WORK PLAN

for Monitoring Well Abandonment
at Air Force Plant 59, Binghamton, New York

Prepared for:

Air Force Center for Environmental Excellence
and
Aeronautical Systems Center

Prepared by:

Earth Tech, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314

Contract No. F41624-97-D-8018
Delivery Order No. 0072

July 2000

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PREFACE

This *Work Plan* was written by Earth Tech to describe the field activities for monitoring well abandonment at Air Force Plant 59 (AFP 59), Binghamton, New York. This plan was developed in accordance with procedures outlined in the October 1996 New York State Department of Environmental Conservation (NYSDEC) document *Groundwater Monitoring Well Decommissioning Procedures* and the Air Force Center for Environmental Excellence (AFCEE) *Model Work Plan* (United States Air Force [USAF], 1996). All work will be completed under AFCEE Contract No. F41624-97-D-8018, Delivery Order No. 0072.

The field effort includes the abandonment of 16 monitoring wells that are not needed to satisfy long-term groundwater monitoring requirements for AFP 59.

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The AFCEE Restoration Team Chief is John McCown. The Air Force Aeronautical Systems Center Integrated Product Team Chief is John Doepker. The Earth Tech Project Manager is Dave Parse.

Approved:

Brian J. Burgher
Vice President
Program Manager

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13.ABSTRACT *(Maximum 200 words)*

This document is the *Work Plan for Monitoring Well Abandonment at Air Force Plant 59*. It summarizes the fieldwork involved in the abandonment of 16 monitoring wells that are not needed to satisfy long-term groundwater monitoring requirements for AFP 59.

14. SUBJECT TERMS **Groundwater monitoring, Well Abandonment**			15. NUMBER OF PAGES 33 16. PRICE CODE
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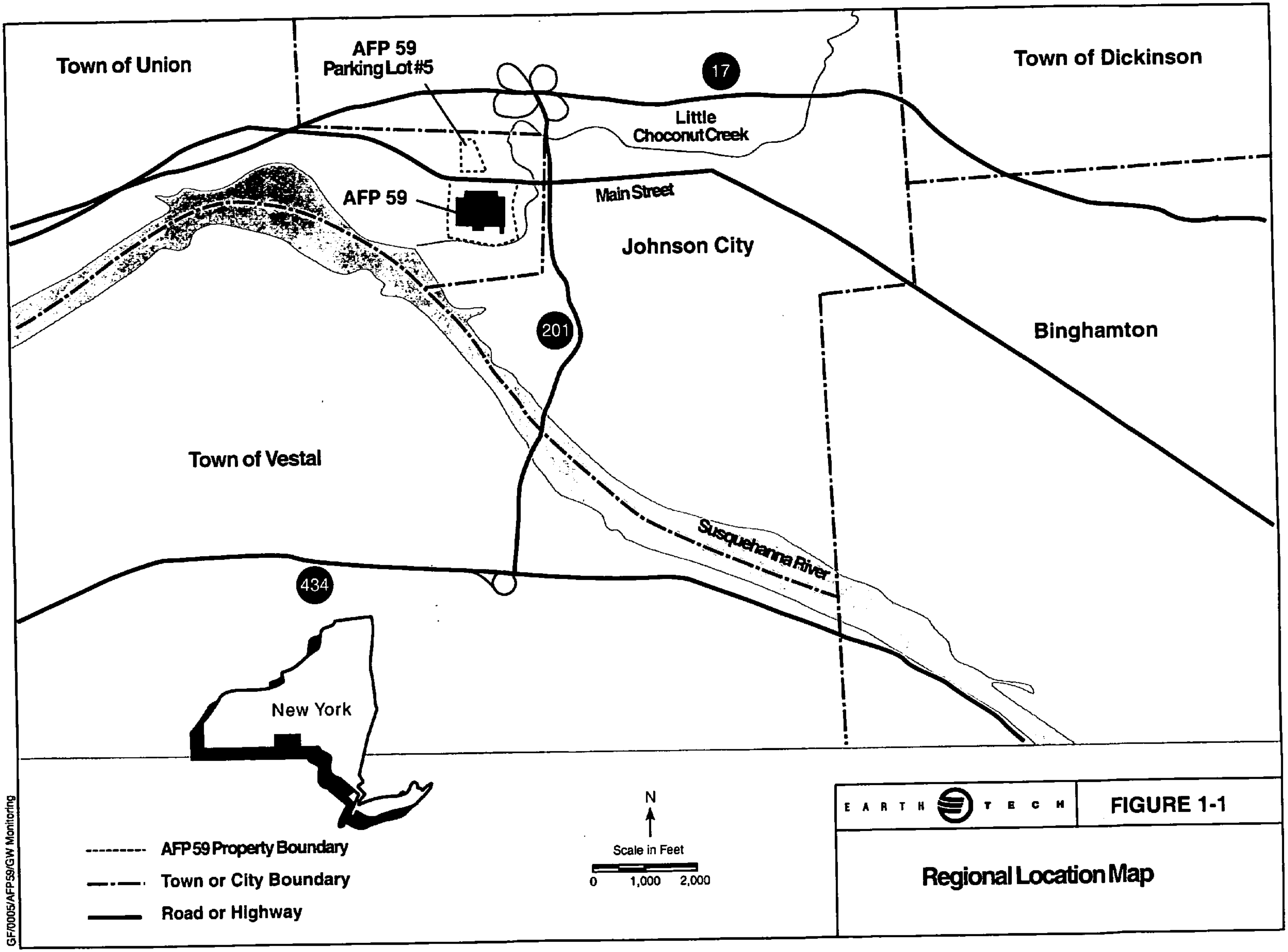
LIST OF ACRONYMS AND ABBREVIATIONS

