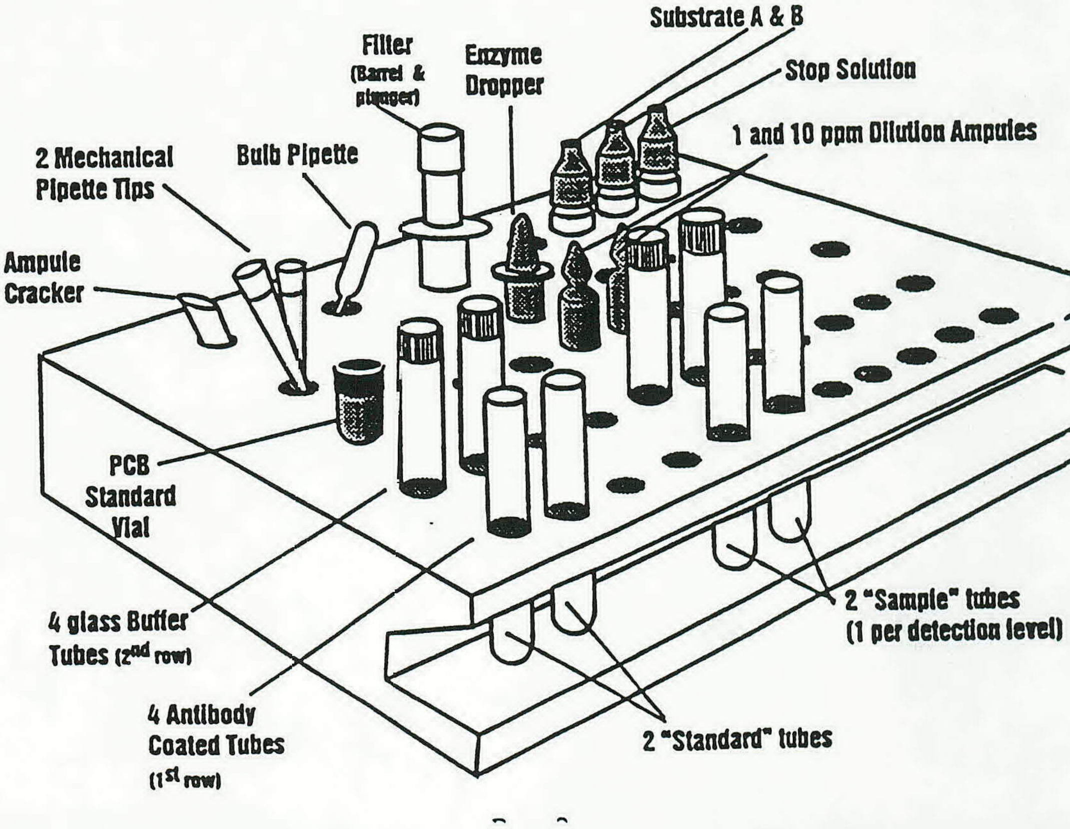
TEST PREPARATION

- Label amber vial "PCB Standard", and the current date, Standard is usable for up to 2 weeks from this date. Open PCB Standard ampule by slipping ampule cracker over top, and then breaking tip at scored neck. Transfer to empty amber vial with bulb pipette. Always cap tightly when finished using Standard.



WORKSTATION SET-UP (Workstation shows components for 1 sample tested at 2 levels)

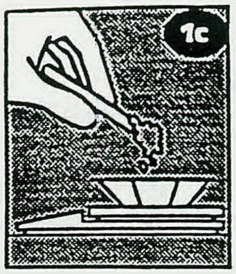
☐ Mechanical pipette tips
☐ Enzyme dropper
☐ PCB standard vial
☐ Substrate A
☐ Filtration barrel & plunger
☐ 1 and 10 ppm dilution ampules
☐ Substrate B
☐ Bulb pipette
☐ 4 glass buffer tubes
☐ Stop solution
☐ Ampule cracker
☐ 4 antibody coated tubes



PHASE 1 EXTRACTION & PREPARATION OF THE SAMPLE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WEIGH SAMPLE

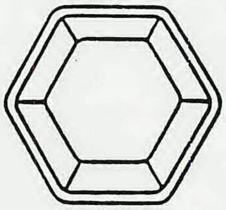


1a Place unused weigh boat on pan balance.

1b Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

1c Weigh out 10 ± 0.1 grams of soil.

1d If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.



Weigh Boat

Pan balance

Wooden spatula

EXTRACT PCBS

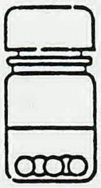
2a Uncap extraction jar and place on a flat surface. Without contacting solvent puncture foil seal with ampule cracker or sharp object. Peel the remainder of the seal off extraction jar.

2b Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

2c Recap extraction jar tightly and shake vigorously for one minute.

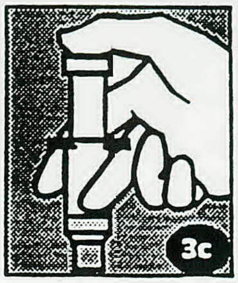
2d Allow to settle for one minute.

Repeat steps 1a - 2c for each sample to be tested.



Extraction jar

FILTER SAMPLE



3a Disassemble filtration plunger from filtration barrel.

3b Insert bulb pipette into top (liquid) layer in extraction jar and draw up sample. Transfer at least ½ bulb capacity into filtration barrel. **Do not use more than one full bulb.**

3c Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).

Repeat steps 3a - 3c for each sample to be tested.

Filtration plunger

Bulb pipette

Filtration barrel

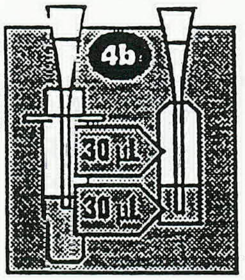
PHASE 2 SAMPLE & STANDARD PREPARATION

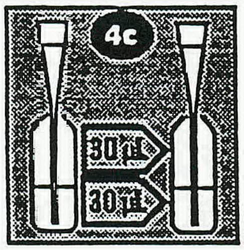
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

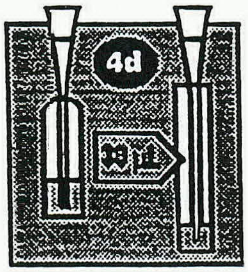
READ BEFORE PROCEEDING

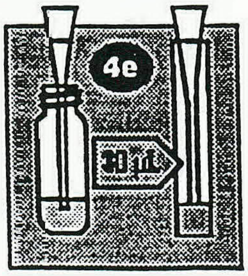
- Tap glass buffer tubes vigorously on hard surface to release buffer trapped in cap.
- Label the glass buffer and plastic antibody coated tubes with a permament marking pen. Uncap glass buffer tubes.
- When using the mechanical pipette always withdraw and dispense below the liquid level.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

DILUTE SAMPLES AND STANDARDS









4a Open 1 and 10 ppm* dilution ampules by slipping ampule cracker over top, and then breaking top at scored neck.

4b Withdraw 30 µL of filtered sample using mechanical pipette and dispense below the liquid level in "1 ppm" dilution ampule. Repeat to transfer a total of 60 µL; gently shake ampule from side to side for 5 seconds to mix thoroughly.

4c Withdraw 30 µL from the "1 ppm" dilution ampule using mechanical pipette and dispense below the liquid level in "10 ppm" dilution ampule. Repeat to transfer a total of 60 µL; gently shake ampule from side to side for 5 seconds to mix thoroughly.

4d Transfer 30 µL from each dilution ampule into a glass buffer tube. Always wipe tip after dispensing into buffer tube.

4e Assemble new pipette tip on mechanical pipette and transfer 30 µL from Standard vial into two glass buffer tubes. Immediately replace cap on PCB Standard vial.

4f Shake all glass buffer tubes for 5 seconds.

* For other test concentrations, follow steps 4b - 4d, transferring from lowest level dilution ampul to higher level dilution ampules. You may be provided with additional dilution ampules to achieve higher test concentrations

If you need assistance call technical support 1-800-242-7472

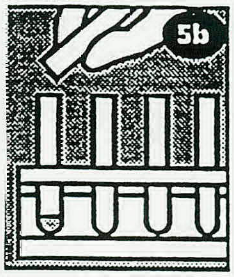
PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- This phase of the procedure requires critical timing and care in handling the antibody coated tubes.

INCUBATION 1



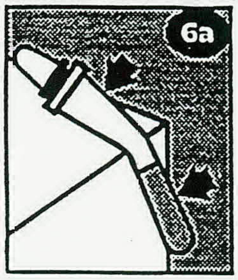
5a Set timer for exactly 10 minutes.

5b Start timing and immediately pour solution from each glass buffer tube into appropriate antibody coated tube. Tap glass tube on antibody coated tube to remove solution.

5c Shake all tubes for 5 seconds.

Antibody coated tubes (contained in resealable "zip-seal" aluminized pouch)

PREPARE ENZYME DROPPER

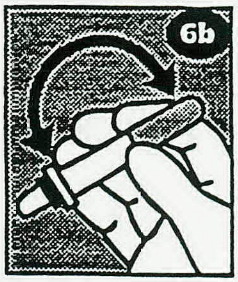


6a Crush glass ampule contained within enzyme dropper by pressing tube against hard edge.

6b Mix enzyme by turning dropper end-over-end 5 times. Do not shake.

6c Remove seal from enzyme dropper.

Repeat steps 6a - 6c to prepare one enzyme dropper for every 5 antibody coated tubes.

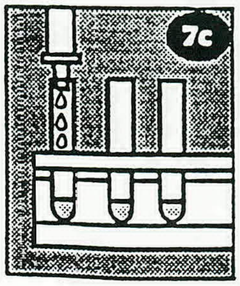


Enzyme dropper

INCUBATION II

7a Dispense first drop from enzyme dropper into liquid waste container.

Note: before dispensing drops, tap capped tip on hard surface to avoid dispensing air bubbles.



7b After the 10 minute incubation, set timer for 5 minutes.

7c Immediately dispense 3 drops of enzyme into each antibody coated tube by squeezing the dropper.

7d Shake antibody coated tubes for 5 seconds.

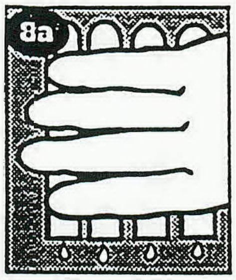
PHASE 3 THE IMMUNOASSAY

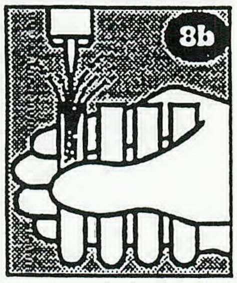
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING
WASH PROCEDURE

- An accurate test requires a virgorous wash accomplished by directing a strong stream into the antibody coated tubes.
- The wash solution is a harmless, dilute solution of detergent.

WASH



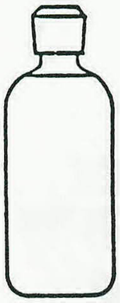


8a After the 5 minute incubation (a total of 15 minutes), empty antibody coated tubes into liquid waste container.

8b Wash antibody coated tubes by vigorously filling and emptying a total of 4 times.

8c Tap antibody coated tubes upside down on paper towels to remove excess liquid. Residual foam in the tubes will not interfere with test results.

Note: When running up to 12 antibody coated tubes, tubes can be washed in two groups - one group immediately following the other group.



Wash bottle

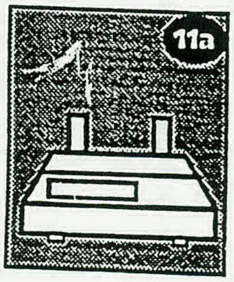
READ BEFORE PROCEEDING

- Keep Substrate dropper bottles vertical and direct each drop to bottom of antibody coated tubes. Addition of more or less than 5 drops may give inaccurate results.
- This phase requires accurate timing.

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

MEASURE SAMPLE



11a Place 1 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 1 ppm.

11b Place 10 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 10 ppm.

AROCLOR SENSITIVITY

Aroclor	Lowest Detection Level
1248	1.0 ppm
1254	0.4 ppm
1260	0.4 ppm
1242	2.0 ppm
1232	4.0 ppm
1016	4.0 ppm

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

System Description

Each PCB RISc Soil Test System contains enough material to perform four complete tests, each at two detection levels, if desired.

The PCB RISc Soil Test is divided into three phases. The instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free: 1-800-242-RISC (7472).

Validation and Warranty Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

PCB-free soil and soil containing 1 ppm or greater of PCBs were tested with the EnSys PCB RISc analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains PCBs. A sample that has developed more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

The company does not guarantee that the results with the PCB RISc Soil Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

EnSys, Inc. warrants that this product conforms to the descriptions contained herein. No other warranties, whether expressed or implied, including warranties of merchantability and of fitness for a particular purpose shall apply to this product.

EnSys, Inc. neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than such as is expressly set forth herein.

Under no circumstances shall EnSys, Inc. be liable for incidental or consequential damages resulting from the use or handling of this product.

How It Works

Standards, Samples, and color-change reagents are added to test tubes, coated with a chemical specific to PCBs. The concentration of PCBs in an unknown Sample is determined by comparing its color intensity with that of a Standard.

Note: PCB concentration is inversely proportional to color intensity; the lighter the color development of the sample, the higher the concentration of PCBs.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.
- Do not use the Test System after any portion has passed its expiration date.
- Do not attempt the test using more than 12 antibody coated tubes (two of which are **Standards**) at the same time.
- Do not exceed incubation periods prescribed by the specific steps.
- Always dispense correct number of drops and wash the number of times indicated in this guide.
- Use EPA Method 8080 or Code of Federal Regulations Title 40, Part 136, Appendix A, Method 680 to confirm results.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If Stop Solution or liquid from the extraction jar comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Standard Solution contains PCBs. Test samples may contain PCBs. Handle with care.

MECHANICAL PIPETTE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE MECHANICAL PIPETTE

To Set Or Adjust Volume

Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "030". Tighten volume lock screw and replace push-button cap.

To Assemble Pipette Tip

Slide larger mounting end of pipette tip onto end of pipette. Holding tip in place, press push-button until plunger rod enters pipette tip. Ensure no gap exists between piston and plunger rod (see illustration).

To Withdraw Sample

With tip mounted in position on pipette, press push-button to first stop and hold it.

Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample

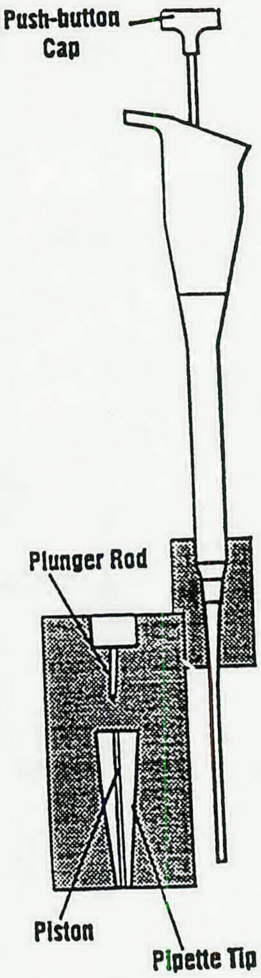
Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipette, please refer to your pipette manual.



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On-Site Quality Control/Quality Assurance Recommendations
EnSys RIS$^{c®}$ Test System

Please read the following before proceeding with field testing!

Sampling

The result of your screening test is only as valid as the sample that was analyzed. Samples should be homogenized thoroughly to ensure that the 10 grams you remove for field testing is representative of the sample as a whole. All other applicable sample handling procedures should be followed, as well.

Prior to Testing Samples

Carefully follow the instructions in the User's Guide included with every test kit. This is the key element in obtaining accurate results. In addition, store your unused test kits at room temperature and do not use them past their expiration date (see label on each test kit).

Internal Test QC

Two standards are analyzed with each sample to provide internal test system quality control. With both standards inserted in the photometer, a valid test is indicated when the magnitude . the displayed number (irrespective of the sign, + or -) is 0.20 or less. Test runs resulting in a greater number should be repeated to ensure valid conclusions.

QA/QC

The validity of field test results can be substantially enhanced by employing a modest, but effective QA/QC plan. EnSys recommends that you structure your QA/QC plan with the elements detailed below. These have been developed based on the data quality principles established by the US Environmental Protection Agency.

A. Sample documentation
   1. Location, depth
   2. Time and date of collection and field analysis

B. Field analysis documentation - provide raw data, calibration, any calculations, and final results of field analysis for all samples screened (including QC samples)

C. Method calibration - this is an integral part of EnSys RIS$^{c®}$ immunoassay tests; a duplicate calibration is performed for each set of samples tested (see the instructions in the User's Guide)

). Site-specific matrix background field analysis - collect and field analyze uncontaminated sample from site matrix to document matrix effect

E. Duplicate sample field analysis - field analyze duplicate sample to document method repeatability; at least one of every 20 samples should be analyzed in duplicate

F. Confirmation of field analysis - provide confirmation of the quantitation of the analyte via an EPA-approved method different from the field method on at least 10% of the samples; choose at least two representative samples testing below the action level or lowest test level and at least two representative samples testing above the action level; provide chain of custody and documentation such as gas chromatograms, mass spectra, etc.

G. Performance evaluation sample field analysis (optional, but strongly recommended) - field analyze performance evaluation sample daily to document method/operator performance

H. Method blank, rinsate blank field analysis (optional)

I. Matrix spike field analysis (optional) - field analyze matrix spike to document matrix effect on analyte measurement

Further Questions?

EnSys technical support personnel are always prepared to discuss your quality needs to help you meet your data quality objectives.

APPENDIX D

FIELD GC PROCEDURES FOR THE ANALYSIS OF SOIL AND GROUNDWATER SAMPLES

FIELD GC PROCEDURES FOR THE ANALYSIS OF SOIL AND GROUNDWATER SAMPLES

Both soil and groundwater samples will be collected during different phases of the current investigation. The field GC screening method presented is a modification of *EPA Region I Volatile Organic Screening for Aqueous Samples* (U.S. EPA, 1990) and is presented in Appendix B. Modifications have been made to include the soil analysis procedures.

The specific aromatic volatile organic compounds that will be analyzed for are as follows:

Benzene
Toluene
Ethylbenzene
m/p - Xylene
o - Xylene

If necessary, the compounds being analyzed for may change based on analytical data gathered from other media sampled during this field investigation or from the results found during groundwater screening and field analysis. The typical equipment requirements and analysis procedures are described below.

Equipment. The following equipment list is intended as a guide for the field team. It includes equipment for the analysis of the samples only. Additional equipment may be required depending on field conditions:

- Field GC equipped with a 10.6-eV lamp
- Volatile organic compound standards - either neat compounds or a premixed calibration standard may be used
- "Mini-nert®" vials for the preparation of concentrated standard
- High performance liquid chromatography - (HPLC) grade methanol for the preparation of concentrated standards in methanol
- Organic free water for the preparation of standards

- Volumetric flasks (5 or 10 ml) for the preparation of concentrated standards in methanol

- Two 40-ml VOA vials per sample

- Gas tight syringes - 100-μl and 500-μl volumes for sample and standard analysis

- Ultra zero grade air (GC carrier gas)

- Heated water bath - large enough to hold ten 40-ml VOA vials

- Scale accurate to 0.1 g - (soil analysis only)

- Large volume syringe - at least 40 ml for delivering water into sample containers prior to analysis (soil analysis only)

- Spare syringe needle - to act as vent during the addition of water to the soil sample containers (soil analysis only)

Field GC Analytical Procedure for Aqueous Analysis

Groundwater samples to be analyzed are contained in 40-ml VOA vials, that have been filled to a predetermined line (approximately 3/4 full). Samples and standards must be handled consistently. Therefore, all samples and standards should be brought to a constant temperature (approximately 70°C) using a water bath.

1. Samples should be placed in the water bath at least 20 minutes prior to analysis. The vials should be inverted so that the top is down.

2. Five minutes prior to analysis agitate the sample by shaking several times. Return the vial to the water bath.

3. When the sample is ready for analysis, turn the vial upright, and withdraw 50 to 100 μl of "gas" from the headspace of the vial through the vial septa using a gas-tight syringe. Larger sample volumes may be used if low concentrations of volatile organics is expected. To avoid instrument saturation use small injection volumes and high instrument sensitivities.

4. Samples may be reanalyzed, although the sample should be reagitated and warmed in the water bath for 5 minutes prior to reanalysis.

5. If an hour or more elapses before reanalysis, the sample should be kept cold and in a dark place.

Field GC Analytical Procedure for Soil Analysis

The soil analytical procedure requires the addition of water to the soil sample to bring the volume of soil and water to a constant volume (about 3/4 full - the same as the aqueous samples). The sample is then handled in the same manner as is required for the aqueous samples. A sample concentration is computed based on the wet weight of the soil sample. The following procedure describes the soil preparation procedure in detail.

1. Prior to collecting the sample it is necessary to record the weight of the 40-ml sample vial. If it is found that the sample container weights vary by less than 0.5 grams than it is not necessary weigh every sample container.

2. After the soil sample is collected weigh the half filled sample container and calculate the mass of the wet soil. Be sure to record all weights and calculations.

3. Using the large volume syringe and the spare syringe needle add enough organic free water to bring the water level to a constant volume of 3/4 full (this volume must be the same for all samples and standards). The water is added by using the large volume syringe. The spare syringe needle is used as a vent as the water is added.

4. The sample can now be analyzed in the same manner that the aqueous samples are analyzed. The results will be converted to soil concentrations as part of the data reduction.

Field GC Data Interpretation and Reduction

This section discusses compound identification and calculation of compound concentrations. In addition, unidentified peaks will be discussed.

Compound Identification. Each peak detected on a chromatogram represents the detection of at least one compound. The identity of a peak is determined by comparing its retention time (RT) to the RT of a peak created by analysis of a standard. If the sample peak is within ±5% of the standard RT then the sample peak is tentatively identified as the standard compound. Professional judgement will be used to identify peaks which fall outside of the ±5% RT window. Factors such as oven temperature, column flow rate, and injection variations (volume or timing) may be considered when making such a judgement. Compound identifications are considered tentative because other compounds, which were not calibrated for, may have the same or similar retention times. Laboratory analysis is required to confirm analysis.

Only those compounds that are present in the working standard will be identified. Compounds that do not correspond to RT of standard compounds will be reflected in the total volatile concentration.

Compound Quantitation. Once compound identification has been made, the quantity of compound present can be computed from the peak area. The following formula shows this calculation for aqueous samples:

$$\text{Concentration}(\mu g/L) = PA \times RF \times \frac{AT}{ST} \times \frac{SV}{AV}$$

where

PA = peak area of sample
RF = response factor from calibration [μg/(L x area units)]
ST = standard attenuation setting
AT = analysis attenuation setting
SV = standard injection volume (μl)
AV = analysis injection volume (μl)

In some instances the peak area calculated by the GC may be inaccurate. Professional judgement should be used to determine when this is the case. In these instances peak height measured from the chromatogram may be used rather than peak area. However, peak height must then also be used to compute the RF from the standard analysis.

Soil concentration calculations will begin with equation listed above to compute an equivalent concentration of the various contaminants in water. This concentration is then converted to a soil concentration using the following equation:

$$C_a x \frac{TV}{SM}$$

where:

C_a = Equivalent aqueous concentration calculated above (μg/L).
TV = Total volume of soil and water added prior to analysis (L).
SM = The mass of the soil in the sample vial (kg)

The total volume (TV) should be carefully measured before hand. An average volume for all of the samples can be used provided that the water is added to each of the samples to bring it to the same volume.

Quantitation of Unidentified Peaks. Frequently there are unidentified peaks and it is necessary to estimate a concentration for these peaks. A total volatile concentration is calculated by summing the areas of all of the peaks, both identified and unidentified, and multiplying it by the average of all of the standard RFs. The same formulas is used for this calculation as is used for compound quantitation described above. Although this technique is useful for comparing total volatile organic concentrations from one location to another it should not be interpreted as more than an estimate of gross volatile concentrations.

Data Reporting. Determinations of data quality will be made after review. The groundwater screening and field analysis data review will include the following:

- GC Calibrations - Both retention times and RFs from each will be compared.

- Blank Analysis - Instrument, syringe, equipment and method blanks will be reviewed to ensure that contamination has not carried over from a previous sample analysis.

- Compound Identification - Retention times will be compared to standards to ensure that compounds have been correctly identified.

- Compound Quantification - Calculations of sample concentrations will be checked.

- Matrix Spike Analysis - Some samples will be reanalyzed with the addition of a spike. The spike will be a known amount of standard compounds. Analysis and the calculation of the percent recoveries will provide an indication of the accuracy of the headspace screening method for soils and water.

AIR NATIONAL GUARD
INSTALLATION RESTORATION PROGRAM

FINAL REMEDIAL INVESTIGATION WORK PLAN

174th FIGHTER WING
NEW YORK AIR NATIONAL GUARD
HANCOCK FIELD
SYRACUSE, NY

QUALITY ASSURANCE PROJECT PLAN

June 1995

QAPP

Hazardous Waste Remedial Action Program
Environmental Restoration and Waste Management Programs
Oak Ridge, Tennessee 37831-7606
Managed by MARTIN MARIETTA ENERGY SYSTEMS, INC.
For the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-840R21400

AIR NATIONAL GUARD
INSTALLATION RESTORATION PROGRAM

REMEDIAL INVESTIGATION
PETROLEUM, OIL, LUBRICATION (POL) AREA

for

174th Fighter Wing
New York Air National Guard
Hancock Field
Syracuse, NY

General Order No. 91B-99791C
Work Release No. K-06

23 June 1995

FINAL
QUALITY ASSURANCE PROJECT PLAN

Submitted to:

AIR NATIONAL GUARD READINESS CENTER
ANDREWS AIR FORCE BASE, MARYLAND

Submitted by:

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
MARTIN MARIETTA ENERGY SYSTEMS, INC.

For the:

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NOTICE

This plan has been prepared for the Air National Guard Readiness Center (ANGRC) for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the plan relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this plan and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this document premature or inaccurate. Acceptance of this document in performance of the contract under which it is prepared does not mean that the ANGRC adopts the conclusions, recommendations or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the Air National Guard Readiness Center.

PREFACE

The objective of this quality assurance program is to ensure that all measurement, data gathering, and data generation activities yield data that are of adequate quality for the intended use. The key to achieving this objective is the successful implementation of a sampling and analysis plan (SAP). The SAP consists of three parts: (1) the field sampling plan (FSP), which provides guidance for all field work by defining in detail the sampling and data-gathering methods to be used on a project; (2) this document, the quality assurance project plan (QAPP), which describes the policy, organization, functional activities, and quality assurance and quality control protocols necessary to achieve data quality objectives dictated by the intended use of the data; and (3) the health and safety plan (HSP), which summarizes site hazards and defines protective measures to be taken for the site.

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LIST OF ACRONYMS AND ABBREVIATIONS

AFCEE	Air Force Center for Environmental Excellence
ANG	Air National Guard
ANGRC	Air National Guard Readiness Center
ARAR	Applicable or Relevant and Appropriate Requirement
API	American Petroleum Institute
ASTM	American Society of Testing and Materials
AWQC	ambient water quality criteria
BOD	biological oxygen demand
BTEX	benzene, toluene, ethylbenzene, xylenes
CADD	Computer Assisted Design Drawing
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COC	Chain-of-Custody Chemicals of Concern
CGI	Combustible Gas Indicator
CRP	Community Relations Plan
CRQL	Contract Required Quantitation Limit
CS	Confirmatory Study
DD	Decision Document
DDD	p,p'-dichlorodiphenyl dichloroethane
DDE	p,p'-dichlorodiphenyl dichloroethylene

LIST OF ACRONYMS AND ABBREVIATIONS

DERA	Defense Environmental Restoration Act
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	Department of Transportation
DQO	Data Quality Objective
DRO	diesel range organics
EB	equipment blank
EIS	Environmental Impact Study
EPA	Environmental Protection Agency
ES	Engineering-Science, Inc.
FB	Field Blank
FFS/RM	Focused Feasibility Study/Remedial Measure
FID	Flame Ionization Detector
FONSI	Finding of No Significant Impact
FR	Federal Register
FS	Feasibility Study
FSP	Field Sampling Plan
FW	Fighter Wing
GC	Gas Chromatograph
HAZWRAP	Hazardous Waste Remedial Actions Program
HSP	Health and Safety Plan

LIST OF ACRONYMS AND ABBREVIATIONS

HCl	Hydrogen Chloride
HPLC	High Performance Liquid Chromatography
IDLH	Immediately Dangerous to Life or Health
IRP	Installation Restoration Program
ITIR	Informal Technical Information Document
JP	Jet Propellant
JP-4	Jet Propellant #4
JP-5	Jet Propellant #5
JP-8	Jet Propellant #8
JRB	JRB Associates
KCl	Potassium Chloride
LEL	Lower Explosive Limit in air, % by volume
LNAPL	Light Non-Aqueous Phase Liquid
LUFT	Leaking Underground Fuel Tank
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MEMW	Metcalf & Eddy monitoring well
mg/kg	milligrams per kilogram
MMES	Martin Marietta Energy Systems
MW	monitoring well
μg/L	microgram per liter

LIST OF ACRONYMS AND ABBREVIATIONS

MS/MSD	matrix spike/matrix spike duplicate
NAPL	Non-Aqueous Phase Liquid
NET	National Environmental Testing
NTU	National Turbidity Units
NYANG	New York Air National Guard
NYSDEC	New York State Department of Environmental Conservation
OSHA	Occupational Safety and Health Administration
OVA	Organic Volatile Analyzer
Pest	pesticide
PCB	Polychlorinated Biphenyl
PEL	Permissible Exposure Limit
PID	Photoionization Detector
POL	Petroleum, Oil and Lubricant
ppb	parts per billion
PPE	Personal Protective Equipment
P/PCB	Pesticides and Polychlorinated Biphenyls
ppm	parts per million
PVC	polyvinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control

LIST OF ACRONYMS AND ABBREVIATIONS

RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RM	Remedial Measure(s)
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SAS	Special Analytical Services
SGSP	Soil Gas Survey Plan
SI	Site Investigation
SOP	Standard Operating Procedure
SOW	Statement of Work
SSHP	Site Specific Health & Safety Plan
STEL	Short-Term Exposure Limit
SVOC	Semivolatile Organic Compounds
TAGM	Technical and Administrative Guidance Memorandum (NYSDEC)
TAL	Target Analyte List
TB	Trip Blank
TCO	Total Combustible Organics
TEL	Threshold Exposure Limit

LIST OF ACRONYMS AND ABBREVIATIONS

TLV	Threshold Limit Value
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
UEL	Upper Explosive Limit in air, % by volume
ULI	Upstate Laboratories, Inc.
U.S.	United States
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WP	Work Plan

1.0 INTRODUCTION

The Installation Restoration Program (IRP) is an environmental program developed by the Department of Defense (DOD) for assessing and remediating hazardous waste problems on military installations. The program is DOD's response to the requirements of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA or Superfund) which requires all federal agencies to comply fully with its procedural substantive requirements. The program was formally designated as the DOD CERCLA program on November 21, 1981.

The activities to be conducted at the Base were determined from the statement of work for the investigation, and discussions and comments from ANGRC, NYSDEC and HAZWRAP. The basic program will consist of the following:

- Field investigation comprised of soil survey, soil borehole sampling, monitoring well installation, development and sampling; in-situ permeability testing; surface water and sediment sampling; and surveying
- Data evaluation
- Define nature and extent of contamination
- Identify Federal/State chemical and location-specific ARARs

This Quality Assurance Project Plan (QAPP) is written to accompany the RI Work Plan, the Field Sampling Plan, and the Health & Safety Plan.

2.0 PROJECT DESCRIPTION

Information as to the site location, description, and history is provided in this section. The scope of the project and the objectives of this investigation are also presented, along with an overview of the planned field investigation activities and associated laboratory analyses.

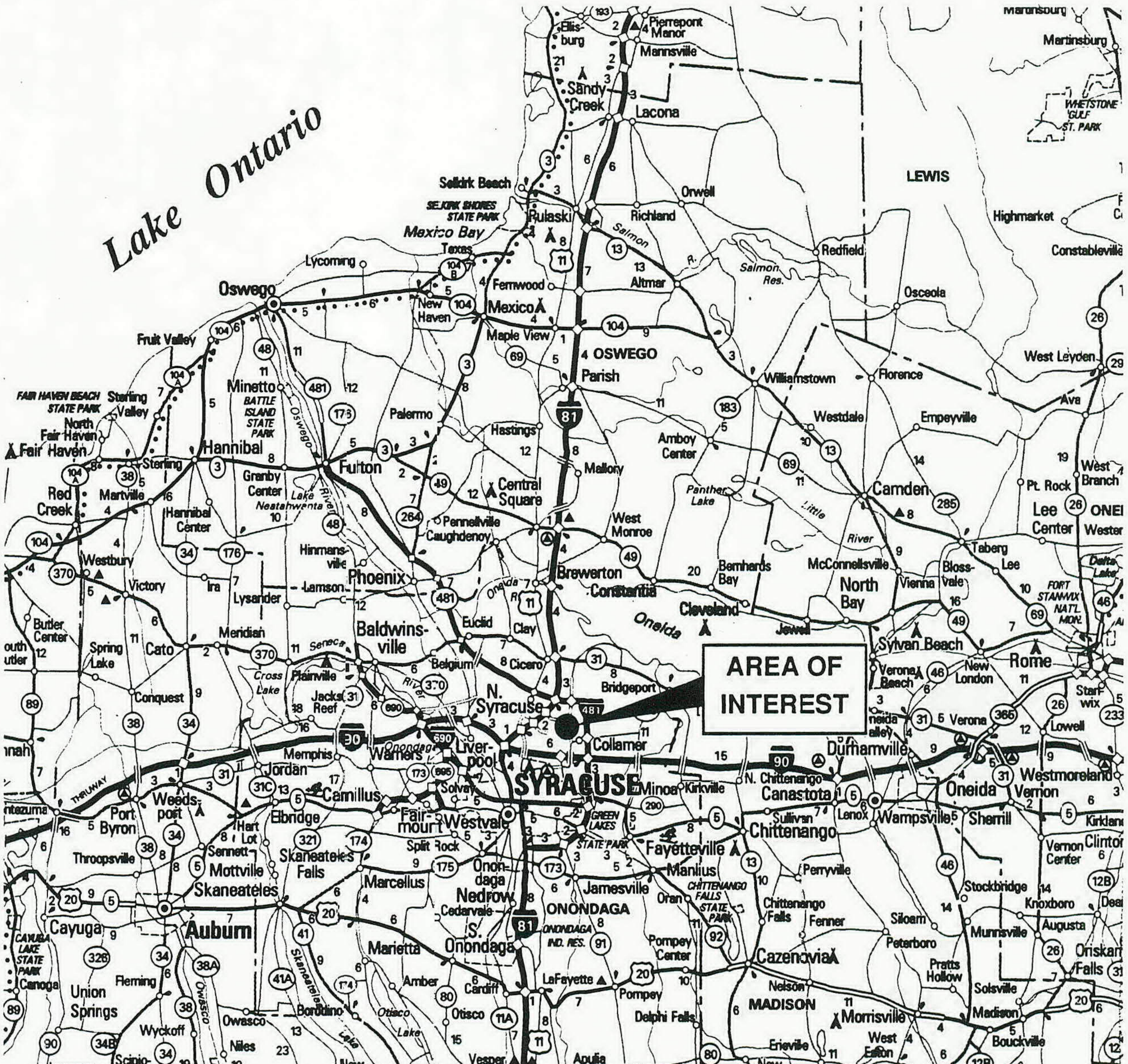
2.1 INSTALLATION LOCATION

Hancock Field, home of the 174th Fighter Wing (FW) of the New York Air National Guard (NYANG) is located approximately 5 miles north-northeast of Syracuse, in Onondaga County in central New York, as shown on Figure 2-1. Hancock Field was built in 1942 as a staging area for warplanes during World War II. Much of the airbase, including the runways, was converted to civilian use as Syracuse Hancock International Airport. The 174th FW of the NYANG is bordered to the east and south by the town of Dewitt, to the north by the town of Cicero, to the west by the town of Salina, and to the northeast by Syracuse International Airport. The facility encompasses 765 acres (SAIC, 1986) and is situated approximately 415 feet above sea level.

2.2 SITE DESCRIPTION

A description of the site known as the petroleum, oil, lubricant (POL) area, is presented below. Much of the information on the POL Area is taken from the 1992 site investigation report (M&E, 1992) with additional information from the 1994 confirmatory study report (M&E, 1994). The location of the site is shown in Figure 2-2.

The POL Area is a 2.5 acre (M&E, 1991) section of Hancock Field, NYANG. The layout of the area is shown in Figure 2-3. The area includes a fuel pumping building, a set of underground tanks currently containing jet propellant #8 (JP-8), and systems for transferring fuel to and from tanker trucks. There is one large above-ground storage tank, and six underground tanks. Each of the six underground tanks are located under the pump building,



SOURCE: 1991 AAA MAP OF NEW YORK

FIGURE 2-1. LOCATION OF HANCOCK FIELD, NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK

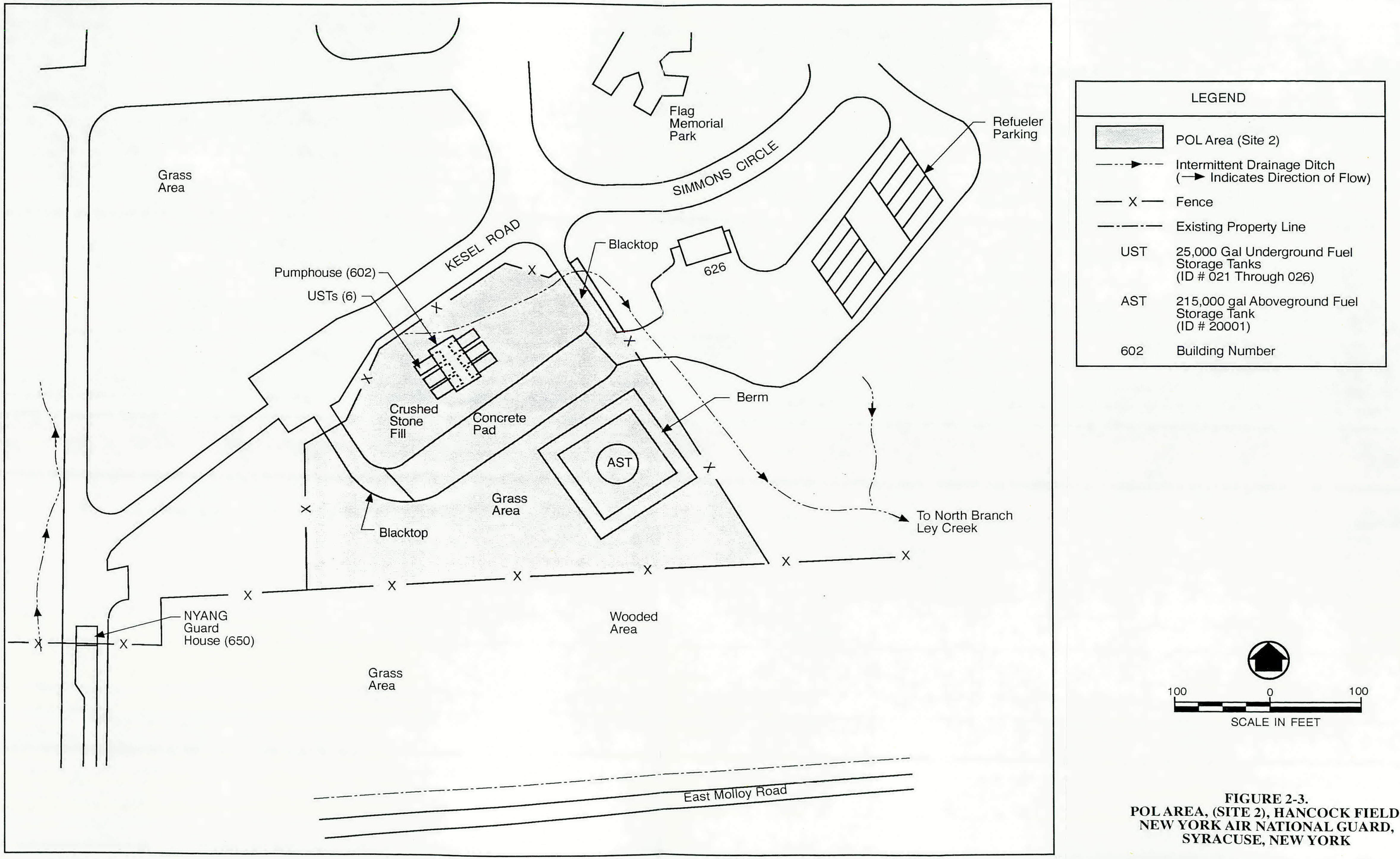
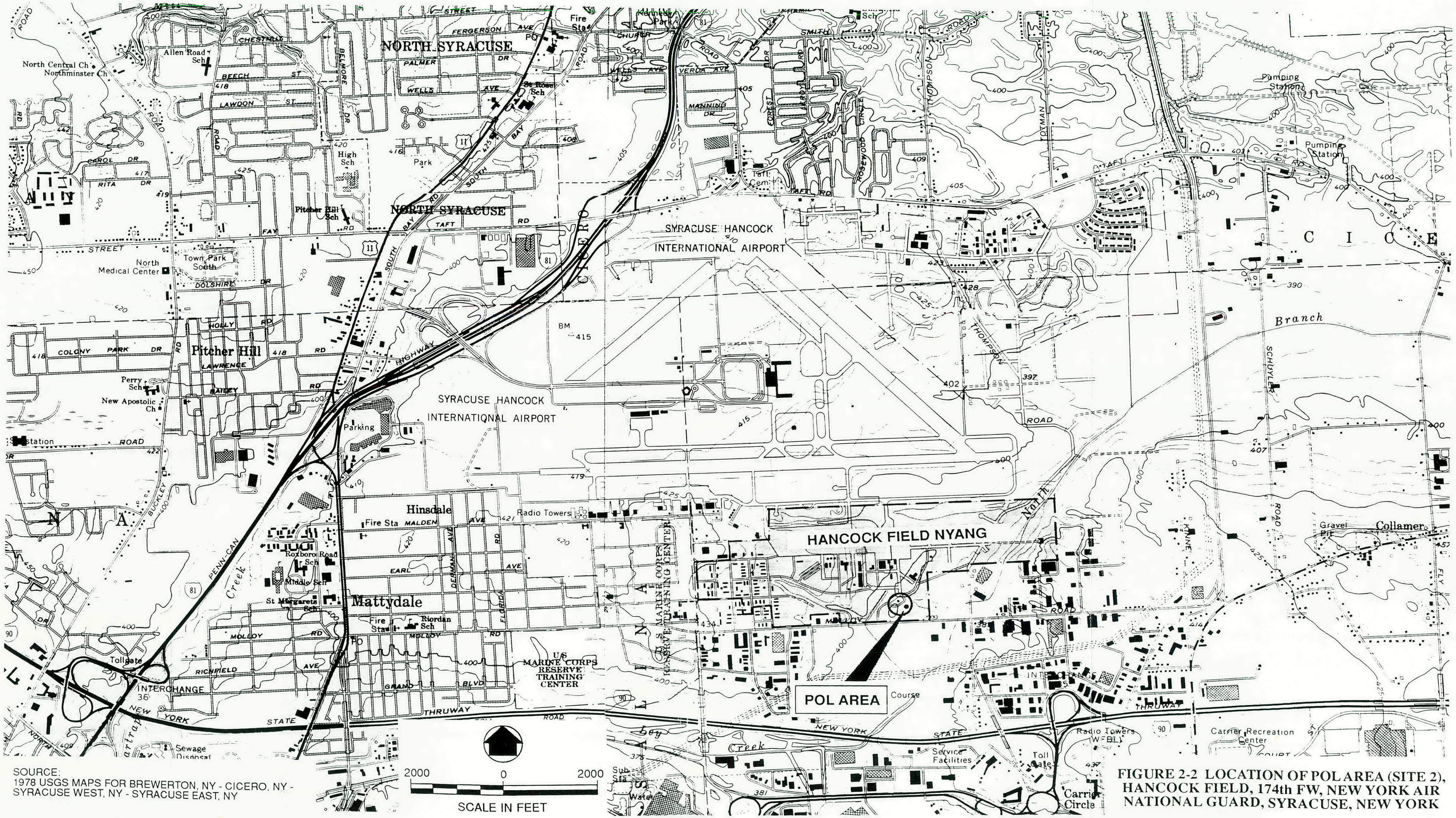