AFCEE	Air Force Center for Environmental Excellence
AFP 59	Air Force Plant 59
ID	Inside Diameter
NYSDEC	New York State Department of Environmental Conservation
PVC	Polyvinyl Chloride
USAF	United States Air Force

1.0 INTRODUCTION

Earth Tech has been contracted by the Air Force Center for Environmental Excellence (AFCEE) to abandon 16 monitoring wells at Air Force Plant 59 (AFP 59), located in Binghamton, New York. The general location of AFP 59 is illustrated in Figure 1-1. This *Work Plan* was developed in accordance with procedures outlined in the October 1996 New York State Department of Environmental Conservation (NYSDEC) document *Groundwater Monitoring Well Decommissioning Procedures* and the AFCEE *Model Work Plan* (United States Air Force [USAF], 1996).

The field effort includes the abandonment of 16 monitoring wells that are not needed to satisfy long-term groundwater monitoring requirements for AFP 59. The monitoring wells will be abandoned under Contract No. F41624-97-D-8018, Delivery Order No. 0072.



EARTH TECH

FIGURE 1-1

Regional Location Map

GF/0005/AFP59/GW Monitoring

2.0 PROJECT TASKS

The following sections describe the fieldwork that will be conducted during monitoring well abandonment.

2.1 Field Investigation Tasks

The abandonment of monitoring wells at AFP 59 will include the following activities: mobilization to and from the site by Earth Tech and subcontractors, abandonment of 16 groundwater monitoring wells, and decontamination of abandonment equipment. A brief description of each field activity is provided in the following sections.

2.1.1 Mobilization

Fieldwork will be conducted during one mobilization. All activities associated with the initiation of the field investigation (e.g., securing identification badges and vehicle passes, locating staging areas for equipment, and identifying monitoring well locations) will be coordinated with the Lockheed Martin point of contact.