FIGURE 2-3.
POL AREA, (SITE 2), HANCOCK FIELD, NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK



SOURCE:
1978 USGS MAPS FOR BREWERTON, NY - CICERO, NY - SYRACUSE WEST, NY - SYRACUSE EAST, NY

FIGURE 2-2 LOCATION OF POL AREA (SITE 2), HANCOCK FIELD, 174th FW, NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK with a pipe protruding above the ground surface outside of the building. The depth of the fuel in each tank is measured by placing a large dipstick down through each pipe.

2.3 SITE HISTORY

Several documents have discussed in detail background information pertaining to Hancock Field. Specifically:

- The Site Investigation (SI) Management Work Plan (M&E, 1991), section 3.0, provides a description of the installation location and a brief description of the site under investigation, based on the information available prior to the Site Investigation.
- The SI Field Sampling Plan (M&E, 1991), section 2.0, contains a similar description as well as a summary of investigations conducted at the site prior to the site investigation, and a discussion of the regional geology and hydrogeology.
- The SI Report (M&E, 1992) provides more detail as to the history of land use on both a regional and a site-specific basis. It also provides more detail as to the regional and site-specific geology and hydrogeology discussions.
- The SI Confirmatory Study Report (M&E, 1994), section 1.3.1, contains an overview of site background, similar to the one presented below, with all information available prior to the most recent study, conducted in late June and early July of 1994.

Three potentially significant spills have occurred in this area. The first was a release of PCBs, presumably from transformers at the southeast end of the pump house, which occurred prior to the 1980s. The second was a release of an estimated 2,000 gallons of jet propellant inside of the pump house in January 1990. Some of the released fuel reportedly flowed out of the doors of the building. The third and most recent spill occurred on June 12, 1994. Approximately 150 gallons of JP-8 was released from tanks located on the northeast side of the building.

The JP-4 spill of 1990 precipitated the installation of four monitoring wells in the area, and four sampling events, involving groundwater, pit wipes and samples from the pump house sump, and soil removed from the spill area. The results of these sampling events indicated the need for further investigation. Consequently, further investigation of the POL area, in the form of a Site Investigation (SI) was undertaken in the fall of 1990. In order to provide more current data with which to direct this remedial investigation, a SI confirmatory study was conducted in the summer of 1994. The results of the 1990 SI and the 1994 confirmatory study are summarized below. A groundwater contour map with the location of the existing groundwater monitoring wells is presented in Figure 2-4.

Analytical Results. In November and December 1990, PCBs were detected in samples of seepage water taken from inside the pump house and in near-surface soil samples collected from soil borings in the vicinity of the pump house. In the seepage water, positive results were as high as 120 ppb for Aroclor-1260 and 15 ppb for Aroclor-1254. There were indications that PCBs were present beneath the pump house. Positive results for the subsurface soils ranged from non-detectable to 240,000 ppb for Aroclor-1260. Contamination was greatest at the area immediately south of the building and at the area to the west. The horizontal and vertical extent of the PCB contamination to the south and east of the pump house were not established, nor was the extent of the PCB-contaminated soil beneath the building determined.

In 1994, Aroclor-1260 was detected in groundwater samples from the monitoring well located immediately south of the pump house, which suggests that the previously-identified PCB contamination is present in soil in the immediate vicinity of that monitoring well.

In 1990, samples of groundwater, seepage from a sump located in the pump house, surface water and sediment were analyzed for jet propellant contamination. Some samples of groundwater, sediment and sump water showed petroleum hydrocarbons consistent with a jet propellant source. No hydrocarbons were detected in the surface water. The results obtained from seepage water samples indicated that there were hydrocarbons beneath the

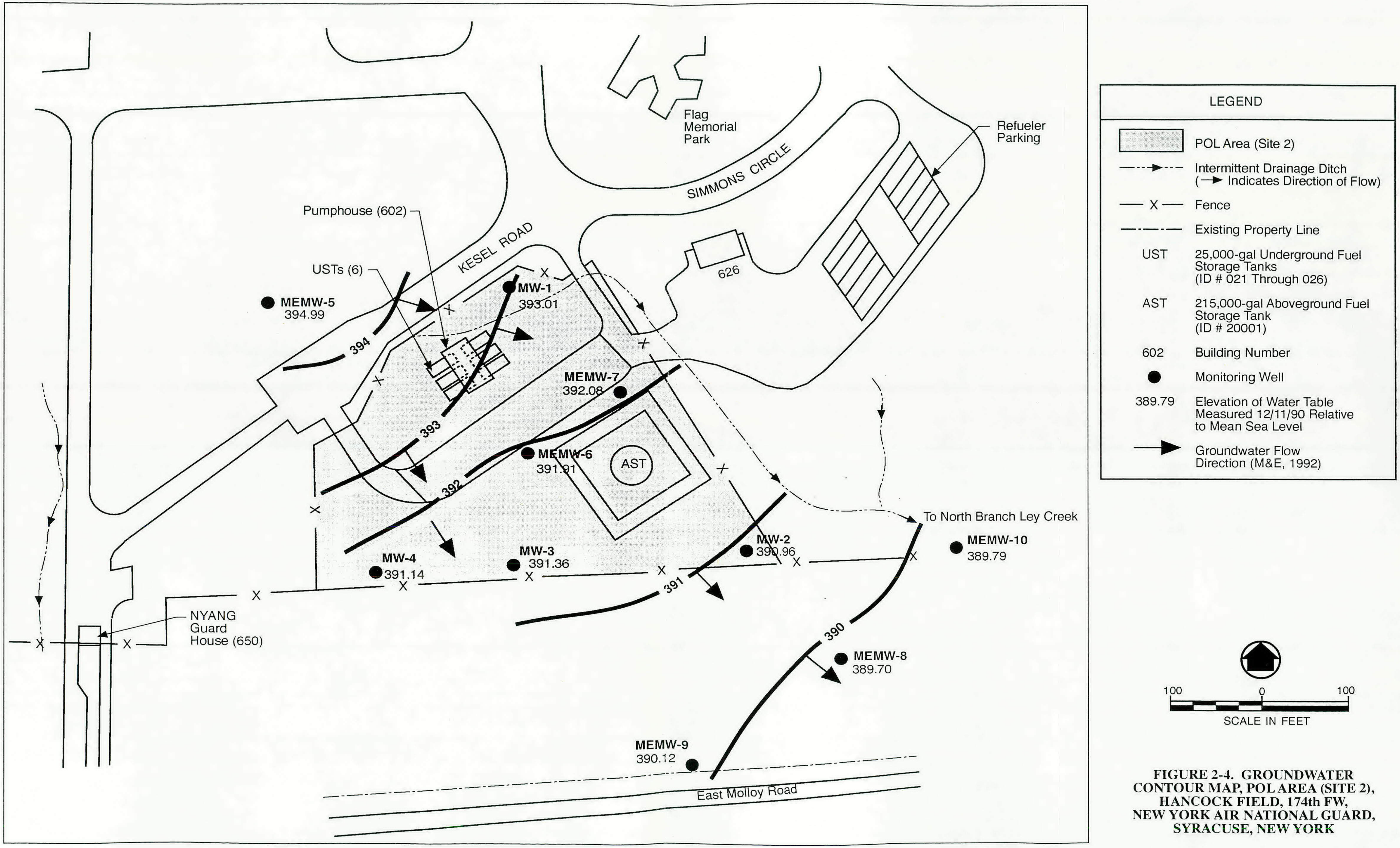


FIGURE 2-4. GROUNDWATER CONTOUR MAP, POL AREA (SITE 2), HANCOCK FIELD, 174th FW, NEW YORK AIR NATIONAL GUARD, SYRACUSE, NEW YORK

pump house. Groundwater contamination was greatest (2.3 ppm total petroleum hydrocarbons (TPH) and 3,020 ppb total for benzene, toluene, ethylbenzene, and xylene (BTEX)) in MEMW-06, the monitoring well closest to, and down-gradient of the south side of the pump house. For the SI, the contemporary extent of the petroleum contamination in groundwater was defined and contamination was only detected as far south as MW-02 and MW-03.

In the confirmatory study of 1994, groundwater samples analyzed for contamination related to jet propellant indicated that contamination had still not migrated to the monitoring wells farthest down-gradient (MEMW-08, MEMW-09, MEMW-10), nor had the jet propellant contamination extended as far west as the western-most monitoring well (MW-04). BTEX concentrations detected ranged from 260 ppb to 1700 ppb. Jet propellant contamination as indicated by diesel-range organics ranged from 1550 ppb to 3130 ppb. Concentrations were highest in the monitoring well located south of the pump house (MW-02), farther down-gradient from MEMW-06, where the highest concentrations of petroleum-related contamination were reported in 1990.

Geology and Hydrology. Fine grained sediments, typical of a glacial lacustrine depositional environment, were found in this area. Water levels measured from five to twelve feet below the ground surface. Groundwater flow was east in the direction of Ley Creek (see Figure 2-4). Low hydraulic conductivities and gradients indicated low linear groundwater flow velocities on the order of 3 to 40 ft/year.

Risk Evaluation. A short-term risk evaluation was performed as part of the SI to determine whether remediation of the site could be reasonably postponed until after the base was decommissioned, which was at that time scheduled for 1994. It was felt that it would be more practical and cost-effective to remediate the area after its decommissioning rather than during its active operation. The risk evaluation determined that delaying remediation of the site until after decommissioning was completed would not result in a significant health risk, so long as precautionary measures are taken, and periodic sampling is conducted.

2.4 PROJECT SCOPE AND OBJECTIVES

Site-specific geologic, hydrogeologic, and analytical data are incomplete or lacking for the study site. Further field investigation is necessary to provide or supplement site-specific data to both establish risk and develop remediation approaches. The RI is designed to provide information on the following data gaps:

- Extent of PCB contamination in groundwater, sediment and soil
- Vertical extent of jet propellant contamination in soil
- Extent of jet propellant contamination in groundwater
- Lithologic features of the aquifer materials
- Groundwater quality upgradient of the jet propellant spill areas
- Confirmation of local groundwater flow direction
- Potential impact of site contamination on surface water and sediment

The chemical analysis data which will be generated from this work are intended to be used to define the nature and extent of contamination, and remedial design. Data of sufficient quality and quantity are required to determine with confidence what remedial actions are required at the site. Such a determination will depend, in part, on the extent of contamination, and on comparison to chemical-specific ARARs.

Activities to be performed during this remedial investigation are discussed in terms of a soil investigation, and a groundwater investigation. Activities to be conducted for the soil investigation include the following:

- Performance of a soil survey of forty (40) points (with an option for twenty (20) additional points) comprising the whole of the area to quickly and roughly determine the extent of petroleum-related contamination in the source area, thereby directing the placement of soil borings in the area

- Installation of twenty (20) soil borings, with a contract option for six (6) additional borings, all to depths of twelve (12) feet except for PCB borings which will stop two (2) feet above the water table

- Performance of semi-quantitative analysis for PCB contamination with EnSys© Immunoassay Field Test Kits on soil samples collected at two-foot intervals from eight (8) of the twenty (20) boreholes

- Collection of up to three (3) samples from each of the PCB soil borings contingent upon results of the EnSys© kits

- Performance of field-screening for petroleum-related contamination using a gas chromatograph with a photoionization detector (GC/PID) on samples collected at two-foot intervals from all boreholes

- Collection of two (2) samples and one (1) optional sample from each of the ten (10) petroleum-screened borings for laboratory analysis for jet-propellant-contamination

- Collection of two (2) samples from each of the two (2) upgradient, background borings for laboratory analyses for jet-propellant-related contamination

- Geotechnical testing on one (1) sample from each of seven (7) boreholes

Activities relating to the groundwater investigation include the following:

- Installation of four (4) shallow overburden monitoring wells (this includes one to replace the damaged background monitoring well, MEMW-05) with a contract option for one (1) additional deep overburden monitoring well

- Field GC screening of soils collected from monitoring well borings to determine the best interval for well screen placement

- Collection of one round of groundwater samples for laboratory analyses and measurement of water levels at each of the four (4) new (plus 1 optional) and nine (9) existing monitoring wells

- Performance of slug testing at each of the four (4) new (plus 1 optional) and nine (9) existing monitoring wells to determine the rising and falling head pressures

- Collection of two (2) surface water and four (4) sediment samples from the drainage ditch located at the site for laboratory analyses

- Geotechnical testing on one (1) sample from each new monitoring well bore hole

The locations of the soil borings and monitoring wells will be based on the contractor's review and analysis of the results from the previous SI and confirmatory study. Placement of the soil borings will be directed by information obtained from the soil survey and the field screening for PCBs. A more detailed description of the rationale for sampling locations and sampling frequency are described in Section 2.0 of the accompanying FSP.

A complete listing of the laboratory analyses to be performed is provided in Section 5.0 of this QAPP. Samples to be submitted for analyses as part of the soil investigation are as follows:

PCB-Related Borings. Up to three (3) soil samples will be collected from each of eight (8) soil borings and analyzed for pesticides/PCBs (polychlorinated biphenyls). One soil sample will be collected from each of two soil borings for selected geotechnical parameters.

Jet-Propellant-Related Borings. Two (2) soil samples will be collected from each of ten (10) jet-propellant-related borings, for a total of twenty (20) soil samples. Eight (8) extra soil samples are allowed for areas that appear to be more contaminated. All jet-propellant-related soil samples will be analyzed for the following analyses:

- VOCs (volatile organic compounds)
- SVOCs (semivolatile orgasmic compounds)

Pesticides/PCB samples will be collected at the surface and just above the water table. Ten (10) samples will also be analyzed for TOC (total organic compounds)

Five (5) samples will be selected for geotechnical analysis, one from each of five of the ten borings. Six (6) additional soil borings are considered optional and will only be sampled with HAZWRAP approval. Two (2) or three (3) soil samples would be collected for the above jet-propellant-related parameters from each optional soil boring.

Background Borings. Two (2) samples will be collected from two (2) upgradient background borings for a total of four (4) soil samples and analyzed for VOCs, and SVOC.

Samples to be submitted for analyses as part of the groundwater investigation are listed below. Temperature, pH, conductivity, and turbidity will be measured for all groundwater and surface water samples.

Groundwater. One (1) sample from each of the thirteen (13) definite and one (1) optional monitoring wells will be collected for the following analyses:

- VOCs
- SVOCs
- Pesticides/PCBs

In addition to the above listed organic parameters, samples will be collected from the four (4) wells (one sample per well) expected to show the highest levels of jet-propellant-related contamination for the following parameters:

- TAL total metals
- Total Suspended Solids (TSS)
- Biological Oxygen Demand (BOD)

Soil. One (1) sample will be collected during installation of each of the four (4) newly installed monitoring wells and tested for selected geotechnical parameters.

Sediment. Four (4) samples will be collected for the following analyses:

- VOCs
- SVOCs
- Pesticide/PCBs

Surface Water. Two (2) samples will be collected for the following analyses:

- VOCs
- SVOCs
- Pesticide/PCBs

The analytical data generated from this work is intended for use in site characterization and site remediation. The quality and quantity of this data must be sufficient to accomplish these ends.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project team organization and the responsibilities of project personnel for the Hancock NYANG Base Remedial Investigation (RI) are described in this section.

3.1 PROJECT STAFFING

Project management is required to coordinate and monitor the work and to ensure timely completion of the work. Specific activities include scheduling adequate staff, preparing budgetary cost estimates, updating the project schedule, attending coordination meetings, preparing monthly reports, submitting invoices, and responding to the specific needs of the client.

3.1.1 Organization

The field team for this project RI includes:

- Program Manager
- Project Manager
- Quality Assurance Officer
- Health and Safety Officer
- Hydrogeologist/Project Scientist
- Chemist
- Subcontract Administrator

Figure 3-1 presents an organizational chart for the RI team. Subcontractors will be used to provide crews and equipment for drilling, surveying, and offsite laboratory analyses. The responsibilities of the various subcontractors are discussed in Section 3.3.

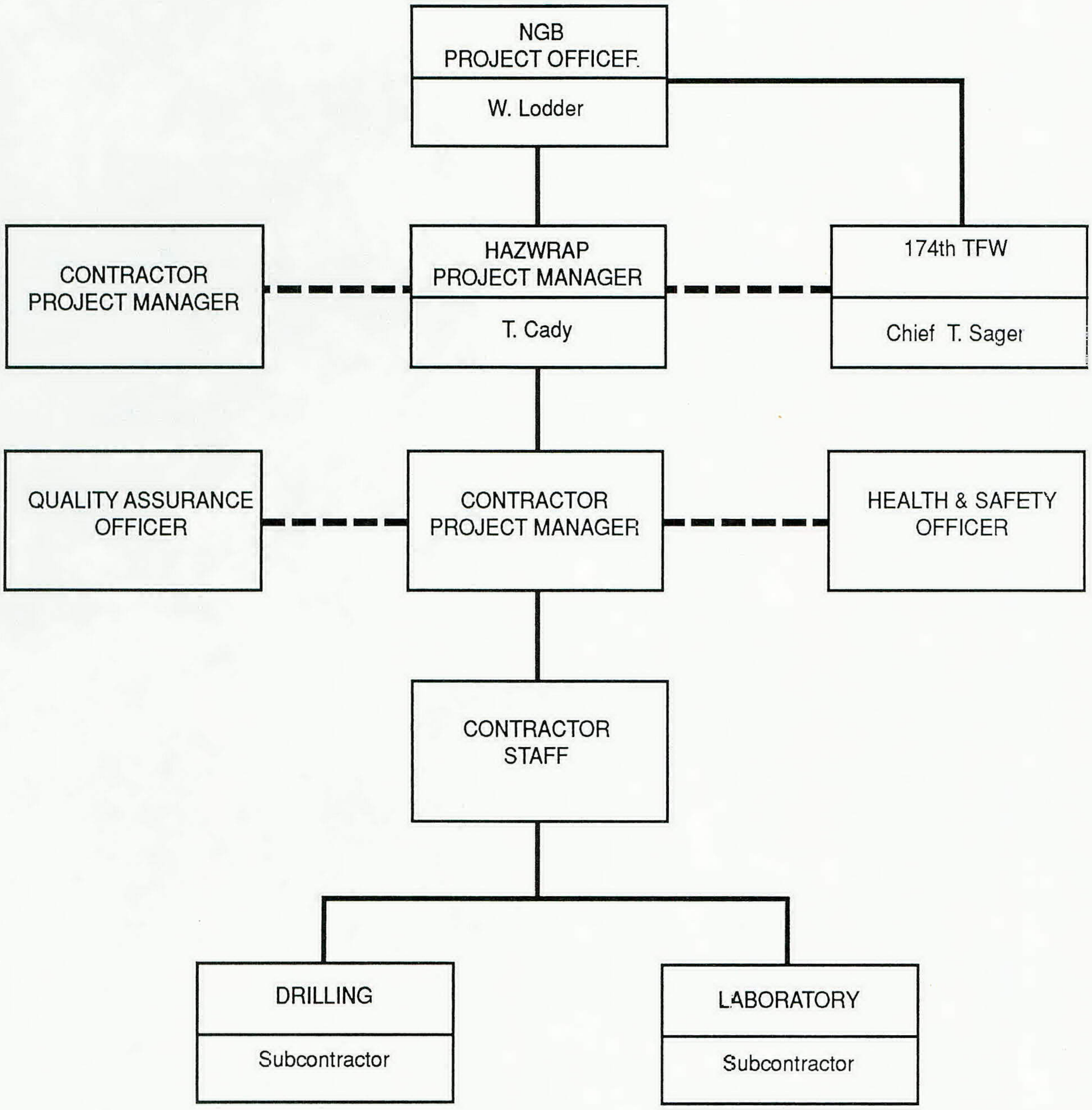


FIGURE 3-1. ORGANIZATION CHART

3.2 RESPONSIBILITIES OF PROJECT PERSONNEL

Specific responsibilities of project personnel are summarized below.

3.2.1 Program Manager

The program manager is responsible for executing all contractual obligations. This individual serves as the primary program point of contact for the client and provides an interface between the client and the project staff.

3.2.2 Project Manager

The project manager is responsible for ensuring that all activities are conducted in accordance with this work plan and within the overall contractual obligations. The project manager also provides technical coordination with the HAZWRAP project manager. This individual will monitor the project budget and schedule and ensure the availability of necessary personnel, equipment, subcontractors, and services. The project manager will participate in developing the field program and also will have primary responsibility for the technical quality of all products. This individual is responsible for preparing progress reports and reviewing the financial progress of the project.

3.2.3 Quality Assurance Officer

The quality assurance officer (QAO) is responsible for ensuring that all QA objectives of the project are met, reviewing selected field and analytical data to ensure adherence to QA/QC procedures, and approving the quality of data before they are included in the RI decision making process.

3.2.4 Health and Safety Officer

The health and safety officer will review and approve the health and safety plan tailored to the specific needs of this investigation. In consultation with the project manager, this individual will ensure that an adequate level of personal protection exists for anticipated potential hazards for all field personnel. As the health and safety officer does not report to either the program or project manager, his actions are not dictated by any program or project constraints (such as budget and schedule) other than the assurance of appropriate safeguards for staff conducting the RI activities.

The project manager will appoint, in coordination with the health and safety officer, an on-site health and safety officer to implement and assure adherence to the Base-specific Health & Safety Plan. The on-site health and safety officer will monitor the breathing zone with air monitoring equipment and notify on-site personnel of any change in personal protective equipment requirements to assure safety.

3.2.5 Project Staff

A number of staff will be assigned to the project to complete the various tasks. Specialists utilized will include a hydrogeologist/project scientist, chemist, and subcontract administration.

3.3 SUBCONTRACTORS

As noted in Section 3.1, subcontractors will be responsible for conducting drilling, surveying, and offsite laboratory analyses. The tasks, the subcontractors selected for these tasks, and their responsibilities with respect to these tasks are presented in this section.

3.3.1 Drilling

The drilling subcontractor will be responsible for the installation and development of monitoring wells, the installation of soil borings, and the collection of split-spoon soil samples from the monitoring well and soil borings. The subcontractor will be familiar with and will conduct all operations according to the applicable HAZWRAP standard operating procedures and quality control guidelines.

3.3.2 Surveying

The subcontractor chosen for the site survey will be responsible for providing the coordinates and elevation of all new monitoring wells and soil borings, as well as local permanent structures to be used as reference points. Coordinates will be tied into the New York State coordinate system, and elevation will be tied into the National Geodesic Survey. The subcontractor will be familiar with and will perform all tasks related to this site according to the applicable HAZWRAP quality control measures and standard operating procedures.

3.3.3 Laboratory Analysis

The subcontract laboratory chosen will be certified by HAZWRAP and the State of New York. As HAZWRAP has requested CLP analyses be performed, the subcontract laboratory will be familiar with CLP methods as well as all applicable HAZWRAP QA/QC and standard operating procedures, and will perform all analyses and reporting according to HAZWRAP guidance. The subcontract laboratory will be responsible for performing analyses on all samples collected from the site, and submitting the results of those analyses to the Contractor.

4.0 QUALITY ASSURANCE OBJECTIVES

Quality assurance objectives developed for this project are discussed in the following sections. Comprehensive QA objectives for the field investigation program provide guidelines for field and laboratory procedures. The intention of the sampling and analysis effort is to produce data of sufficient quality to allow for accurate evaluation of the nature and extent of site contamination, accurate evaluation of site characteristics, risk assessment, and site remediation.

The primary QA objectives for this RI are that all measurements be representative of actual site conditions, that all data resulting from sampling and analysis activities be comparable, and that the quality of the data obtained be known and documented. The use of accepted and published sampling and analysis methods as well as the use of standardized units, will aid in ensuring the comparability of the data.

4.1 PROJECT DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) for this RI were selected to satisfy the needs of all those who will be using the data collected during the RI. These include the New York Air National Guard, NYSDEC, HAZWRAP, the Contractor project manager, and the technical staff for site characterization, risk assessment, and evaluation of remedial alternatives.

In order to achieve the RI data quality objectives (DQOs), a combination of laboratory services, field analyses, and field screening will be used and are discussed below. To ensure that data of known and documented quality are obtained, each of the analyses in these categories will be performed and evaluated according to the appropriate HAZWRAP level of quality control (HAZWRAP DOE/HWP-69/R1 and DOE/HWP-65/RI) as presented below:

Field Screening (Level A). Field screening will provide the lowest data quality, but the fastest results. These data will be qualitative rather than quantitative. The purpose of the field screening is twofold: 1) screening data will be used at the site for health and safety monitoring; and 2) preliminary screening will identify those samples requiring confirmation sampling (Level C). Field screening Level A analyses include the following:

- Health and safety screening for total organic vapors (FID and/or PID)
- Screening of split-spoon samples for total organic vapors
- Measurement of groundwater pH, conductivity, temperature, and turbidity

Field Analyses (Level B). Level B field analyses will provide quantitative or semi-quantitative information. Those analyses which will be performed according to Level B quality control criteria include the following:

- Analysis for selected volatile organics in soil and groundwater by field gas chromatograph (GC)
- Semi-quantitative analysis for PCBs by EnSys© Immunoassay Field Test Kits

Subcontract Laboratory Analyses (Level C). Laboratory analyses to be conducted by subcontracted laboratories will be performed to meet Level C QC criteria. These include the following:

- Geotechnical analyses for soil characterization
- Analyses for confirmation of field results and for risk assessment

4.2 QUALITY ASSURANCE OBJECTIVES OF ANALYTICAL DATA

As stated in Section 4.2, the chemical analysis data which will be generated from this work are intended to be used for determination of the extent of contamination and remedial design. Data of sufficient quality and quantity are required to determine with confidence what remedial actions are required at the site. Such a determination will depend, in part, on the extent of contamination and on comparison to chemical-specific ARARs.

The five major characteristics of data quality as they apply to environmental sampling and analysis are defined below. Specific QA objectives pertinent to this field investigation program are presented in Sections 10 and 13 of this QAPP.

4.2.1 Accuracy

Accuracy is defined as the degree of agreement of a measurement (or measurement average) with an accepted reference or true value. It is a measure of system bias and is usually expressed as a percentage of the true value. An evaluation of accuracy incorporates both laboratory and field sampling variables.

Accuracy will be determined in the laboratory through the use of matrix spike and matrix spike duplicate (MS/MSD) analyses. Accuracy criteria for the CLP methods and non-CLP methods chosen for this project are defined in the method protocol and are listed in Tables 4-1 and 4-2. Accuracy criteria for field measurements are listed in Table 4-3.

The field team will select one environmental sample in 20 or fewer samples or one in every sample delivery group to be analyzed for accuracy for each matrix being submitted. The resulting MS/MSD analysis will be used to evaluate accuracy and precision for organic analyses. The matrix spike analyses will be used to evaluate accuracy for inorganic analyses. Matrix effects may affect the analyte recoveries of the spiked compounds. The percent recoveries of the target compounds will be calculated and used as an indication of the accuracy of the analyses performed.

Laboratory accuracy will also be ensured by the analysis of method blanks and, in inorganic analyses, by the laboratory control standard (LCS). The blanks will be prepared in the laboratory in a similar fashion as the associated samples of a particular matrix (i.e., soil, water, etc.) and analyzed along with these samples. The LCS is analyzed for each batch of samples analyzed for metals. The results of these analyses are a measure of the preparation accuracy and serve as a check on any sample contamination that may be encountered during sample preparation.

TABLE 4-1. LABORATORY QA OBJECTIVES: GROUNDWATER/SURFACE WATER ANALYSES

Parameter/Analytical Level (1)		Precision(2) (as RPD)	Accuracy(3) (Recovery)	Completeness
INORGANIC ANALYSES				
TAL Metals (CLP)	**Level C**			
Aluminum		20%/30%	75-125%	90%
Antimony		20%/30%	75-125%	90%
Arsenic		20%/30%	75-125%	90%
Barium		20%/30%	75-125%	90%
Beryllium		20%/30%	75-125%	90%
Cadmium		20%/30%	75-125%	90%
Calcium		20%/30%	75-125%	90%
Chromium		20%/30%	75-125%	90%
Cobalt		20%/30%	75-125%	90%
Copper		20%/30%	75-125%	90%
Iron		20%/30%	75-125%	90%
Lead		20%/30%	75-125%	90%
Magnesium		20%/30%	75-125%	90%
Manganese		20%/30%	75-125%	90%
Mercury		20%/30%	75-125%	90%
Nickel		20%/30%	75-125%	90%
Potassium		20%/30%	75-125%	90%
Selenium		20%/30%	75-125%	90%
Silver		20%/30%	75-125%	90%
Sodium		20%/30%	75-125%	90%
Thallium		20%/30%	75-125%	90%
Vanadium		20%/30%	75-125%	90%
Zinc		20%/30%	75-125%	90%
ORGANIC TCL ANALYSES				
Volatile Organics Low Level CLP (10/92 SOW)	**Level C**			
Chloromethane		NPM/30%	NPM	90%
Bromomethane		NPM/30%	NPM	90%
Vinyl Chloride		NPM/30%	60-140%	90%

TABLE 4-1 (Continued). LABORATORY QA OBJECTIVES: GROUNDWATER/SURFACE WATER ANALYSES

Parameter/Analytical Level [(1)]	Precision[(2)] (as RPD)	Accuracy[(3)] (Recovery)	Completeness
Chloroethane	NPM/30%	NPM	90%
Methylene Chloride	NPM/30%	NPM	90%
Acetone	NPM/30%	NPM	90%
Carbon Disulfide	NPM/30%	NPM	90%
1,1-Dichloroethene	NPM/30%	NPM	90%
1,1-Dichloroethane	NPM/30%	NPM	90%
cis-1,2-Dichloroethane	NPM/30%	NPM	90%
trans-1,2-Dichloroethane	NPM/30%	NPM	90%
Chloroform	NPM/30%	NPM	90%
1,2-Dichloroethane	NPM/30%	60-140%	90%
2-Butanone	NPM/30%	NPM	90%
Bromochloromethane	NPM/30%	NPM	90%
1,1,1-Trichloroethane	NPM/30%	NPM	90%
Carbon Tetrachloride	NPM/30%	60-140%	90%
Bromodichloromethane	NPM/30%	NPM	90%
1,2-Dichloropropane	NPM/30%	60-140%	90%
cis-1,3-Dichloropropene	NPM/30%	60-140%	90%
Trichloroethene	NPM/30%	60-140%	90%
Dibromochloromethane	NPM/30%	NPM	90%
1,1,2-Trichloroethane	NPM/30%	60-140%	90%
Benzene	NPM/30%	60-140%	90%
trans-1,3-Dichloropropene	NPM/30%	NPM	90%
Bromoform	NPM/30%	60-140%	90%
4-Methyl-2-pentanone	NPM/30%	NPM	90%
2-Hexanone	NPM/30%	NPM	90%
Tetrachloroethene	NPM/30%	60-140%	90%
1,1,2,2-Tetrachloroethane	NPM/30%	NPM	90%
1,2-Dibromomethane	NPM/30%	60-140%	90%
Toluene	NPM/30%	NPM	90%
Chlorobenzene	NPM/30%	NPM	90%
Ethyl Benzene	NPM/30%	NPM	90%

TABLE 4-1 (Continued). LABORATORY QA OBJECTIVES: GROUNDWATER/SURFACE WATER ANALYSES

Parameter/Analytical Level [1]	Precision[2] (as RPD)	Accuracy[3] (Recovery)	Completeness
Styrene	NPM/30%	NPM	90%
Xylenes (total)	NPM/30%	NPM	90%
1,3-Dichlorobenzene	NPM/30%	NPM	90%
1,4-Dichlorobenzene	NPM/30%	60-140%	90%
1,2-Dichlorobenzene	NPM/30%	NPM	90%
1,2-Dibromo-3-chloropropane	NPM/30%	NPM	90%
Semivolatile Organics Low Level CLP (SOW 10/92) Level C			
Phenol	NPM/30%	44-120%	90%
bis(2-Chloroethyl)ether	NPM/30%	64-110%	90%
2-Chlorophenol	NPM/30%	58-110%	90%
2-Methylphenol	NPM/30%	NPM	90%
2,2'-oxybis(1-Chloropropane)	NPM/30%	NPM	90%
4-Methylphenol	NPM/30%	NPM	90%
N-Nitroso-di-n-propylamine	NPM/30%	34-102%	90%
Hexachloroethane	NPM/30%	32-77%	90%
Nitrobenzene	NPM/30%	NPM	90%
Isophorone	NPM/30%	49-110%	90%
2-Nitrophenol	NPM/30%	NPM	90%
2,4-Dimethylphenol	NPM/30%	NPM	90%
bis(2-Chloroethoxy)methane	NPM/30%	NPM	90%
2,4-Dichlorophenol	NPM/30%	NPM	90%
1,2,4-Trichlorobenzene	NPM/30%	44-96%	90%
Naphthalene	NPM/30%	56-160%	90%
4-Chloroaniline	NPM/30%	35-98%	90%
Hexachlorobutadiene	NPM/30%	NPM	90%
4-Chloro-3-methylphenol	NPM/30%	NPM	90%
2-Methylnaphthalene	NPM/30%	NPM	90%
Hexachlorocyclopentadiene	NPM/30%	NPM	90%
2,4,6-Trichlorophenol	NPM/30%	NPM	90%
2,4,5-Trichlorophenol	NPM/30%	NPM	90%

TABLE 4-1 (Continued). LABORATORY QA OBJECTIVES: GROUNDWATER/SURFACE WATER ANALYSES

Parameter/Analytical Level [1]	Precision[2] (as RPD)	Accuracy[3] (Recovery)	Completeness
2-Chloronaphthalene	NPM/30%	NPM	90%
2-Nitroaniline	NPM/30%	NPM	90%
Dimethylphthalate	NPM/30%	NPM	90%
Acenaphthylene	NPM/30%		90%
2,6-Dinitrotoluene	NPM/30%	NPM	90%
3-Nitroaniline	NPM/30%	NPM	90%
Acenaphthene	NPM/30%	NPM	90%
2,4-Dinitrophenol	NPM/30%	NPM	90%
4-Nitrophenol	NPM/30%	NPM	90%
Dibenzofuran	NPM/30%	NPM	90%
2,4-Dinitrotoluene	NPM/30%	61-140%	90%
Diethylphthalate	NPM/30%	76-104%	90%
4-Chlorophenyl-phenyl ether	NPM/30%	NPM	90%
Fluorene	NPM/30%	NPM	90%
4-Nitroaniline	NPM/30%	NPM	90%
4,6-Dinitro-2-methylphenol	NPM/30%	NPM	90%
N-Nitrosodiphenylamine	NPM/30%	35-120%	90%
4-Bromophenyl-phenylether	NPM/30%	NPM	90%
Hexachlorobenzene	NPM/30%	30-95%	90%
Pentachlorophenol	NPM/30%	NPM	90%
Phenanthrene	NPM/30%	NPM	90%
Anthracene	NPM/30%	NPM	90%
Di-n-butylphthalate	NPM/30%	NPM	90%
Fluoranthene	NPM/30%	NPM	90%
Pyrene	NPM/30%	NPM	90%
Butylbenzylphthalate	NPM/30%	NPM	90%
3,3'-Dichlorobenzidine	NPM/30%	NPM	90%
Benzo(a)anthracene	NPM/30%	NPM	90%
Chrysene	NPM/30%	NPM	90%
bis(2-Ethylhexyl)phthalate	NPM/30%	NPM	90%
Di-n-octylphthalate	NPM/30%	NPM	90%

TABLE 4-1 (Continued). LABORATORY QA OBJECTIVES: GROUNDWATER/SURFACE WATER ANALYSES

Parameter/Analytical Level (1)	Precision(2) (as RPD)	Accuracy(3) (Recovery)	Completeness
Benzo(b)fluoranthene	NPM/30%	NPM	90%
Benzo(k)fluoranthene	NPM/30%	NPM	90%
Benzo(a)pyrene	NPM/30%	55-92%	90%
Indeno(1,2,3-cd)pyrene	NPM/30%	NPM	90%
Dibenz(a,h)anthracene	NPM/30%	NPM	90%
Benzo(g,h,i)perylene	NPM/30%	NPM	90%
Pesticides /PCBs (CLP Modified(4)) Level C			
Aldrin	25%/30%	40-120%	90%
alpha-BHC	NPM/30%	NPM	90%
beta-BHC	NPM/30%	NPM	90%
delta-BHC	NPM/30%	NPM	90%
gamma-BHC (Lindane)	25%/30%	56-123%	90%
Chlordane (Technical)	NPM/30%	NPM	90%
4,4'-DDD	NPM/30%	NPM	90%
4,4'-DDE	NPM/30%	NPM	90%
4,4'-DDT	25%/30%	38-127%	90%
Dieldrin	25%/30%	52-126%	90%
Endosulfan I	NPM/30%	NPM	90%
Endosulfan II	NPM/30%	NPM	90%
Endosulfan sulfate	NPM/30%	NPM	90%
Endrin	25%/30%	56-121%	90%
Endrin aldehyde	NPM/30%	NPM	90%
Heptachlor	NPM/30%	40-131%	90%
Heptachlor epoxide	NPM/30%	NPM	90%
Methoxychlor	NPM/30%	NPM	90%
Toxaphene	NPM/30%	NPM	90%
Aroclor-1016	NPM/30%	NPM	90%
Aroclor-1221	NPM/30%	NPM	90%
Aroclor-1232	NPM/30%	NPM	90%
Aroclor-1242	NPM/30%	NPM	90%
Aroclor-1248	NPM/30%	NPM	90%

TABLE 4-1 (Continued). LABORATORY QA OBJECTIVES: GROUNDWATER/SURFACE WATER ANALYSES

Parameter/Analytical Level [1]		**Precision**[2] **(as RPD)**	**Accuracy**[3] **(Recovery)**	**Completeness**
Aroclor-1254		NPM/30%	NPM	90%
Aroclor-1260		NPM/30%	NPM	90%
Biochemical Oxygen Demand (405.1)	**Level C**	NPM/20%	80-120%	90%
Total Suspended Solids (160.2)	**Level C**	NPM/20%	80-120%	90%
Total Organic Carbon (415.1)	**Level C**	NPM/20%	80-120%	90%
FIELD GC ANALYSES (FSP, App. E):	**Level B**			
Benzene		NPM/20%	80-120%	90%
Chlorobenzene		NPM/20%	80-120%	90%
Ethylbenzene		NPM/20%	80-120%	90%
Toluene		NPM/20%	80-120%	90%
Xylene		NPM/20%	80-120%	90%

NOTES:

1. Method References

CLP Organics:	USEPA Contract Laboratory Program, Statement of Work for Organics Analysis (Multi-Media/Multi-Concentration). Document No. OLM01.0 with revisions through OLM01.9. (U.S. EPA, 1991a).
Low Level CLP Organics:	Superfund Analytical Methods for Low Concentrations Water for Organic Analysis 10/92. (U.S. EPA, 1992a).
CLP Inorganics:	USEPA Contract Laboratory Program, Statement of Work for Inorganics Analysis (Multi-Media/Multi-Concentration). Document No. ILM01.0 with revisions through ILM03.0. (U.S. EPA, 1993b).
160.2, 405.1, 415.1:	USEPA, Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020. (U.S. EPA, 1983).