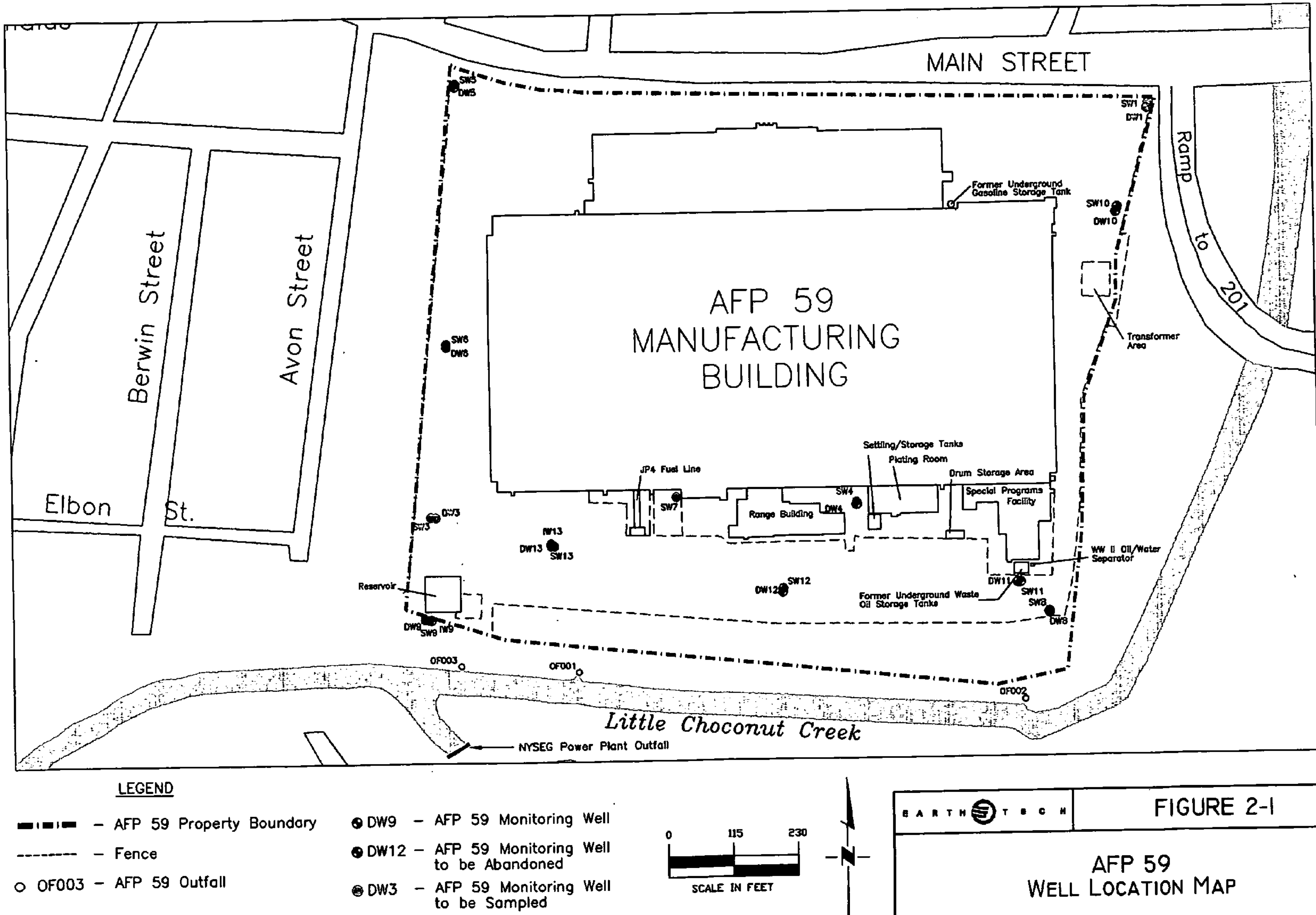
2.1.2 Monitoring Well Abandonment

A total of 16 monitoring wells no longer needed for long-term groundwater monitoring at AFP 59 will be abandoned. They are:

DW4	SW5	DW5
SW6	DW6	SW8
DW8	SW10	DW10
SW11	DW11	SW12
DW12	SW13	IW13
DW13		

The locations of the monitoring wells scheduled for abandonment are shown in Figure 2-1. By not abandoning monitoring wells SW9, IW9, and DW9, these wells will be available for future sampling if the integrity of monitoring well SW3 or DW3 is compromised, all five monitoring wells are downgradient of the suspected source area..