2. Precision - Relative percent difference (RPD) between laboratory replicates/field duplicate analyses.
3. Accuracy - Acceptable matrix spike or laboratory control sample recovery range as specified by the method.
4. Method has been modified to lower detection limits by a factor of 10. Sample extract is concentrated for a final volume of 1 mL instead of 10 mL.

NPM Not part of method

TABLE 4-2. LABORATORY QA OBJECTIVES: SOIL/SEDIMENT ANALYSES

Parameter/Analytical Level(1)		Precision(2) (as RPD)	Accuracy(3) (Recovery)	Completeness
INORGANIC ANALYSES:				
TAL Metals (CLP)	**Level C**			
Aluminum		35%/50%	75-125%	90%
Antimony		35%/50%	75-125%	90%
Arsenic		35%/50%	75-125%	90%
Barium		35%/50%	75-125%	90%
Beryllium		35%/50%	75-125%	90%
Cadmium		35%/50%	75-125%	90%
Calcium		35%/50%	75-125%	90%
Chromium		35%/50%	75-125%	90%
Cobalt		35%/50%	75-125%	90%
Copper		35%/50%	75-125%	90%
Iron		35%/50%	75-125%	90%
Lead		35%/50%	75-125%	90%
Magnesium		35%/50%	75-125%	90%
Manganese		35%/50%	75-125%	90%
Mercury		35%/50%	75-125%	90%
Nickel		35%/50%	75-125%	90%
Potassium		35%/50%	75-125%	90%
Selenium		35%/50%	75-125%	90%
Silver		35%/50%	75-125%	90%
Sodium		35%/50%	75-125%	90%
Thallium		35%/50%	75-125%	90%
Vanadium		35%/50%	75-125%	90%
Zinc		35%/50%	75-125%	90%
ORGANIC ANALYSES:				
Volatile Organics (8240)	**Level C**			
Chloromethane		NPM/50%	NPM	90%
Bromomethane		NPM/50%	NPM	90%
Vinyl Chloride		NPM/50%	NPM	90%
Chloroethane		NPM/50%	NPM	90%

TABLE 4-2 (Continued). LABORATORY QA OBJECTIVES: SOIL/SEDIMENT ANALYSES

Parameter/Analytical Level[1]	Precision[2] (as RPD)	Accuracy[3] (Recovery)	Completeness
Methylene Chloride	NPM/50%	NPM	90%
Acetone	NPM/50%	NPM	90%
Carbon Disulfide	NPM/50%	NPM	90%
1,1-Dichloroethene	22%/50%	59-172%	90%
1,1-Dichloroethane	NPM/50%	NPM	90%
1,2-Dichloroethene (total)	NPM/50%	NPM	90%
Chloroform	NPM/50%	NPM	90%
1,2-Dichloroethane	NPM/50%	NPM	90%
2-Butanone	NPM/50%	NPM	90%
1,1,1-Trichloroethane	NPM/50%	NPM	90%
Carbon Tetrachloride	NPM/50%	NPM	90%
Bromodichloromethane	NPM/50%	NPM	90%
1,2-Dichloropropane	NPM/50%	NPM	90%
cis-1,3-Dichloropropene	NPM/50%	NPM	90%
Trichloroethene	24%/50%	62-137%	90%
Dibromochloromethane	NPM/50%	NPM	90%
1,1,2-Trichloroethane	NPM/50%	NPM	90%
Benzene	21%/50%	66-142%	90%
trans-1,3-Dichloropropene	NPM/50%	NPM	90%
Bromoform	NPM/50%	NPM	90%
4-Methyl-2-pentanone	NPM/50%	NPM	90%
2-Hexanone	NPM/50%	NPM	90%
Tetrachloroethene	NPM/50%	NPM	90%
Toluene	21%/50%	59-139%	90%
1,1,2,2-Tetrachloroethane	NPM/50%	NPM	90%
Chlorobenzene	21%/50%	60-133%	90%
Ethyl Benzene	NPM/30%	NPM	90%
Styrene	NPM/50%	NPM	90%
Xylenes (total)	NPM/50%	NPM	90%

TABLE 4-2 (Continued). LABORATORY QA OBJECTIVES: SOIL/SEDIMENT ANALYSES

Parameter/Analytical Level[(1)]		Precision[(2)] (as RPD)	Accuracy[(3)] (Recovery)	Completeness
Semivolatile Organics (CLP)	**Level C**			
Phenol		35%/50%	26-90%	90%
Bis(2-chloroethyl)ether		NPM/50%	NPM	90%
2-Chlorophenol		50%/50%	25-102%	90%
1,3-Dichlorobenzene		NPM/50%	NPM	90%
1,4-Dichlorobenzene		27%/50%	28-104%	90%
1,2-Dichlorobenzene		NPM/50%	NPM	90%
2-Methylphenol		NPM/50%	NPM	90%
2,2'-oxybis(1-Chloropropane)		NPM/50%	NPM	90%
4-Methylphenol		NPM/50%	NPM	90%
N-Nitroso-di-n-propylamine		38%/50%	41-126%	90%
Hexachloroethane		NPM/50%	NPM	90%
Nitrobenzene		NPM/50%	NPM	90%
Isophorone		NPM/50%	NPM	90%
2-Nitrophenol		NPM/50%	NPM	90%
2,4-Dimethylphenol		NPM/50%	NPM	90%
Bis(2-chloroethoxy)methane		NPM/50%	NPM	90%
2,4-Dichlorophenol		NPM/50%	NPM	90%
1,2,4-Trichlorobenzene		23%/50%	39-98%	90%
Naphthalene		NPM/50%	NPM	90%
4-Chloroaniline		NPM/50%	NPM	90%
Hexachlorobutadiene		NPM/50%	NPM	90%
4-Chloro-3-methylphenol		33%/50%	26-103%	90%
2-Methylnaphthalene		NPM/50%	NPM	90%
Hexachlorocyclopentadiene		NPM/50%	NPM	90%
2,4,6-Trichlorophenol		NPM/50%	NPM	90%
2,4,5-Trichlorophenol		NPM/50%	NPM	90%
2-Chloronaphthalene		NPM/50%	NPM	90%
2-Nitroaniline		NPM/50%	NPM	90%
Dimethylphthalate		NPM/50%	NPM	90%
Acenaphthylene		NPM/50%	NPM	90%
2,6-Dinitrotoluene		NPM/50%	NPM	90%

TABLE 4-2 (Continued). LABORATORY QA OBJECTIVES: SOIL/SEDIMENT ANALYSES

Parameter/Analytical Level[1]	Precision[2] (as RPD)	Accuracy[3] (Recovery)	Completeness
3-Nitroaniline	NPM/50%	NPM	90%
Acenaphthene	19%/50%	31-137%	90%
2,4-Dinitrophenol	NPM/50%	NPM	90%
4-Nitrophenol	50%/50%	11-114%	90%
Dibenzofuran	NPM/50%	NPM	90%
2,4-Dinitrotoluene	47%/50%	28-89%	90%
Diethylphthalate	NPM/30%	NPM	90%
4-Chlorophenyl-phenyl ether	NPM/50%	NPM	90%
Fluorene	NPM/50%	NPM	90%
4-Nitroaniline	NPM/50%	NPM	90%
4,6-Dinitro-2-methylphenol	NPM/50%	NPM	90%
N-Nitrosodiphenylamine	NPM/50%	NPM	90%
4-Bromophenyl-phenylether	NPM/50%	NPM	90%
Hexachlorobenzene	NPM/50%	NPM	90%
Pentachlorophenol	47%/50%	17-109%	90%
Phenanthrene	NPM/50%	NPM	90%
Carbazole	NPM/50%	NPM	90%
Anthracene	NPM/50%	NPM	90%
Di-n-butylphthalate	NPM/50%	NPM	90%
Fluoranthene	NPM/50%	NPM	90%
Pyrene	36%/50%	35-142%	90%
Butylbenzylphthalate	NPM/50%	NPM	90%
3,3-Dichlorobenzidine	NPM/50%	NPM	90%
Benzo(a)anthracene	NPM/50%	NPM	90%
Chrysene	NPM/50%	NPM	90%
Bis(2-ethylhexyl)phthalate	NPM/50%	NPM	90%
Di-n-octylphthalate	NPM/50%	NPM	90%
Benzo(b)fluoranthene	NPM/50%	NPM	90%
Benzo(k)fluoranthene	NPM/50%	NPM	90%
Benzo(a)pyrene	NPM/50%	NPM	90%
Indeno(1,2,3-cd)pyrene	NPM/50%	NPM	90%

TABLE 4-2 (Continued). LABORATORY QA OBJECTIVES: SOIL/SEDIMENT ANALYSES

Parameter/Analytical Level[(1)]		Precision[(2)] (as RPD)	Accuracy[(3)] (Recovery)	Completeness
Dibenz(a,h)anthracene		NPM/50%	NPM	90%
Benzo(g,h,i)perylene		NPM/50%	NPM	90%
Pesticides/PCBs (CLP Modified[(4)])	**Level C**			
alpha-BHC		NPM/50%	NPM	90%
beta-BHC		NPM/50%	NPM	90%
delta-BHC		NPM/50%	NPM	90%
gamma-BHC (Lindane)		50%/50%	46-127%	90%
Heptachlor		31%/50%	35-130%	90%
Aldrin		43%/50%	34-132%	90%
Heptachlor epoxide		NPM/50%	NPM	90%
Endosulfan I		NPM/50%	NPM	90%
Dieldrin		38%/50%	31-134%	90%
4,4'-DDE		NPM/50%	NPM	90%
Endrin		45%/50%	42-139%	90%
Endosulfan II		NPM/50%	NPM	90%
4,4'-DDD		NPM/50%	NPM	90%
Endosulfan sulfate		NPM/50%	NPM	90%
4,4'-DDT		50%/50%	23-134%	90%
Methoxychlor		NPM/50%	NPM	90%
Endrin ketone		NPM/50%	NPM	90%
Endrin aldehyde		NPM/50%	NPM	90%
alpha-Chlordane		NPM/50%	NPM	90%
gamma-Chlordane		NPM/50%	NPM	90%
Toxaphene		NPM/50%	NPM	90%
Aroclor-1016		NPM/50%	NPM	90%
Aroclor-1221		NPM/50%	NPM	90%
Aroclor-1232		NPM/50%	NPM	90%
Aroclor-1242		NPM/50%	NPM	90%
Aroclor-1248		NPM/50%	NPM	90%
Aroclor-1254		NPM/50%	NPM	90%
Aroclor-1260		NPM/50%	NPM	90%

TABLE 4-2 (Continued). LABORATORY QA OBJECTIVES: SOIL/SEDIMENT ANALYSES

Parameter/Analytical Level[1]		Precision[2] (as RPD)	Accuracy[3] (Recovery)	Completeness
Total Combustible Organics (D2974)	**Level C**	NPM/20%	80-120%	90%
Total Organic Carbon (415.1)	**Level C**	NPM/20%	80-120%	90%
FIELD GC ANALYSES (FSP, App. E):	**Level B**			
Benzene		50%/50%	60-140%	95%
Ethylbenzene		50%/50%	60-140%	95%
Chlorobenzene		50%/50%	60-140%	95%
Toluene		50%/50%	60-140%	95%
Xylenes		50%/50%	60-140%	95%
PCB IMMUNOASSAY TEST KIT ANALYSES (4020):	**Level B**	50%	NPM	95%
GEOTECHNICAL ANALYSES:	**Level C**			
Atterburg Limits (D4318)		NPM/NPM	NPM	90%
Grain Size (D422)		NPM/NPM	NPM	90%
Moisture Content (D2216)		NPM/NPM	NPM	90%

NOTES:

1. Method References

CLP Organics:	USEPA Contract Laboratory Program, Statement of Work for Organics Analysis (Multi-Media/Multi-Concentration). Document No. OLM01.0 with revisions through OLM01.9. (U.S. EPA, 1991a).
CLP Inorganics:	USEPA Contract Laboratory Program, Statement of Work for Inorganics Analysis (Multi-Media/Multi-Concentration). Document No. ILM01.0 with revisions through ILM03.0. (U.S. EPA, 1991b).
415.1:	USEPA, Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020. (U.S. EPA, 1983).
4020, 8240:	USEPA, Test Methods for Evaluating Solid Waste, SW846, 3rd ed. (U.S. EPA, 1986).
D2974:	Annual Book of ASTM Methods (ASTM, 1992)

GEOTECHNICAL: Annual Book of ASTM Methods (ASTM. 1992)

2. Precision - Relative percent difference (RPD) between laboratory replicates/field duplicate analyses.
3. Accuracy - Expected recovery as specified by the method.
4. Method has been modified to lower detection limits by a factor of 10. Sample extract is concentrated for a final volume of 1 mL instead of 10 mL.

NPM Not part of method

TABLE 4-3. QA OBJECTIVES FOR FIELD MEASUREMENTS

Parameter	Method[1] Reference	Precision[2]	Accuracy[3]	Completeness
Standing Water Levels	Solinst Water Level Indicator	±0.01 ft	0.005 ft	95%
Temperature	170.1, Mercury Thermometer or Electronic Temperature Probe	±0.1 °C	0.05 °C	95%
Conductivity	120.1, Electrometric	±25 μmho/cm^2	10 μmho/cm^2	95%
pH	150.1, Electrometric	±0.1 pH units	0.05 pH units	95%
Turbidity	180.1, Nephelometric	±4.7 NTU	NA	95%

NOTES:

1.	Source: Method for Chemical Analysis for Water and Wastes (U.S. EPA, 1983)
2.	Expressed as the acceptable deviation from the scale.
3.	Expected based on equipment manufacturer specifications.
NA	Not Available

The HAZWRAP control chart program may also be used to monitor laboratory accuracy. For each method of analysis and sample matrix analyzed with respect to this project, laboratory control samples (LCS, not to be confused with the inorganic LCS) will be analyzed, and their results compared to generate relative percent recoveries, or other suitable statistical measurements of precision. These results will then be plotted. Using statistical analysis, warning limits and control limits will be established, and the control chart will be examined for any LCS results that fall outside of these limits. Corrective action will be taken should results fall outside of the established limits.

The laboratory selected by the Contractor shall be qualified to implement the HAZWRAP control chart program.

Sampling accuracy will be maintained by the implementation and adherence to strict procedural protocols. Trip blanks will be collected and analyzed to ensure that no cross-contamination of samples occurred during sampling, or the trip to and from the laboratory. Field blanks will be collected to indicate whether contamination is present in water used in decontamination procedures or from field contamination. Equipment blanks will be collected to ensure that no contamination is carried from one sample to the next, and to ensure that decontamination procedures were sufficient. Field blanks will show if water used for equipment decontamination contain contaminants.

4.2.2 Precision

Precision is a measure of agreement among individual measurements of the same property under similar conditions. It is expressed in terms of relative percent difference (RPD) between replicates or in terms of the standard deviation when three or more replicate analyses are performed. Laboratory precision will be determined through the use of MS/MSD analyses (as described in Section 4.2.1) for organic analysis and laboratory duplicates for inorganic analysis. The RPD between the two results will be calculated as a measure of analytical precision. Specific criteria for precision are listed in Tables 4-1 through 4-3.

Laboratory precision will also be monitored with the HAZWRAP control chart program. For each method of analysis and sample matrix analyzed with respect to this project, laboratory control samples (LCS, not to be confused with the inorganic LCS) will be analyzed, and their results plotted. Using statistical analysis, warning limits and control limits will be established, and the control chart will be examined for any LCS results that fall outside of these limits. Corrective action will be taken should results fall outside of the established limits. Specific details as to the laboratory's control sample program are provided in the laboratory QAPP, found in Appendix A.

Sampling precision will be determined through the collection and analysis of field duplicates. Field duplicate analysis also provides an estimate of the sample media's actual heterogeneity.

4.2.3 Completeness

Completeness is a measure of the amount of valid data obtained compared to the amount expected to be collected. It is usually expressed as a percentage. The objectives for the field sampling activities are to obtain samples for all analyses required in each individual area, to provide a sufficient quantity of sample for each of the required analyses, and to obtain quality control samples representative of all possible contamination sources (e.g., sample collection, storage, transportation, etc.).

4.2.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a data population, process condition, a sampling point, or an environment.

For this field investigation program, grab and composite samples will be taken; such samples are, by definition, representative of the matrix only under the conditions at the point in time collected, within sampling and analytical error.

4.2.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another. To achieve comparability in this project, the data generated will be reported using units of μg/L, μg/kg, and mg/kg. By using sampling and analysis procedures consistent with CLP and HAZWRAP protocols all data sets will be comparable within the Hancock Field site and between other sites to ensure that a consistent data base is used from which decisions concerning remedial action are made. To ensure data comparability, standard reference materials will be analyzed to establish that analytical procedures are generating valid data.

4.2.6 Procedures for Data Assessment

The QA objectives for the analyses conducted during this investigation are listed in Tables 4-1 and 4-2. Accuracy values include components of both random error (i.e., variability due to imprecision) and systematic error (i.e., bias), thereby reflecting the total error for a given measurement, expressed as a percentage of the true value. The precision values presented therein represent variability for replicate measurements of the same analyte and are expressed in terms of the RPD for duplicate measurements of the same samples.

The QA objectives for the analyses are based primarily on performance data derived from method validation studies for analyses from MS/MSD, surrogate spike recoveries, and other QC samples. These are not intended to represent data validation criteria per se, but rather to represent the performance capability of the methods. The QA objectives for field measurements taken during sampling are presented in Table 4-3. An overview of procedures used in assessing data quality is provided below.

Accuracy

- Computing percent recoveries for spiked samples
- Calculating the standard deviation in the overall average recovery value
- Determining the range of uncertainty at a given level of confidence
- Flagging the laboratory data to qualify any systematic errors (bias) that are discovered

Precision

- Examining split samples and pairs of samples for differences in inter- and intra-sample scatter
- Determining if sampling error has occurred by comparing inter- and intra- samples
- Validating data on groups of samples, all of which should have the same composition, by examining the scatter in each group in comparison to the overall scatter (invalid data are discharged)
- Computing an overall relative standard deviation that is applicable to all the field investigation data from a particular sampling campaign
- Examining control charts generated by the laboratory for any out-of-control results

Completeness

- Computing the fraction of the QA test data that remains valid after discarding any invalid accuracy or precision data

Representativeness and Comparability

- Determining whether these terms have meaning within the project framework
- Identifying the appropriate statistical methods
- Correctly applying the statistical methods and reporting the results

Additional QA objectives specific to the laboratory control sample program are outlined in HAZWRAP Requirements for Quality Control of Analytical Data (DOE/HWP-65/R1), and provided in greater detail in the laboratory QAPP in Appendix A.

5.0 SAMPLING

All sampling methods in this section are Standard Operating Procedures based on recognized USEPA and HAZWRAP protocols when available. Step-by-step sample collection procedures are presented in the Field Sampling Plan (FSP) accompanying this document. The standard operating procedures presented therein have been compiled from a variety of sources including:

> HAZWRAP/DOE document DOE/HWP-69/R1, Quality Control Requirements for Field Methods.
>
> HAZWRAP/DOE document DOE/HWP-65/R1, Requirements for Quality Control of Analytical Data.
>
> HAZWRAP/DOE document DOE/HWP-100, Standard Operating Procedures for Site Characterizations.
>
> Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, USEPA SOW, Third Edition, November 1986.

During the remedial investigation, the field team will collect and submit for laboratory analysis the following types of environmental media:

- Subsurface (Boring) Soil
- Groundwater
- Surface Water
- Sediment

In addition, a soil gas survey will be conducted, and groundwater and soil samples will be field-screened for selected volatile organic compounds. A detailed description of the sampling locations and procedures that will be used during the field investigation program are presented in Section 2.0 of the FSP. A summary of the samples being collected by media are presented in Tables 5-1 through 5-3.