Seven of the wells are approximately 85 feet deep and constructed of 4-inch inside diameter (ID), schedule 80 polyvinyl chloride (PVC) casing and screen. The remaining nine wells are approximately 30 feet deep and constructed of 2-inch ID, schedule 40 PVC casing and screen. Each of the wells has a flush-mount completion consisting of a concrete pad and steel valve box.



EARTH TECH

FIGURE 2-1

AFP 59
WELL LOCATION MAP

P/41012 AFP 59/Reports/Well Aband./Gis/0626RI2.DWG

Per procedures outlined in the October 1996 NYSDEC document *Groundwater Monitoring Well Decommissioning Procedures* (provided in Appendix A), and for reasons outlined in the April 27, 1999 and May 13, 2000 letters to Jim Lister of the NYSDEC, grouting the monitoring wells (both shallow and deep wells) in place is the most appropriate abandonment method. As per the NYSDEC, the listed monitoring wells will be abandoned by:

- Breaking out the flush-mount completion,
- Cutting the casing off below the parking lot surface,
- Pumping grout to the top of the casing,
- Filling the remaining hole with clean backfill, and
- Re-paving the area to match the existing grade.

Each well casing will be grouted from the bottom-up in one continuous operation through a tremie pipe. Per NYSEC *Groundwater Monitoring Well Decommissioning Procedures*, "Grout will be placed in the borehole from the bottom to the top using a tremie pipe of not less than 1-inch diameter...The surface of the borehole will be restored to the condition of the area surrounding the borehole." The grout will be prepared in the following proportions: 94 pounds of neat Type I-II Portland or American Petroleum Institute Class A cement, not more than 4 pounds of 100 percent sodium bentonite powder, and not more than 8 gallons of potable water. The grout will be prepared on site in a mechanical mixer to produce a thick, lump-free slurry.

After allowing the grout to set for a minimum of 24 hours, depressions due to settlement will be filled using a grout mixture prepared as described previously. The beginning and ending times of the cement grout emplacement, the grouted interval, the amount of cement grout used, and the proportions used to prepare the cement grout (gallons of water per bag of cement and the cement/bentonite ratio) will be recorded in the field logbook.

The area at each abandoned well will be re-paved to match the grade of the existing parking lot using a 2.5-inch-thick binder followed by 1.5 inches of top-coat asphalt.

All abandonment activities will be conducted by Nothnagle Drillling, a licensed drilling company in the State of New York. An on-site Earth Tech representative will supervise all abandonment activities.

A closure report (letter format) will document the abandonment the monitoring wells.

2.1.3 Decontamination

The following procedure will be used for decontamination. The external surfaces of construction materials/equipment will be washed with potable water and Alconox™ and, if necessary, scrubbed until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed. The construction materials/equipment will then be rinsed with potable water and allowed to air dry. The inside surfaces will also be washed as described.

Decontamination activities will occur in two buckets, one for the Alconox wash, the other for a potable water rinse. Spent decontamination water will be contained in 55-gallon drums and stored on site at a temporary staging area prior to off-site disposal.

2.2 Waste Characterization and Disposal

All waste may be classified as noninvestigative waste.

Noninvestigative waste, such as litter and household garbage, will be collected on an as-needed basis to maintain each site in a clean and orderly manner. This waste will be containerized and transported to the designated sanitary landfill or collection bin. Acceptable containers will be sealed boxes or plastic garbage bags.

3.0 RECORDS AND REPORTING REQUIREMENTS

The following sections describe record keeping and reporting requirements for the well abandonment at AFP 59.

3.1 Record Keeping

Information regarding all field activities will be recorded with indelible ink in a permanently bound notebook with sequentially numbered pages. These records will be archived in an easily accessible form and made available to the USAF upon request.

The following information will be recorded for all field activities: (1) location, (2) date and time, (3) identity of people performing activity, and (4) weather conditions. The following information will be recorded for all field measurements: (1) the numerical value and units of each measurement, and (2) the identity of and calibration results for each field instrument.

In addition to the information entered into the logbook, the following forms will be completed: NYSDEC Field Inspection Log, and well abandonment log.

3.2 Reporting Requirements

After completion of field activities, the following document will be provided to the USAF and NYSDEC:

- **Well Abandonment Report.** This report will include individual well abandonment reports for each monitoring well abandoned during the field effort.

4.0 REFERENCES

Earth Tech, 1994. Installation Restoration Program – Final Health and Safety Plan, Air Force Plant 59.

Earth Tech. 1999. Letter to NYSDEC discussing groundwater monitoring program and well abandonment at AFP 59, 27 April.

Earth Tech. 1999. Letter to NYSDEC summarizing a telephone call about monitoring well abandonment at AFP 59, 13 May.

New York State Department of Environmental Conservation, 1996. *Groundwater Monitoring Well Decommissioning Procedures*, October.

United States Air Force (USAF), 1996. *Air Force Center for Environmental Excellence Model Work Plan*. July.

Appendix A

NYSDEC Groundwater Monitoring Well Decommissioning Procedures

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GROUNDWATER MONITORING WELL DECOMMISSIONING PROCEDURES

October 1996

Prepared for:

New York State Department of Environmental Conservation

Division of Environmental Remediation

Prepared by:

Malcolm Pirnie, Inc.

DECOMMISSIONING PROCEDURES

NYS SUPERFUND STANDBY CONTRACT
WORK ASSIGNMENT D002852-10

NPL SITE MONITORING WELL DECOMMISSIONING

NEW YORK STATE DEPARTMENT
OF ENVIRONMENTAL CONSERVATION

MAY 1995
Revised October 1996

0266-317-002

DISCLAIMER

October 21, 1996

RE: New York State Department of Environmental Conservation
Division of Environmental Remediation
Monitoring Well Decommissioning Procedures

Per your request, the enclosed referenced document is being made available to you for informational purposes. These procedures may be used as a guidance when decommissioning a monitoring well. Please note that this document does not address some site specific special situations that may be encountered in the field. These procedures have not been adopted by the Department of Environmental Conservation. Compliance with the procedures set forth in this document does not relieve any party of the obligation to successfully and satisfactorily decommission a well.

If you have any questions, please contact Ben Loredo, of my staff, at (518) 457-0927.

Sincerely,

Gerald J. Rider, Jr., P.E.
Chief, Operation, Maintenance and Support Section
Bureau of Hazardous Site Control
Division of Environmental Remediation
New York State Department of Environmental Conservation

Enclosure

INTRODUCTION

Malcolm Pirnie, Inc. has developed hazardous waste site monitoring well decommissioning procedures for the New York State Department of Environmental Conservation (NYSDEC) under the New York State Superfund Standby Contract, Work Assignment No. DOO2852-10. These procedures have been established as a guide for successful decommissioning of wells that are no longer used for monitoring at select National Priorities List (NPL) sites in New York State. A well is successfully decommissioned when:

- Migration of existing or future contaminants into an aquifer or between aquifers cannot occur.
- Migration of existing or future contaminants in the vadose zone cannot occur.
- The potential for vertical or horizontal migration of fluids in the well or adjacent to the well is minimized.
- Aquifer yield and hydrostatic head are conserved

The decommissioning procedures are based on NYSDEC-approved methods originally developed by Malcolm Pirnie which entailed an extensive literature search and consultations with industrial and NYSDEC officials. The literature search included sources from the National Ground Water Association, American Society for Testing and Materials (A.S.T.M.), State and EPA guidance documents, Malcolm Pirnie decommissioning procedures, and various other technical sources. A complete listing of sources is included at the end of these procedures. The industry officials consulted include drilling contractors, equipment suppliers and manufacturers, and A.S.T.M. members on Soil and Rock (D-18) and Water (D-19) committees.