TABLE 5-1. SUMMARY OF SOIL INVESTIGATION SAMPLES

22-Jun-95

PARAMETER	METHOD	NUMBER OF BOREHOLES	SAMPLES PER BOREHOLE(7)	NUMBER OF SAMPLES	QUALITY CONTROL SAMPLES					TOTAL SAMPLES(6)
					MS/MSD(1)	FIELD DUP(2)	TRIP BLANK(3)	EQUIP. BL.(2)	FIELD BL.(4)	
SOIL SURVEY										
Soil Samples										
VOCs	CLP	40	1	40	6	2	4	2	2	56
Optional Soil Samples (8)										
VOCs	CLP	20	1	20	4	1	2	1		28
PCB BORINGS										
Soil Samples										
Pest/PCBs	CLP	8	2-3	22	4	2		2	2	32
Geotechnical Parameters(5)	ASTM	2	1	2						2
JP-RELATED BORINGS										
Soil Samples										
Pest/PCBs	CLP	10	2	20	4	3		3		30
VOCs	CLP	10	2-3	28	4	3	4	3	2	44
SVOCs	CLP	10	2-3	28	4	3		3	2	40
TOC	EPA 415.1	5	2-3	10	2	1		1	2	16
Geotechnical Parameters(5)	ASTM	5	1	5						5
BACKGROUND BORINGS										
Soil Samples										
VOCs	CLP	2	2	4		1	1	1		7
SVOCs	CLP	2	2	4		1		1		6
OPTIONAL BORINGS (8)										
Soil Samples										
Pest/PCBs	CLP	6	2	12	2	2		2		18
VOCs	CLP	6	2-3	17	2	1	2	1		23
SVOCs	CLP	6	2-3	17	2	1		1		21
Geotechnical Parameters(5)	ASTM	6	0	0						0
TOTAL ANALYTICAL (7)				156	24	16	9	16	10	231
OPT. ANALYTICAL				66	10	5	4	5	0	90
TOTAL GEOTECH. (7)				7	0	0	0	0	0	7
OPT. GEOTECHNICAL				0	0	0	0	0	0	0

NOTES:

(1) - Each MS/MSD is indicated as two samples. Additional volume is not required for soil MS/MSD analysis.
(2) - Equipment blanks and field duplicates must be collected at a 10% frequency for each matrix sampled. Equip. blanks are aqueous samples.
(3) - Aqueous samples. A trip blank must be included for each cooler containing volatile samples shipped to the laboratory.
(4) - Aqueous samples. A field blank must be collected for each source of decontamination water used. Both tap water and the DIUF water will be analyzed.
(5) - Geotechnical parameters will include: grain size (D422), moisture content (D2216), and Atterburg limits (D4318).
(6) - Sample total includes soil and aqueous samples.
(7) - In some cases, 3 samples will be taken, rather than 2, based on field screening results (it is assumed that this will happen 75% of the time).
(8) - Optional samples will only be analyzed with the approval of HAZWRAP. If the optional samples are collected during a different field mobilization, additional QC samples may be necessary.

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TABLE 5–2. SUMMARY OF GROUNDWATER INVESTIGATION SAMPLES

22–Jun–95

PARAMETER	METHOD	NO. OF WELLS SAMPLED	SAMPLE FREQUENCY	NO. OF SAMPLES	QUALITY CONTROL SAMPLES					TOTAL SAMPLES
					MS/MSD(1)	FIELD DUP(2)	TRIP BLANK(3)	EQUIP. BL.(2)	FIELD BL.(4)	
GROUNDWATER INVESTIGATION										
Aqueous Samples										
VOCs	low level CLP	13	each well	13	4	2	5	2	2	28
SVOCs	low level CLP	13	each well	13	2	2		2	2	21
Pest/PCBs	CLP(8)	13	each well	13	2	2		2	2	21
TAL Metals (total)	CLP	4	contam. wells(6)	4	2	1		1	2	10
TSS	EPA 160.2	4	contam. wells(6)	4	2	1		1	2	10
BOD	EPA 405.1	4	contam. wells(6)	4	2	1		1	2	10
Soil Samples										
Geotechnical Testing	ASTM	4	each new well	4						5
Optional Aqueous Samples(5)										
VOCs	low level CLP	1	each well	1			1			2
SVOCs	low level CLP	1	each well	1						1
Pest/PCBs	CLP(8)	1	each well	1						1
TAL Metals (total)	CLP	1	each well	1						1
TSS	EPA 160.2	1	each well	1						1
BOD	EPA 405.1	1	each well	1						1
Optional Soil Samples										
Geotechnical Testing	ASTM	1	each new well	1						1
TOTAL ANALYTICAL(7)				51	14	9	5	9	12	100
OPT. ANALYTICAL				6	0	0	1	0	0	7
TOTAL GEOTECHNICAL				4	0	0	0	0	0	5
OPT. GEOTECHNICAL(7)				1	0	0	0	0	0	1

NOTES:

(1) – Each MS/MSD is indicated as two samples. One additional sample volume is required for each of the MS and MSD analysis of aqueous samples. Thus, aqueous samples for MS/MSD analysis must be collected in triple volume.

(2) – Equipment blanks and field duplicates must be collected at a 10% frequency. Equipment blanks must also be collected for each type of sampling equipment.

(3) – A trip blank must be included for each cooler containing volatile samples shipped to the laboratory. (Assume 1 cooler/day, 10–day sampling period.)

(4) – A field blank must be collected for each source of decontamination water used. Both tap water and the DIUF water will be analyzed.

(5) –The optional samples will only be collected if the optional well is approved by HAZRAP for installation and installed. QC samples for this optional well are included with those for the other definate wells.

(6) – Contaminated wells scheduled for sampling for these parameters are: MW–2; MW–3; MW–4; MEMW–6; and MEMW–7.

(7) – Optional items not included.

(8) – The CLP method will be modified so that the sample extract is concentrated to a final extract of 1 ml rather than 10 ml as specified by the method.

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TABLE 5–3. SUMMARY OF SURFACE WATER AND SEDIMENT SAMPLES

22–Jun–95

PARAMETER	METHOD	NUMBER OF SAMPLES	QUALITY CONTROL SAMPLES					TOTAL SAMPLES(6)
			MS/MSD(1)	FIELD DUP(2)	TRIP BLANK(3)	EQUIP. BL.(2)	FIELD BL.(4)	
SEDIMENT								
Soil Samples								
VOCs	CLP	4	2	1	1(5)	1(5)	2(5)	11
Pest/PCBs	CLP	4	2	1		1(5)	2(5)	10
TAL Metals (total)	CLP	4	2	1		1(5)	2(5)	10
SURFACE WATER								
Aqueous Samples								
VOCs	low level CLP	2	2	1	1	1	2	9
Pest/PCBs	CLP	2	2	1		1	2	8
TAL Metals (total)	CLP	2	2	1		1	2	8
TOTAL SEDIMENT		12	6	3	1	3	6	31
TOTAL SW		6	6	3	1	3	6	25

NOTES:

(1) – Each MS/MSD is indicated as two samples. Additional sample volume is not required of the sediment samples. One additional sample volume is required for both the MS and MSD analysis of aqueous samples. Thus, aqueous MS/MSD analysis requires the submittal of triple sample volume.

(2) – Equipment blanks and field duplicates must be collected at a 10% frequency. Equipment blanks must also be collected for each type of sampling equipment.

(3) – A trip blank must be included for each cooler containing volatile samples shipped to the laboratory. (assume 1 cooler/day & 10 days.)

(4) – A field blank must be collected for each source of decontamination water used. Both tap water and the DIUF water will be analyzed.

(5) – These QC samples are aqueous.

(6) – Sample total includes soil and aqueous samples.

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5.1 SELECTION OF SAMPLING LOCATIONS

The rationale for sample locations and sampling frequency is described in Section 2.0 of the FSP.

5.2 SAMPLING PROTOCOLS

Sampling protocols to be adhered to during this field investigation program are detailed in Section 2.0 of the FSP.

5.3 SAMPLE HANDLING

Project-specific standard operating procedures for the collection and handling of samples for both laboratory and field analysis are discussed in the FSP accompanying this document.

Sample preservation and holding time are an integral part of the Quality Assurance Program. Proper sample handling and careful preservation are as important as the actual analysis. Adherence to the proper holding time is also of high importance to ensure sample integrity. The cleanliness and correct material of the sample container is the third most important factor in sample integrity. Table 5-4 contains the proper containers, preservations, and holding times for the media and analytical parameters to be performed.

TABLE 5-4. SAMPLING PARAMETERS, CONTAINERS, PRESERVATION AND HOLDING TIME FOR SAMPLES COLLECTED AT HANCOCK FIELD POL AREA

Parameter	Container	Preservative	Holding Time
SOILS/SEDIMENT			
Volatile Organic Compounds (VOCs)	Split spoon liner (soil) 4 oz. glass with TEFLON®-lined lid (sediment)	Cool, 4°C	14 days
Semivolatile Organic Compounds (SVOCs)	8 oz. glass with TEFLON®-lined lid	Cool, 4°C	Extract within 14 days of sampling; analyze within 40 days
Pesticides and PCBs (P/PCBs)	8 oz. glass with TEFLON®-lined lid	Cool, 4°C	Extract within 14 days of sampling; analyze within 40 days
Target Analyte List (TAL) Metals	8 oz. glass with TEFLON®-lined lid	Cool, 4°C	180 days
Total Organic Carbon (TOC)	4 oz. glass with TEFLON®-lined lid	Cool, 4°C	28 days
Geotechnical Parameters	6-inch segment of split-spoon liner	Cool, 4°C	Not established by methods
Field PCB Analysis	4 oz. glass with TEFLON®-lined lid	Cool, 4°C	48 hours
Field GC Analysis	2 x 40 ml glass vial with TEFLON®-lined lid(2)	Cool, 4°C	24 hours
Total Combustible Organics (TCO)	4 oz. glass with TEFLON®-lined lid	Cool, 4°C	28 days
AQUEOUS			
Volatile Organic Compounds (VOCs)	2 x 40 ml glass vial with TEFLON®-lined lid	HCl to pH <2 Cool, 4°C	14 days
Semivolatile Organic Compounds (SVOCs)	2 x 1 liter amber glass with TEFLON®-lined lid	Cool, 4°C	Extract within 7 days of sampling; analyze within 40 days
Pesticides and PCBs (P/PCBs)	2 x 1 liter amber glass with TEFLON®-lined lid	Cool, 4°C	Extract within 7 days of sampling; analyze within 40 days
Target Analyte List (TAL) Metals	1 liter plastic with TEFLON®-lined lid	HNO_3 to pH <2 Cool, 4°C	180 days for all metals but mercury; 28 days for mercury
Total Suspended Solids (TSS)	50 ml plastic with TEFLON®-lined lid	Cool, 4°C	7 days
Biological Oxygen Demand (BOD)	1 liter plastic with TEFLON®-lined lid	Cool, 4°C	48 hours
Total Organic Carbon (TOC)	125 ml glass with TEFLON®-lined lid	H_2SO_4 or HCl to pH <2, Cool, 4°C	28 days

(1) Soil samples for these parameters can be collected into the same container for samples being analyzed for both parameters

(2) Soil samples for field GC screening should only be filled half full.

6.0 SAMPLE IDENTIFICATION AND CUSTODY

Standard procedures concerning sample custody and identification during field operations and laboratory operations are discussed in this section.

6.1 FIELD OPERATIONS

An overriding consideration essential for the validation of environmental measurement data is the necessity to demonstrate that samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Evidence of the sample traceability from collection to shipment, laboratory receipt, and laboratory custody (until proper sample disposal and the introduction of field investigation results as evidence in legal proceedings when pertinent) must be documented. A sample is considered to be in a person's custody if the sample is:

- In a person's actual view
- In view after being in person's possession
- Locked so that no one can tamper with it after having been in physical custody
- In a secured area, restricted to authorized personnel

The Field Team Leader is responsible for overseeing and supervising the implementation of proper sample custody procedures in the field. She is also designated as the field sample custodian and is responsible for ensuring sample custody until the samples have been transferred to a courier and sent directly to the laboratory.

Once the samples have been received by the laboratory, samples proceed through an orderly processing sequence specifically designed to ensure continuous integrity of both the sample and its documentation. The following field operations ensure proper sample identification and custody.

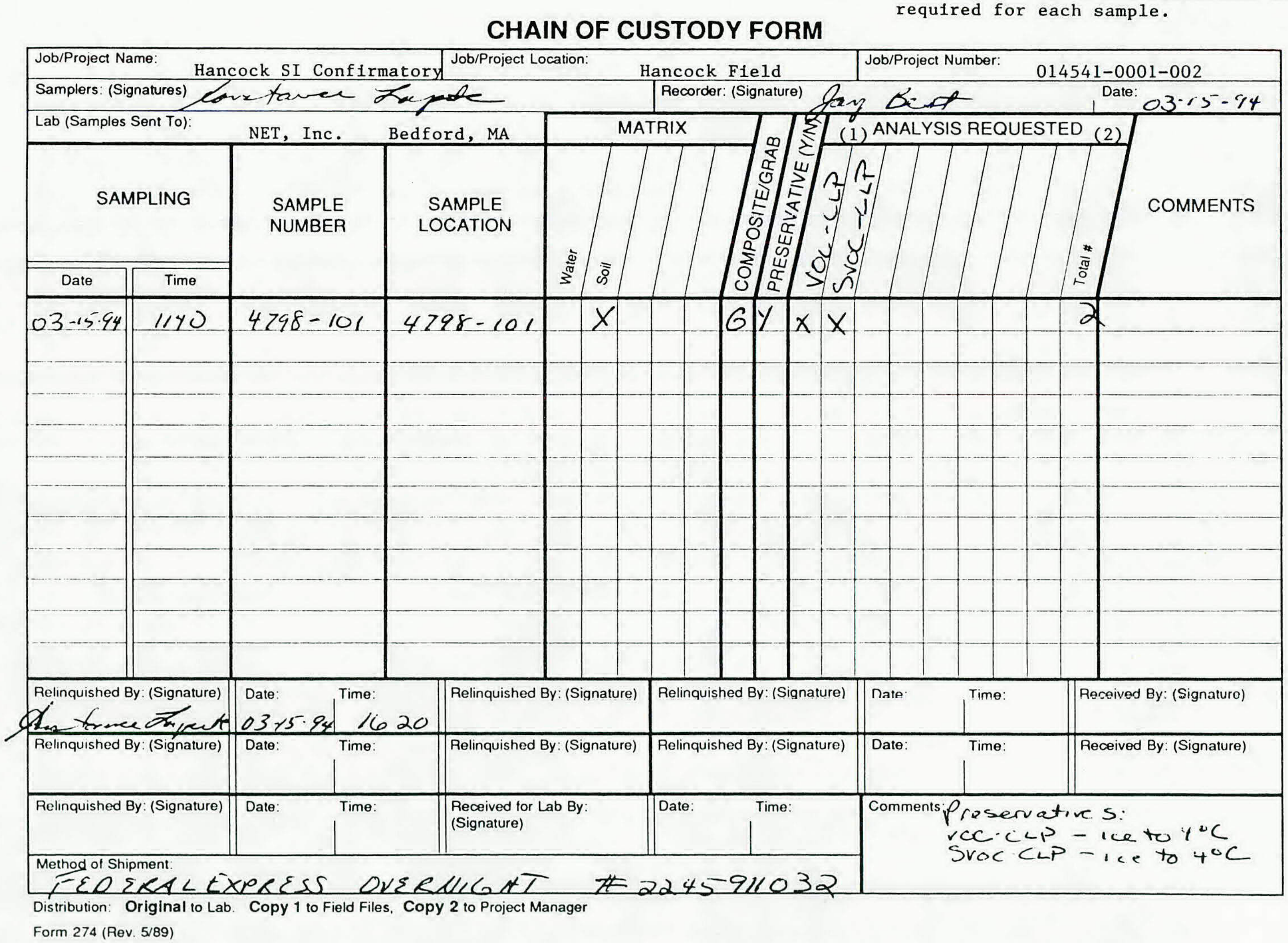
Chain of Custody. The chain-of-custody procedures are initiated in the field following sample collection. The procedures consist of: 1) preparing and attaching a unique sample label to each sample collected, 2) completing the chain-of-custody form, and 3) preparing and packing the samples for shipment. These procedures are further described in below.

Sample Labels. Field personnel are responsible for uniquely identifying and labeling all samples collected during a field investigation. All labeling must be done in indelible/waterproof ink. Any errors are crossed out with a single line, dated, and initialled. Each sample label securely affixed to the appropriate sample container must contain the following information:

- Client/Site Name
- Unique project-specific sample identification number (i.e., station number)
- Sample location/description number
- Designation of the sample as a grab or composite
- Type of analysis to be performed and the name of the laboratory to whom the samples are being sent
- Sample volume, container type, and the type of chemical preservation used
- Sampling date and time
- Initials of the sampler

Chain-of-Custody Form. A chain-of-custody form (Figure 6-1) must be completed for each sample set collected at a sampling location. The form is maintained as a record of sample collection, transfer, shipment, and receipt by the laboratory. The forms must also contain pertinent information concerning sampling location, date, and times; signatures of the sampling team members; types of samples collected along with a unique sample identification number; the specific analyses requested; the preservative used for each analysis for each

1) If the "Preservative" column is marked as a "Yes", under "Comments" specify the chemical preservative(s) used.
2) Identify the specific, particular analyses required for each sample.



CHAIN OF CUSTODY FORM

Job/Project Name: Hancock SI Confirmatory
Job/Project Location: Hancock Field
Job/Project Number: 014541-0001-002
Samplers: (Signatures)
Recorder: (Signature) Jay Best
Date: 03-15-94
Lab (Samples Sent To): NET, Inc. Bedford, MA

SAMPLING Date	SAMPLING Time	SAMPLE NUMBER	SAMPLE LOCATION	MATRIX Water	MATRIX Soil	MATRIX	MATRIX	MATRIX	COMPOSITE/GRAB	PRESERVATIVE (Y/N)	(1) ANALYSIS REQUESTED (2) VOC-CLP	SVOC-CLP							Total #	COMMENTS
03-15-94	1140	4798-101	4798-101		X				G	Y	X	X							2	

Relinquished By: (Signature)	Date: 03-15-94	Time: 1620	Relinquished By: (Signature)	Relinquished By: (Signature)	Date: Time:	Received By: (Signature)
Relinquished By: (Signature)	Date:	Time:	Relinquished By: (Signature)	Relinquished By: (Signature)	Date: Time:	Received By: (Signature)
Relinquished By: (Signature)	Date:	Time:	Received for Lab By: (Signature)	Date: Time:	Comments: Preservatives: VOC-CLP - ice to 4°C SVOC CLP - ice to 4°C	

Method of Shipment: FEDERAL EXPRESS OVERNIGHT #2245911032

Distribution: **Original** to Lab. **Copy 1** to Field Files, **Copy 2** to Project Manager

Form 274 (Rev. 5/89)

FIGURE 6-1. CHAIN OF CUSTODY (COC) FORM

sample; the number of the sample collected and shipped for analysis in each lot; the project name and number; and the name of the laboratory to which the samples are being sent.

Transfer of Custody. Samples will be accompanied by an approved and completed chain-of-custody form during each step of custody, transfer, and shipment. When physical possession of samples is transferred, both the individual relinquishing the samples and the individual receiving them will sign, date, and record the time on the chain-of-custody form. In the case of sample shipment by an overnight courier, a properly prepared airbill will serve as an extension of the chain-of-custody form while the samples are in transit.

6.2 LABORATORY OPERATIONS

Sample Receipt. Upon sample receipt, the laboratory representative responsible for accepting incoming sample shipments must compare the samples received against the list on the chain-of-custody form and examine all of the samples to determine if the proper temperature was maintained during shipment. The condition of the samples will be documented in a signed, dated, and bound log book. If the samples were damaged during transfer, the remaining samples must be carefully examined to determine whether they were affected. Any samples so affected must also be considered damaged and the pertinent information noted on the chain-of-custody form (specifying which samples were damaged and that the samples were removed from the sampling program). Field personnel are notified of any sample damage as soon as possible so that resampling can take place or the testing program can be changed.

The laboratory representative must also: 1) verify that sample holding times have not been exceeded, 2) sign and date the chain-of-custody form, 3) record the received samples using the laboratory's sample log-in procedure, 4) notify the Laboratory Manager of sample arrival and alert the laboratory manager of any analyses requiring immediate attention due to short holding time, 5) record the temperature of the temperature blank or cooler, and 6) store the samples according to the requirements of the analytical protocols.

Chain of Custody. The chain-of-custody forms are maintained and filed in the laboratory's sample log-in area according to contract name and project number, becoming part of the permanent project documentation. All analysts are required to sign for receipt and return of samples obtained for analysis.

Laboratory Storage of Samples. Samples will be maintained in storage in one of the secured storage refrigerators prior to sample preparation and analysis. Storage refrigerators are maintained at 4° ±2° C. Refrigerator storage is designed to segregate samples to prevent cross-contamination and to prevent sample mix-up. This includes storage of volatile samples separate from semivolatile and inorganic samples. Within the refrigerators, samples are stored according to CLP protocol by batch number for easy retrieval. During analysis, the transfer of sample custody to the analyst is documented.

7.0 CALIBRATION PROCEDURES AND FREQUENCIES

7.1 FIELD EQUIPMENT

Prior to use in the field, test equipment must be properly calibrated. Specific calibration procedures for various instruments are described in detail in the FSP.

7.2 LABORATORY INSTRUMENTATION

Instruments and equipment used by laboratories are controlled by a formal calibration program. The program verifies that the equipment is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and equipment which measure a quantity, or whose performance is expected at a stated level, are subject to calibration. The laboratory QAPP, located in Appendix A, provides details of this formal calibration program as well as information concerning the number and type of instruments available.