These decommissioning procedures describe criteria for a satisfactorily decommissioning a monitoring well. Selection of a preferred decommissioning method will be dependent on site-specific and location-specific conditions such as the type of aquifer, the nature of the contamination, geological conditions and the type of well construction. Prior to initiating field work, the available site and location-specific data will be collected and reviewed, and a pre-construction inspection of the monitoring well will be conducted to assist in determining the best-suited decommissioning method.

For maximum protection of human health and the environment, any material brought to the surface during the decommissioning process will be treated as a hazardous waste unless sample data indicates otherwise. The selection of disposal methods for these materials will depend on information reported in site investigation reports and analytical characterization of the retrieved materials for hazardous characteristics (see Sections 4.1.3 through 4.1.4). An appropriate procedure will be followed for the physical and hydrologic setting of the well that best protects the environment.

The following sections describe the procedures that will be implemented to properly decommission a well, including the procedure for selecting which decommissioning method will be used. There are eleven elements to be addressed in decommissioning a monitoring well at a hazardous waste site:

1) Reviewing Site Data
2) Selecting the Well Decommissioning Method
3) Preparing a Site-Specific Health and Safety Plan
4) Preparing a Materials Handling and Disposal Plan
5) Establishing Decontamination Procedures
6) Locating and Setting-Up on the Well
7) Removing the Protective Casing
8) Decommissioning of Screen and Riser
9) Selecting, Mixing, and Placing Grout
10) Backfilling and Site Restoration
11) Quality Assurance/Quality Control (QA/QC) Procedures

The proper well decommissioning methods and selection process are presented on the flow chart presented as Plate 1. For each decommissioning method, the specific procedures are determined by (1) geology, (2) contaminants, and (3) well design. For example, decommissioning a well that penetrates a confining layer may require a different approach than decommissioning an unconfined water table well.

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NYS SUPERFUND STANDBY CONTRACT NPL SITE MONITORING WELL DECOMMISSIONING

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C	Construction Inspection Forms
D	Hydraulic Pressure Testing SOP

1.0 REVIEWING SITE DATA

The first step in selecting the well decommissioning process consists of reviewing all pertinent site information; boring and well logs, field inspection sheets, and laboratory analytical results performed on site soil and groundwater samples. This site information will form the basis for decisions throughout the decommissioning process. Field inspection of the wells prior to decommissioning is also recommended to verify the characteristics and conditions of the wells. Special conditions such as access problems, well extensions through capped and covered landfills, and cap conditions due to seasonal weather patterns should be assessed. At well locations that have been extended, the burial of a previous concrete pad may require the excavation of soil to the top of the concrete pad to remove the well. Decommissioning work requiring the use of heavy vehicular equipment on RCRA landfill caps should be scheduled during dry weather if possible so as to minimize damage to the cover. If work must be performed during the Spring, Winter or inclement weather, special measures such as placement of plywood to reduce ruts should be employed to maintain the integrity of the completed landfill cover system. A sample Monitoring Well Field Inspection Log indicating the minimum information to be collected during field verification activities is included as Figure 1.

2.0 SELECTING THE WELL DECOMMISSIONING METHOD

The primary rationale for well decommissioning is to prevent contaminant migration along the disturbed construction zone created by the original well boring. This requires selection of a decommissioning procedure that takes into account factors such as:

- The hydrogeological conditions at the well site.
- The presence or absence of contamination in the groundwater.
- The original well construction details.

This section presents a summary of the well decommissioning methods and the selection process, which is illustrated in the flow chart presented as Plate 1. The primary well decommissioning procedures consist of:

- Casing pulling.
- Overdrilling.
- Grouting the casing in-place.
- Perforating the casing followed by grouting in-place.

A general discussion of each decommissioning procedure is presented in Sections 2.1 through 2.4.

2.1 CASING PULLING

In general, casing pulling is the preferred method for decommissioning wells where: no contamination is present; contamination is present but the well does not penetrate a confining layer; and when both contamination and a confining layer are present but the contamination cannot cross the confining layer. Additionally, the well construction materials and well depth must be such that pulling can be effected without breaking the riser.

Casing pulling involves removing the well casing by lifting. The procedure for removing the casing must allow grout to be added during pulling. The grout will fill the space once occupied by the material being withdrawn. Grout mixing and placement must be performed according to the procedures in Section 9.0.

An acceptable procedure to remove casing involves puncturing the bottom of the casing, flushing with water to remove sand (if necessary to mitigate lock-up of the casing during pulling), filling the casing with grout tremied from the bottom of the well, using jacks to free casing from the hole, and lifting the casing out by using a drill rig, backhoe, crane, or other suitable equipment. Additional grout must be added to the casing as it is withdrawn. In wells or wellpoints in which the bottom cannot be punctured, the casing or screened interval will be perforated prior to being filled with grout. This procedure should be followed for wells installed in collapsible formations or for highly contaminated wells. At site locations in which the borehole does not collapse it may not be necessary to perforate the well casing prior to pulling the well (i.e., grouting the borehole can be completed after the well materials have been removed). However, measurements of the borehole depth must

SITE NAME:

SITE ID.: ______
INSPECTOR: ______
DATE/TIME: ______
WEll ID.: ______

MONITORING WELL FIELD INSPECTION LOG
NYSDEC WELL DECOMMISSIONING PROGRAM

	YES	NO
WELL VISIBLE? (If not, provide directions below)		
WELL I.D. VISIBLE?		
WELL LOCATION MATCH SITE MAP? (if not, sketch actual location on back)		

WELL I.D. AS IT APPEARS ON PROTECTIVE CASING OR WELL: ......

	YES	NO
SURFACE SEAL PRESENT?		
SURFACE SEAL COMPETENT? (If cracked, heaved etc., describe below)		
PROTECTIVE CASING IN GOOD CONDITION? (If damaged, describe below)		

HEADSPACE READING (ppm) AND INSTRUMENT USED ______
TYPE OF PROTECTIVE CASING AND HEIGHT OF STICKUP IN FEET (If applicable) ______
PROTECTIVE CASING MATERIAL TYPE: ______
MEASURE PROTECTIVE CASING INSIDE DIAMETER (Inches): ______

	YES	NO
LOCK PRESENT?		
LOCK FUNCTIONAL?		
DID YOU REPLACE THE LOCK?		
IS THERE EVIDENCE THAT THE WELL IS DOUBLE CASED? (If yes,describe below)		
WELL MEASURING POINT VISIBLE?		

MEASURE WELL DEPTH FROM MEASURING POINT (Feet): ______
MEASURE DEPTH TO WATER FROM MEASURING POINT (Feet): ______
MEASURE WELL DIAMETER (Inches): ______
WELL CASING MATERIAL: ______
PHYSICAL CONDITION OF VISIBLE WELL CASING: ______
ATTACH ID MARKER (if well ID is confirmed) and IDENTIFY MARKER TYPE ______
PROXIMITY TO UNDERGROUND OR OVERHEAD UTILITIES ______

DESCRIBE ACCESS TO WELL: (Include accessibility to truck mounted rig, natural obstructions, overhead power lines, proximity to permanent structures, etc.); ADD SKETCH OF LOCATION ON BACK, IF NECESSARY.

DESCRIBE WELL SETTING (For example, located in a field, in a playground, on pavement, in a garden, etc.) AND ASSESS THE TYPE OF RESTORATION REQUIRED.