8.0 ANALYTICAL PROCEDURES

8.1 STANDARD ANALYTICAL METHODS

The standard analytical methods to be utilized for the samples collected during the RI field investigation program will consist of EPA-approved CLP methods whenever possible. Other EPA-approved methods will be used when CLP methods are not available or do not meet the analytical needs of the RI. The subcontract laboratory chosen for this project will be certified by HAZWRAP and the State of New York and will be familiar with all applicable HAZWRAP QA/QC and Standard Operating Procedures. The analytical methods to be used are summarized in Tables 8-1 and 8-2. Methods to be used for the field measurements of aqueous samples are also listed in Table 8-1.

8.2 PROJECT SPECIFIC DETECTION LIMITS

Project specific detection limits which are expected to be achieved by the laboratory during the analytical testing of this investigation are shown in Table 8-3.

8.3 LABORATORY STANDARDS AND REAGENTS

Laboratory standards and reagents are discussed in the laboratory QAPP. All laboratory standards and reagents used for calibration, internal standards, and surrogate standards will be of the highest purity available. Laboratory reagents used in analyses will be of adequate purity as not to jeopardize or interfere with the analysis and/or the results.

Laboratory standards and reagents are obtained from the following suppliers:

- For organic analysis, analytical standards are obtained from EPA repositories, USATHAMA, National Institutes of Standards and Technology (NIST), Supelco, Inc. (Bellefonte, PA), and Ultra Scientific (Hope, RI). Spectral grade and reagent grade solvents and reagents are obtained from Fisher

Scientific, Burdick and Jackson, and American Scientific. Also, chemicals are purchased from various suppliers for use as analytical standards.

- For inorganic analysis, standard reference materials are obtained from NIST and Spex. Spectral grade and reagent grade standards are obtained from Spex or Fisher.

It is common practice that all standards and laboratory reagents, with the exception of common laboratory solvents, are dated upon receipt. Also, the preparation and use of all standards are recorded in a laboratory notebook which allow for standard traceability to EPA or NBS standards. Additional information recorded includes the date of preparation, concentration of the prepared standard, and the name of the analyst.

TABLE 8-1. ANALYTICAL METHODS FOR AQUEOUS SAMPLES

Parameter	Method	Reference
Laboratory Analyses		
TAL Metals	CLP	Contract Laboratory Program, Statement of Work for Inorganics Analysis, (Multi-Media/Multi-Concentration). Document No. ILM01.0 with revisions through ILM03.0.
Semivolatile Organics	Low Level CLP	Superfund Analytical Methods for Low Concentrations Water for Organic Analysis (U.S. EPA 1992a)
Volatile Organics	Low Level CLP	
Pesticides/PCBs	Low Level CLP(1)	Contract Laboratory Program, Statement of Work for Organics Analysis, (Multi-Media/Multi-Concentration). Document No. OLM01.0 including revisions OLM01.1 through OLM01.9.
Biological Oxygen Demand	405.1	Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020. (U.S. EPA, 1983).
Total Organic Carbon	415.1	
Total Suspended Solids	160.2	
Field Analyses		
BTEX (Field GC)		see FSP Appendix E
Temperature	170.1	Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020. (U.S. EPA, 1983).
Specific Conductivity	120.1	
pH	150.1	
Turbidity	180.1	

NOTES:

1. The CLP Pesticide/PCB method has been modified to obtain lower detection limits necessary to meet site-specific ARAR's for PCBs. The extraction process will be modified such that the final volume of the sample extract will be 1 mL instead of 10 mL.

TABLE 8-2. ANALYTICAL METHODS FOR SOIL/SEDIMENT SAMPLES

Parameter	Method	Reference
Laboratory Analyses		
TAL Metals	CLP	Contract Laboratory Program, Statement of Work for Inorganics
Semivolatile Organics	CLP	Contract Laboratory Program, Statement of Work for Organics Analysis, (Multi-Media/Multi-Concentration). Document No. OLM01.0 including revisions OLM01.1 through OLM01.9.
Pesticides/PCBs	CLP	
Volatile Organics	CLP	
Total Organic Carbon	415.1	Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020. (U.S. EPA, 1983).
Total Combustible Organics	D2974	Annual Book of ASTM Methods, (ASTM, 1992).
Geotechnical Analyses		
Atterburg Limits	D4318	Annual Book of ASTM Methods, (ASTM, 1992).
Grain Size	D422	
Moisture Content	D2216	
Unconfined Compressive Strength	D2166	
Field Analyses		
BTEX (Field GC)	--	see FSP Appendix D
PCB (Immunoassay Test Kit)	4020	USEPA, Test Methods for Evaluating Solid Waste, SW846, 3rd ed. (U.S. EPA, 1992b) also see FSP Appendix D

TABLE 8-3. PROJECT SPECIFIC DETECTION LIMITS

Parameter/Analytes	Water Detection Limit[(1)]	Soil/Sediment Detection Limit[(1)(2)]
TAL Metals (CLP)	**(μg/L)**	**(mg/kg)**
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1
Cadmium	5	1
Calcium	5,000	1,000
Chromium	10	2
Cobalt	50	10
Copper	25	5
Iron	100	20
Lead	3	0.6
Magnesium	5,000	1,000
Manganese	15	3
Mercury	0.2	0.1
Nickel	40	8
Potassium	5,000	1,000
Selenium	5	1
Silver	10	2
Sodium	5,000	1,000
Thallium	10	2
Vanadium	50	10
Zinc	20	4
Volatile Organics		
Chloromethane	1	10
Bromomethane	1	10
Vinyl Chloride	1	10
Chloroethane	1	10
Methylene Chloride	2[(6)]	10
Acetone	5	10
Carbon Disulfide	1	10
1,1-Dichloroethene	1	10
1,1-Dichloroethane	1	10
cis-1,2-Dichloroethene[(5)]	1	10
trans-1,2-Dichloroethane[(5)]	1	10
Chloroform	1	10
1,2-Dichloroethane	1	10
2-Butanone	5	10
Bromochloromethane	1	NPM
1,1,1-Trichloroethane	1	10

TABLE 8-3 (Cont'd). PROJECT SPECIFIC DETECTION LIMITS

Parameter/Analytes	Water Detection Limit(1)	Soil/Sediment Detection Limit(1)(2)
Volatile Organics (8240) (Cont'd)	**(μg/L)**	**(μg/kg)**
Carbon Tetrachloride	1	10
Bromodichloromethane	1	10
1,2-Dichloropropane	1	10
cis-1,3-Dichloropropene	1	10
Trichloroethene	1	10
Dibromochloromethane	1	10
1,1,2-Trichloroethane	1	10
Benzene	1	10
trans-1,3-Dichloropropene	1	10
Bromoform	1	10
4-Methyl-2-pentanone	5	10
2-Hexanone	5	10
Tetrachloroethene	1	10
1,1,2,2-Tetrachloroethane	1	10
1,2-Dibromomethane	1	NPM
Toluene	1	10
Chlorobenzene	1	10
Ethyl Benzene	1	10
Styrene	1	10
Xylenes (Total)	1	10
1,3-Dichlorobenzene	1	NPM
1,4-Dichlorobenzene	1	NPM
1,2-Dichlorobenzene	1	NPM
1,2-Dibromo-3-chloropropane	1	NPM
Semivolatile Organics (CLP)	5	330
Phenol	5	330
bis(2-Chloroethyl)ether	5	330
2-Chlorophenol	NPM	330
1,3-Dichlorobenzene	NPM	330
1,4-Dichlorobenzene	NPM	330
1,2-Dichlorobenzene	5	330
2-Methylphenol	5	330
2,2'-oxybis(1-Chloropropane)	5	330
4-Methylphenol	5	330
N-Nitroso-di-n-dipropylamine	5	330
Hexachloroethane	5	330
Nitrobenzene	5	330
Isophorone	5	330
2-Nitrophenol	5	330
2,4-Dimethylphenol		

TABLE 8-3 (Cont'd). PROJECT SPECIFIC DETECTION LIMITS

Parameter/Analytes	Water Detection Limit[(1)]	Soil/Sediment Detection Limit [(1)(2)]
Semivolatile Organics (Cont'd)	(µg/L)	(µg/kg)
1,2,4-Trichlorobenzene	5	330
Naphthalene	5	330
4-Chloroaniline	5	330
Hexachlorobutadiene	5	330
4-Chloro-3-methylphenol	5	330
2-Methylnapthalene	5	330
Hexachlorocyclopentadiene	5	330
2,4,6-Trichlorophenol	5	330
2,4,5-Trichlorophenol	20	800
2-Chloronaphthalene	5	330
2-Nitroaniline	20	800
Dimethylphthalate	5	330
Bis(2-chloroethoxy)methane	5	330
2,4-Dichlorophenol	5	330
1,2,4-Trichlorobenzene	5	330
Naphthalene	5	330
4-Chloroaniline	5	330
Hexachlorobutadiene	5	330
Acenaphthylene	5	330
2,6-Dinitrotoluene	5	330
3-Nitroaniline	20	800
Acenaphthene	5	330
2,4-Dinitrophenol	20	800
4-Nitrophenol	20	800
Dibenzofuran	5	330
2,4-Dinitrotoluene	5	330
Diethylphthalate	5	330
4-Chlorophenyl-phenyl ether	5	330
Fluorene	5	330
4-Nitroaniline	20	800
4,6-Dinitro-2-methylphenol	20	800
N-nitrosodiphenlamine	5	330
4-Bromophenyl-phenylether	5	330
Hexachlorobenzene	5	330
Pentachlorophenol	20	800
Phenanthrene	5	330
Carbozole	NPM	330
Benzo(a)anthracene	5	330
Chrysene	5	330
bis(2-Ethylhexyl)phthlate	5	330
Di-n-octylphthalate	5	330

TABLE 8-3 (Cont'd). PROJECT SPECIFIC DETECTION LIMITS

Parameter/Analytes	Water Detection Limit(1)	Soil/Sediment Detection Limit (1)(2)
TCL Semivolatile Organics (Cont'd)	**(µg/L)**	**(µg/kg)**
Anthracene	5	330
Di-n-butylphthalate	5	330
Fluoranthene	5	330
Pyrene	5	330
Butylbenzylphthalate	5	330
3,3'-Dichlorobenzidine	5	330
Benzo(a)anthracene	5	330
Chrysene	5	330
Bis(2-ethylhexyl)phthalate	5	330
Di-n-octylphthalate	5	330
Benzo(b)fluoranthene	5	330
Benzo(k)fluoranthene	5	330
Benzo(a)pyrene	5	330
Indeno(1,2,3-cd)pyrene	5	330
Dibenz(a,h)anthracene	5	330
Benzo(g,h,i)perylene	5	330
Pesticides/PCBs	**(µg/L)**	**(µg/kg)**
alpha-BHC	0.005	1.7
beta-BHC	0.005	1.7
delta-BHC	0.005	1.7
gamma-BHC	0.005	1.7
Heptachlor	0.005	1.7
Aldrin	0.005	1.7
Heptachlor epoxide	0.005	1.7
Endosulfan I	0.005	1.7
Dieldrin	0.01	3.3
4,4'-DDE	0.01	3.3
Endrin	0.01	3.3
Endosulfan II	0.01	3.3
4,4'-DDD	0.01	3.3
Endosulfan sulfate	0.01	3.3
4,4'-DDT	0.01	3.3
Methoxychlor	0.05	17
Endrin ketone	0.01	3.3
Endrin aldehyde	0.01	3.3
alpha-Chlordane	0.005	1.7
gamma-Chlordane	0.005	1.7
Toxaphene	0.5	170

TABLE 8-3 (Cont'd). PROJECT SPECIFIC DETECTION LIMITS

Parameter/Analytes	Water Detection Limit[1]	Soil/Sediment Detection Limit [1][2]
Pesticides/PCBs (Cont'd)	**(μg/L)**	**(μg/kg)**
Aroclor-1016	0.1	33
Aroclor-1221	0.2	67
Aroclor-1232	0.1	33
Aroclor-1242	0.1	33
Aroclor-1248	0.1	33
Aroclor-1254	0.1	33
Aroclor-1260	0.1	3.3
Field GC Analyses (FSP Appendix E)	**(μg/L)**	**(μg/kg)**
Benzene	5	10
Chlorobenzene	5	10
Ethylbenzene	5	10
Toluene	5	10
Xylenes	10	20
PCB Immunoassay Test Kit Analyses	NA	1 mg/kg
Biological Oxygen Demand (405.1)	(3)	NA
Total Organic Carbon (415.1)	1 mg/L	50 mg/kg
Total Suspended Solids (160.2)	50 mg/L	NA
Geotechnical Parameters	NA	(3)
Atterburg Limits (D4318)		
Grain Size (D422)		
Moisture Content (D2216)		

NOTES:

1. Detection limits listed for organic aqueous analyses are Low Level CLP CRQLs (contract required quantitation limits).
2. Detection limits listed for soil/sediment are based on wet weight from the CLP SOWs for organic and inorganic analysis. As results are reported on a dry-weight basis, the actual soil/sediment detection limits will be higher. Contract required detection limits (CRDLs) for soil inorganic analyses are not provided by the CLP SOW. Detection limits listed assume 1 gram of sample in 200 ml of solvent.
3. Detection limits are not appropriate for these parameters.
4. The Low Level CLP Pesticide/PCB method has been modified to obtain lower detection limits necessary to meet site-specific ARAR's for PCBs. The extraction process will be modified such that the final volume of the sample extract will be 1 mL instead of 2 mL.
5. Total 1,2-Dichloroethene will be reported in the soil/sediment samples rather than separated into *cis* and *trans* isomers.
6. In the case of Methylene chloride, the CRQL value in this table is based on the lowest level of detection in samples contaminated with the common laboratory solvent that can be achieved by reasonable means in a production laboratory.

NPM - Not part of Method

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 LABORATORY PROCEDURES

This section describes data reduction, and reporting procedures which will be used by the subcontracted laboratory and by Contractor personnel as a final review. A flowchart outlining the steps of the data review process is shown in Figure 9-1. Primary responsibility for implementation of these procedures within the laboratory resides with the Laboratory Manager. The Laboratory Manager conducts the final review and approves of all data reports before transferring the information to the Point of Contact (POC). Final responsibility for data validation resides with the Contractor Project Chemist.

9.2 CONTRACTOR VALIDATION PROCEDURES

Quality control data provided by the laboratory will enable the Contractor to review the validity of the analytical data in terms of accuracy, precision, and environmental significance.

For purposes of this investigation, data review will be completed in-house by Contractor personnel. Data validation is not anticipated for this project. Laboratory analytical data will be reviewed for acceptable holding times, completeness, verification of instrument standardization and verification that samples are within acceptable laboratory QC limits. Geotechnical soil analyses and volatile organic data from soil screening and groundwater field analysis will be reviewed by the Contractor, but not validated.

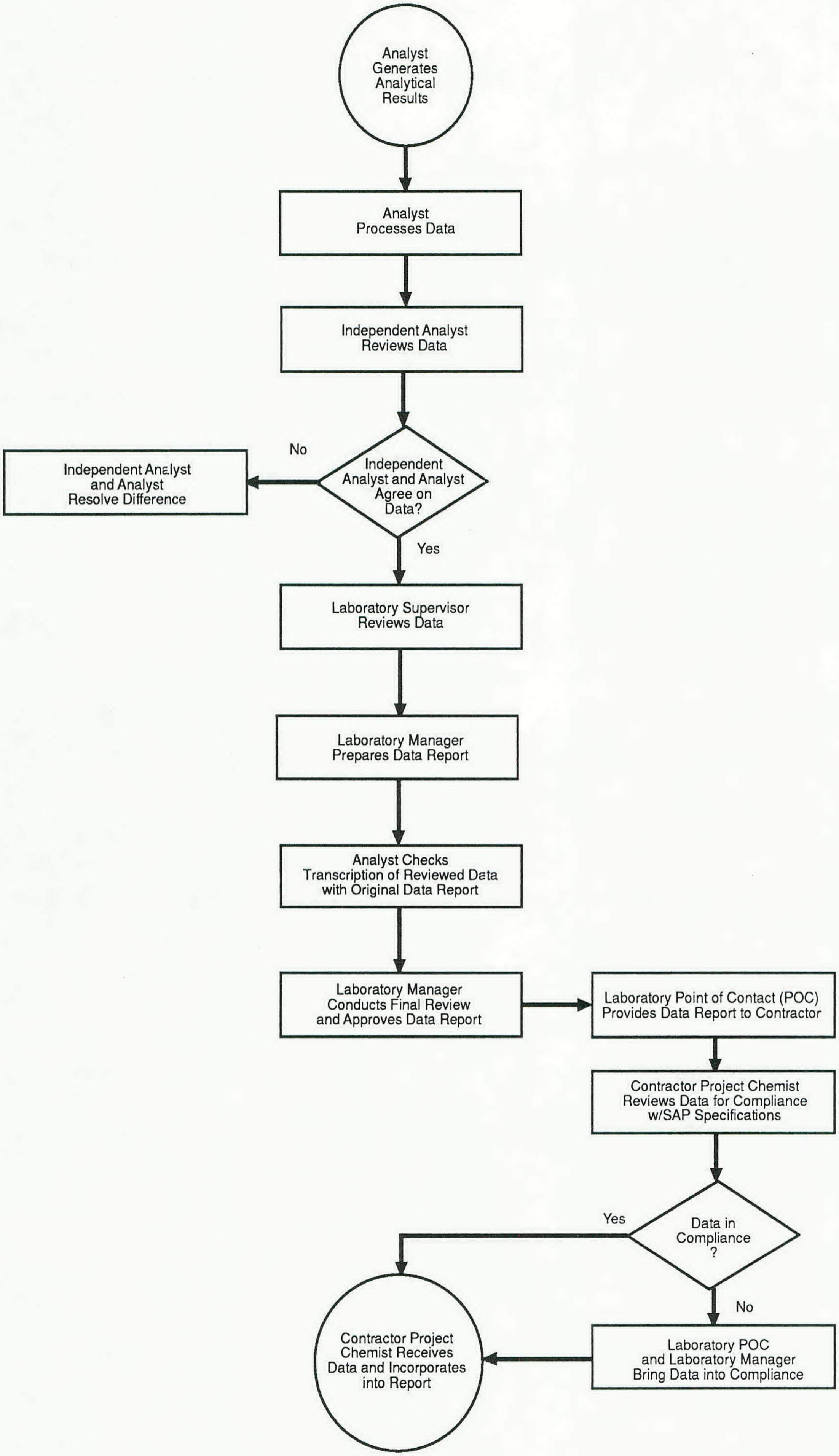


FIGURE 9-1. DATA REVIEW FLOWCHART

10.0 INTERNAL QUALITY CONTROL CHECKS

10.1 FIELD GENERATED QC SAMPLES

Quality control samples that will be collected in the field and submitted to the laboratories along with the environmental samples are discussed in this section. The types of QC samples that will be collected during the field investigation program include: trip blanks, equipment blanks, field blanks, and field duplicates.

Trip Blanks

One trip blank will be submitted to the laboratory with each shipment of samples for volatile organic analysis. The analysis of this blank will provide a baseline measurement of any contamination that the samples may have been exposed to during transport. A trip blank is comprised of a sample bottle filled with water shown to be free of organic compounds which is then preserved, handled like a sample, and sent to the laboratory for analysis. The trip blank for soil/sediment samples also uses the organic-free water.

Equipment Blanks

One equipment blank will be collected per sampling episode per sampling medium or at a frequency equal to approximately 10% of the samples collected for each media, whichever is more frequent. The analysis of these blanks serves to verify the cleanliness of the sampling equipment. An equipment blank is collected by rinsing decontaminated field equipment with water, transferring the water to a sample bottle, and sending the sample for analysis. Organic-free water should be used for QC samples submitted for organic analyses. For other QC samples, deionized ultra-filtered (DIUF) water should be used. The equipment blank is analyzed for the same parameters as the samples collected with that type of equipment.

Field Blank

A sample of each source of water used for decontamination of drilling and sampling equipment during each sampling episode will be collected. A minimum of two samples (one tap and one deionized water sample) will be submitted for complete analysis of all project-specific analytes.

Field Duplicates

Approximately 10% of all the samples will be collected in duplicate and submitted for laboratory analysis. Duplicates are two samples collected independently from one sampling location during a single episode of sampling. Duplicates provide information about variability in sampling as well as sample heterogeneity.

10.2 LABORATORY GENERATED QC SAMPLES

The laboratory will comply with the QC sample requirements of each analytical method specified. The QC sample types generally required by the analytical methods are described below and are referenced in the analytical methods.

Laboratory Control Sample

Laboratory control samples (LCS) will be analyzed for every analysis and matrix analyzed with respect to this project. The results of the LCS must fall into the control limits established for the applicable method and matrix. Should results be "out-of-control", or outside of the control chart limits, corrective action must be taken. Details as to the type of LCS, the frequency of LCS analysis, and the generation of the control charts are presented for each analysis in the laboratory QAPP in Appendix A.

A LCS solution is typically prepared by adding known quantities of an EMSL-Cincinnati Standard, a NIST Standard Reference Material, or a reference-traceable stock material to deionized water or the solvent of interest. A LCS solution is typically carried through the entire sample preparation and analysis procedure.

For volatile organic and semivolatile organic analyses, a LCS consisting of laboratory water spiked with the surrogate compounds used in the method of analysis is recommended. For the Pesticide/PCB LCS, a spike containing at least two pesticides and at least one PCB is recommended. For metals analysis by ICP (inductively coupled plasma), at least three metals are recommended. For GFAA (graphite furnace atomic absorption) and CVAA (cold-vapor atomic absorption), it is recommended that each element analyzed should be spiked into the LCS.

Calibration Check Sample

One calibration check sample (CCS) will be analyzed for all project-specific analytes per day of analysis. A CCS is chosen as one of the mid-range working calibration standards that is reanalyzed periodically throughout the sample analysis to verify that the original calibration is still valid.

Method/Reagent Blank

One method/reagent blank will be analyzed with every 20 samples or every batch of samples supplied from the field. A method blank is comprised of laboratory-pure, analyte-free water carried through the entire sample preparation and analysis procedure. Analysis of the method blank provides a check of the background contamination due to sample preparation procedures.

Laboratory Replicate

One sample for every 20 samples or every batch of samples supplied from the field will be analyzed in replicate for project-specific parameters. A replicate sample is produced by dividing a single collected sample into two equal parts for the purpose of determining analytical precision. The low level CLP methods for aqueous analysis do not require laboratory duplicate analysis.

Matrix Spike/Matrix Spike Duplicate

Matrix spikes and matrix spike duplicates will be performed for organic soil and sediment analyses, and matrix spikes and duplicates will be performed for inorganic analyses. These analyses will be performed once for each medium for every 20 samples or fewer or once for every batch of samples of that medium supplied from the field. The analyte spike will be added prior to digestion/distillation of the sample. If the spike recovery is not within the acceptable criteria limits specific to this project, the data of those samples associated with that spiked sample must be handled appropriately. The low level CLP method for aqueous analysis do not require matrix spike or matrix spike duplicate analysis.

Surrogate Spikes

All collected samples requiring organic analysis by GC/MS or GC will be spiked with an appropriate set of surrogate standards prior to sample preparation. The surrogate standards will encompass the full range of types of organics to be analyzed in the sample and will also serve as checks on any matrix interference exhibited by the samples. If the percent recoveries of the surrogates are outside the acceptable project-specific criteria limits, the associated samples may be reanalyzed if the problem appears to be due to laboratory error. An independent analyst or laboratory unit leader will determine whether to reanalyze the sample or qualify the data. Surrogate spikes may not be used for field GC analysis.

11.0 PROGRAM AUDITS

An audit is a systematic check to determine the quality of operation of some function or activity. The following procedures describe audits for the POL Area.

11.1 CONTRACTOR AUDITING PRACTICES

This QA program includes audit procedures to cover specific environmental data collection activities and documentation. Performance audits are performed on an ongoing basis during the project as field data are generated, reduced, and analyzed. The auditor compares observed practices with written project plans such as this QAPP, and with procedures applicable by rule or by reference. Documentation may also be audited. Audits are performed by the QA manager or designee.

11.1.1 Audit Procedure

Internal audits conducted by the Contractor follow a standardized format depending on the audit to be performed. The following subsections describe these procedures.

11.1.1.1 Audit Preparation. An individual audit plan is developed by the QA manager. The plan identifies the scope and schedule of the audit. The persons being audited are notified in advance of audit performance. The auditor then prepares a checklist, based on applicable standards and project-specific procedures.

11.1.1.2 Audit Performance. A brief conference is held with the management to be audited. The audit itself is conducted by observation of objective evidence, following the prepared checklist. After completion of the audit, significant deficiencies will be discussed with the field staff. If any of these deficiencies affect the integrity of the samples being collected, the auditor will inform the field staff immediately, so that corrections may be implemented immediately.

11.1.1.3 Post-Audit Conference and Report. Following the audit, the auditor prepares a draft audit report describing the audit and citing apparent discrepancies between written procedures and site activities. After this is distributed to audited management, a post-audit conference is held. The purpose of this session is to discuss preliminary audit results with the audit participants. The debriefing session is followed by a detailed audit report that identifies the confirmed findings of the audit.

11.1.1.4 Corrective Action Responsibility. The prime contractor's QA manager will review the audit report. If the audit report details discrepancies from accepted procedure, the QA Manager requests that the project manager take corrective action. The project manager has the responsibility to select and implement corrective actions, based on the result of the audit report. The QA manager and the program manager must be informed of the completion of the corrective action. Preparation of a corrective action report is the standard format for transmitting this information.

11.1.1.5 Audit Documentation. The Contractor QA manager will keep the following items, to document the conduct and findings of audits: the audit plan, a copy of the original (blank) checklist, the final audit report, and the corrective action report.

11.2 AUDITS PLANNED FOR HANCOCK FIELD NYANG

The following environmental data collection activities have been chosen for system auditing:

- Health and Safety (including documentation of personnel)
- Field Investigation Program
- Laboratory Activities (including QA/QC procedures)

The types and frequencies of the audits pertinent to the field investigation program are described in the following sections.

11.2.1 Health and Safety Activities

Health and safety activities will be audited by a health and safety specialist at least once during the field investigation program. The site health and safety plan will have been approved by the corporate H&S officer prior to field activities and a full-time, on-site H&S coordinator will be designated during the field investigation program. The H&S coordinator will be responsible for day-to-day health and safety-related activities. One audit will be performed within the first quarter of the project. A one-day trip into the field during the geotechnical operations or environmental sampling is sufficient. This audit may be combined with other audits.

11.2.2 Field Investigation Program

Audits will be conducted during the field investigation program to review environmental sampling. It is expected that one-day audits will be conducted on the following field activities:

- Soil borings
- Monitoring well installations
- Groundwater sampling
- Surface water and sediment sampling

11.2.3 Laboratory Self-Auditing Practices

All data generated is reviewed by the laboratory (peer review and supervisory review). Laboratory performance audits are conducted by the Laboratory QA Manager. The audits will include:

- Verification and analyst(s) understanding of written procedures

- Verification and documentation of procedures and documents
- Weekly unannounced inspection of the sample handling group
- Weekly unannounced inspection of the analytical process recordkeeping
- Review of 25 percent of all analytical data and calculations.

In addition, all numerical manipulations, including manual calculations, will be documented. All records of numerical analyses must be legible, of reproducible quality, and sufficiently complete to permit logical reconstruction by a qualified individual other than the originator. Corrective action will be taken for any deficiencies noted during the audit.

12.0 PREVENTIVE MAINTENANCE

12.1 LABORATORY EQUIPMENT

The ability to generate valid analytical data requires that all analytical instrumentation be properly and regularly maintained. It also requires that instrument capacity, sufficient to meet sample holding times, be maintained. Elements of this maintenance program typically include a schedule of routine preventative maintenance, provisions for emergency instrument service, redundancy in the type of instruments the laboratory maintains, and an inventory of essential spare parts. The elements of the laboratory maintenance program are provided in greater detail in the Laboratory Quality Assurance Plan (Appendix A).

12.2 FIELD EQUIPMENT

Preventative maintenance of field equipment is also required in order to ensure the recording of valid field measurements. All necessary maintenance procedures are fully documented in the project-specific field logbook. The type and frequency of such preventative maintenance is detailed in Section 4.0 and Appendix A of the FSP.

13.0 PROCEDURES FOR ASSESSING PRECISION, ACCURACY, AND COMPLETENESS

Following are the procedures recommended for evaluating the precision and accuracy of all environmental measurement data generated by this project. The protocol used for QC requirements is in accordance with specific analytical procedures.

13.1 REVIEW OF QC SAMPLES DATA

Upon completion of the analysis of a sample set, the results are reviewed and evaluated to assess the validity of the data set. The review is based on the criteria as follows:

- **Reagent Blank Evaluation** - The reagent and/or method blank results are evaluated for high readings characteristic of background contamination. If high blank values are observed, laboratory glassware and reagents are checked for contamination.

- **Trip Blank Evaluation** - Trip blank results are evaluated for high readings similar to the reagent and/or method blanks described above. If high field blank readings are encountered, the procedure for sample collection, shipment, and laboratory analysis must be reviewed. If both the reagent and /or method blanks and the trip blanks exhibit significant background contamination, the source of the contamination is probably within the laboratory.

- **Field Blank Evaluation** - Field blanks are evaluated like trip blanks, however if the field blank is the only blank to exhibit contamination, the material or solvent that was sampled should be suspected.

- **Matrix Spike Evaluation** - The observed recovery of the spike versus the theoretical spike recovery is used to calculate accuracy as defined by the percent recovery. The accuracy value (the percent recovery) may be plotted on a control chart for the parameter determined to show method performance.

- **Calibration Standard Evaluation** - The calibration curve is evaluated to determine linearity through its full range, and to verify that sample values are within the range defined by the low and high standards. If the curve does not meet method calibration criteria, corrective action is taken.

- **Replicate Sample Evaluation** - Duplicate sample analysis for metals from the sample set is used to determine the precision of the analytical method for the sample matrix. The duplicate results are used to calculate the precision as defined by the relative percent difference (RPD).

- **Reference Standard Evaluation** - Standard Reference Material analyses are compared with true values and acceptable ranges. Values outside of the acceptable ranges require corrective action to determine the source of error and provide corrective action. All sample analyses should be halted pending this evaluation. Following correction of the problem, the Standard Reference Material should be reanalyzed.

- **Check Standard Evaluation** - The results of the check standard analyses are compared with the true values and the percent recovery of the check standard is calculated. If correction is required, the check standard should be reanalyzed to demonstrate that the corrective action has been successful.

- **Surrogate Standard Evaluation** - The results of surrogate standard determinations are compared with the true values spiked into the sample matrix prior to extraction and analysis and the percent recoveries of the surrogate standards are determined. Average recovery values for surrogates in each GC/MS fraction will be reported.

13.2 EVALUATION OF ANALYTICAL PRECISION

In order to evaluate precision, the RPD is calculated between duplicate results. For duplicate results D_1 and D_2, the RPD is calculated from:

$$\text{RPD \%} = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

When the RPD is obtained for at least ten replicate pairs, the average RPD and the standard deviation are calculated using:

$$\overline{m} = \frac{\sum^{n} m_i}{n} \quad \text{where } i=1$$

$$\text{and } S_m = \left[\frac{\sum^{n} (m-\overline{m})^{2^{1/2}}}{n-1} \right] \quad \text{where } i=1$$

where:

m_i = the RPD of a replicate pair,

$\overline{m}$ = the average of the Relative Percent Difference Determinations,

Sm = the standard deviation of the data set of RPD determinations, and

n = the number of RPD determinations.

When constructing a control chart for a specific parameter, typically the Warning and Control Limits are then calculated from the following:

Upper Control Limit = $\overline{m}$ + 3 Sm
Lower Control Limit = $\overline{m}$ - 3 Sm
Upper Warning Limit = $\overline{m}$ + 2 Sm
Lower Warning Limit = $\overline{m}$ - 2 Sm

A control chart is established by plotting the RPD of each replicate pair on a graph generated as follows:

- The calculated RPD of each replicate pair is plotted on the graph to determine whether the RPD is within the Warning and Control Limits of the Control Charts. These control charts are used to show method performance and to document that the default control limits used by the laboratory for method control are met on a routine basis.

- If the RPD plots are outside the Control Limits for control spikes (blank spikes of LCS's), the source of error is determined and corrective action is implemented.

13.3 EVALUATION OF ANALYTICAL ACCURACY

To determine the accuracy of an analytical method and/or the laboratory analyst, a periodic program of sample spiking is conducted. The results of sample spiking will be used to calculate the quality control parameter for accuracy evaluation, the percent recovery (%R).

The %R is defined by 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike.

$$\% R = \frac{O_i - O_s}{T_i} \times 100$$

where:

$\%R$ = the percent recovery
O_i = the observed spiked sample concentration,
O_s = the sample concentration, and
T_i = the true concentration of the spike

The true concentration is calculated from:

$$T_i = \frac{\text{Spike Concentration [c] (mg/L) x Volume of spike (in mL)}}{\text{Volume of Sample [in mL] + Volume of Spike (in mL) (1000)}}$$

When the Percent Recovery is obtained for at least ten spike samples, the mean percent recovery and the standard deviation are calculated using the formulae:

$$\%\ \bar{R} = \frac{\sum^{n} \%\ R_i}{n} \text{ where } i=1$$

$$S_R = \left(\frac{[\sum^{n} (\%\ R_i - \%\ \bar{R})^2]^{1/2}}{n-1} \right) \text{ where } i=1$$

where:

$\%\bar{R}$ = the mean percent recovery
$\%R_i$ = the percent recovery of a single spike sample,
n = the number of results, and
S_R = the standard deviation of the data set of percent recovery determinations.

Then the Warning Control Limits are typically calculated from the following equations:

Upper Control Limit = $\%\bar{R} + 3\ S_R$
Lower Control Limit = $\%\bar{R} - 3\ S_R$
Upper Warning Limit = $\%\bar{R} + 2\ S_R$
Lower Warning Limit = $\%\bar{R} - 2\ S_R$

A control chart is generated by plotting the percent recovery data on a graph as follows:

- The average of the percent recovery determinations for the original data set is established as the midpoint on the Y axis above the mean of the percent recovery on the graph.
- The Upper Warning and Control Limits calculated above are plotted as solid horizontal lines across the graph at their respective points on the Y axis above the mean of the percent recovery determinations.
- The Lower Warning and Control Limits calculated above are plotted as solid horizontal lines.
- If the percent recovery is plotted outside the Control Limits for reference controls (blank spikes and duplicates, LCS and duplicates), the source of error is determined and corrective action is implemented. Once the error source has been resolved, the data set will be reanalyzed on a case by case basis.

- On a periodic basis, the Warning and Control Limits are recalculated for the entire data set and the Control Chart for the corresponding parameter is updated.

All control charts are maintained by the Quality Assurance Coordinator, as well as distributed to appropriate management.

13.4 EVALUATION OF COMPLETENESS

Completeness is calculated as the percentage of valid data points obtained compared to the amount of valid data that was planned to be collected to achieve particular project requirements. Data points may not be valid if samples exceeded holding times, if quality control sample criteria were not met and reanalysis of samples was not possible, or if sample containers were broken or otherwise destroyed. The overall completeness objective for this project is 90%.

14.0 CORRECTIVE ACTION PROCEDURES

14.1 FIELD CORRECTIVE ACTION

Corrective action procedures will be initiated in the field when a failure to properly follow project plans or standard operating procedures (SOPs) field is recognized. Errors in following sampling protocols or improperly or inadequately decontaminating sampling equipment may ultimately make it impossible to meet the project data quality objectives. Therefore, the deficiencies noted in following standard protocol will be addressed immediately upon recognition.

Corrective action procedures for this project may be the result of a field surveillance activity, a direct result of performance or system audits as described in Section 11, or an observation made by a field team member or other trained personnel. The person recognizing the failure is responsible for bringing the error to the attention of the responsible party (i.e., the person improperly following the procedure), making note of the problem in the field notebook, and, if appropriate, orally notifying the task manager of the error. If the problem recurs, the person recognizing the deficiency will address the error through submittal of a Recommendation for Corrective Action (RCA) form to the Program QA Manager. The Program QA Manager, in turn, will file the original RCA, send a memo along with a copy of the RCA to the person in a position to effect the corrective action (be it prime contractor or subcontractor personnel), and request a written response to the memo within a specified period of time. The issue addressed in the RCA is subject to follow up by the Program QA Manager during the next field surveillance or audit.

14.2 LABORATORY CORRECTIVE ACTION

Corrective action procedures in the laboratory are normally initiated by the analytical laboratory personnel directly involved with the analysis of the samples and the implementing of the procedures presented in this QAPP. Quality control records for daily instrument calibration, replicate analyses, and surrogate analysis are utilized to indicate the necessity for corrective action. Control records will be established for each procedure indicating upper and lower limit ranges. At the point when the control records indicate a determination is outside the warning ranges, investigation as to the cause will be initiated.

The laboratory analyst will verify that all quality control procedures are followed and that the results of the analysis of quality control samples are within the allowable acceptance criteria. This requires that the analyst assess the correctness of all of the following items as appropriate:

- Sample preparation procedure
- Initial calibration
- Calibration verification
- Method blank result
- Duplicate analysis
- Laboratory control standard
- Fortified sample result

If the assessment reveals that any of the QC acceptance criteria are not met, the analyst must immediately assess the analytical system to correct the problem. The analyst notifies the appropriate supervisor and QA Manager of the problem and, if possible, identifies potential causes and corrective action. In turn, the Laboratory QA Manager will notify the prime contractor if the quality of data deliverables has been compromised or if the laboratory has determined that the problem is field related.

When the appropriate corrective action measures have been defined and the analytical system is determined to be "in control", the analyst documents the problem and the corrective action. Copies of the form summarizing these actions are provided to the Laboratory Section Manager and QA Coordinator.

Data generated concurrently with an out-of-control system will be evaluated for usability in light of the nature of the deficiency. If the deficiency does not impair the usability of the results, data is reported and the deficiency is noted in the case narrative. Where sample results are impaired, the Laboratory Project Manager is notified and appropriate corrective action (e.g., reanalysis) is taken.

The routine analytical corrective action procedures within the laboratory are documented and may result in the reanalysis of samples or recalibration of analytical instrumentation. Routine corrective action will take place as necessary and does not require the approval of the prime contractor Quality Assurance Manager. However, should significant events occur such as sample breakage or loss, exceeding sample holding times, extensive instrumentation downtime, or changes or additions to sample clean-up for removal of interferences, the laboratory will report these events to the prime contractor immediately.

15.0 QUALITY ASSURANCE REPORTS

A report of Contractor quality assurance activities will be sent to the HAZWRAP Project Manager and will be designated as a HAZWRAP QA record. The report will describe the scope of audits performed during the project as well as the corrective actions taken in response to surveillance, audits, and recommendations for corrective action.

The QA report will also indicate the location of field logbooks, data received from the laboratory, and will indicate the length of time which these materials will be stored at the Contractor's office.

The laboratory will also submit quality assurance reports to the prime contractor. These reports include the following:

Performance and Reporting. A case narrative outlining non-conformance pertaining to project samples will accompany all sample results.

Corrective Action Following Audits. The Laboratory Manager and Quality Assurance Manager will seek to directly resolve all discrepancies concerning cited non-conformance, request for corrective action, or the completion of corrective action. If the differences cannot be resolved, higher levels of management will be consulted for resolution.

Management Review of the Quality Assurance Program. The review of the appropriateness and adequacy of the Quality Assurance Program is ongoing. The Laboratory Manager must present recommended changes to the divisional Quality Assurance Director as they arise.

The divisional QA Director in turn will provide quarterly reports to the corporate QA Manager. These reports summarize QA activities for the reporting period including: results of performance audits (external and internal), results of system audits (external and internal), summaries of corrective action used to remedy any situations which have caused QA data to be outside the prescribed criteria requirements, and recommendation for the revision of laboratory procedures to improve the analytical systems. The project manager is notified immediately of all laboratory QA situations requiring immediate corrective action.

During system audits, the Quality Assurance Program is discussed. The corresponding audit report will document all system revision recommendations made by either the Laboratory Manager, the prime contractor's Project QA Manager, or the audit team.

Document Control. The laboratory will maintain copies of all data packages, calibration records, and other QA-related records delivered to the project manager until the project manager either requests possession of the records or provides a written request for description of the records. The laboratory will develop a standard operating procedure that provides instructions for all QC-related paper work and instructions as to record storage for document control to include tracking.

16.0 REFERENCES

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APPENDIX A

(To be included after the subcontract laboratory has been selected.)

AIR NATIONAL GUARD
INSTALLATION RESTORATION PROGRAM

FINAL REMEDIAL INVESTIGATION WORK PLAN

174th FIGHTER WING
NEW YORK AIR NATIONAL GUARD
HANCOCK FIELD
SYRACUSE, NY

HEALTH & SAFETY PLAN

June 1995

Hazardous Waste Remedial Action Program
Environmental Restoration and Waste Management Programs
Oak Ridge, Tennessee 37831-7606
Managed by MARTIN MARIETTA ENERGY SYSTEMS, INC.
For the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-840R21400

HEALTH & SAFETY PLAN

NOTE:

The Health and Safety Plan describes measures to protect the health and safety of Contractor employees during their activities at a specific hazardous waste site. The health and safety of any Contractor's employee is solely the responsibility of the Contractor, who shall evaluate the potential hazards to their employees and adhere to a site-specific safety and health plan. The Contractor selected for the remedial investigation activities must provide a company-approved, site-specific Health and Safety Plan to address procedures of their employees during their activities at the site.