IDENTIFY ANY NEARBY POTENTIAL SOURCES OF CONTAMINATION, IF PRESENT (e.g. Gas station, salt pile, etc.):

REMARKS:

be taken before and after the well is pulled to ensure that no collapse of well construction or formation materials occurred.

In the event that the casing or well screen is severed during casing pulling or if borehole collapse occurs, the remaining materials can be removed by overdrilling using the conventional augering method described in Section 2.2. In situations where well materials such as PVC screens and risers are suspected to sever, and removal of all well materials is required (i.e., at wells that are contaminated or those that penetrate an aquiclude), the contractor should install rods inside the well so that the rods would serve as a steel guide pipe for advancing augers during overdrilling.

At sites in which well casings have been grouted into a rock socket the casing pulling procedure may not be feasible. An alternative procedure involving overdrilling into the bedrock, pulling the casing, and subsequently grouting the openhole interval may be employed. For uncontaminated wells or wells with low levels of contamination, overdrilling, grinding on the rock, and grouting inside and outside of the well should be acceptable if the casing cannot be pulled. When this procedure is not acceptable and the casing must be pulled from a contaminated well, a spin and flush drilling technique may be used to advance flushpoint casing equipped with a diamond cutting shoe to the bottom of the casing socket. Water used during the spin and flush casing advancement will be controlled by the use of oversized casing, a coupling and a drilling tee. Drilling water will be containerized and disposed of in accordance with the site specific Material Handling and Disposal Plan.

2.2 OVERDRILLING

Overdrilling is used where casing pulling is determined to be unfeasible, or where installation of a temporary casing is necessary to prevent cross-contamination, such as when a confining layer is present and contamination in the deeper aquifer could migrate to the upper aquifer as the well was pulled (see Section 2.5). The overdrilling method should:

- Follow the original well bore.
- Create a borehole of the same or greater diameter than the original boring.
- Remove all of the well construction materials.

Acceptable methods for overdrilling include the following:

- Using conventional augering (i.e., a hollow stem auger fitted with a plug). The plug cutter will grind the well construction materials, which will be brought to the well surface by the auger.
- Using a conventional cable tool rig to advance casing having a larger diameter than the original boring. The cable tool kit is advanced within the casing to grind the well construction materials and soils, which are periodically removed with large diameter bailer. This method is not applicable to bedrock wells.
- Using an over-reaming tool with a pilot bit nearly the same size as the inside diameter of the casing and a reaming bit slightly larger than the original borehole diameter. This method can be used for wells with steel casings.
- Using a hollow-stem auger with outward facing carbide cutting teeth having a diameter two to four inches larger than the casing. Outward-facing cutting teeth will prevent severing the casing and drifting off center.
- Using a hollow-stem auger with a steel guide pipe inside. The casing guides the cutter head and remains inside the auger. The guide pipe should be firmly attached to the inside of the casing by use of a packer or other type of expansion or friction device.

Prior to overdrilling, an expandable J-plug or other suitable well cap will be used to prevent the introduction of soil or cuttings into the well, thereby ensuring a continuous grout column for wells that are grouted in place.

In all cases above, overdrilling should advance through the original bore depth by a distance of 0.5 feet to ensure complete removal of the construction materials. When the overdrilling is complete, the casing and screen can be retrieved from the center of the auger (American Society for Testing and Materials, Standard D 5299-92, 1992), if one of the hollow stem auger methods described above is employed. Subsequent to overdrilling at flush mount well locations where it may be impractical to remove well materials from inside the augers, a 1-2 foot deep area should be excavated by hand around the flush-mount well to facilitate a conventional well removal while tremie-grouting inside the well. Alternatively, the soil within the annular space may be removed by raising the augers to allow the soil to fall out and re-advance the augers to the original target depth. Grout should then be tremied within the annular space between the augers and well casings. The grout level in the borehole should be maintained as the drilling equipment and well materials are sequentially removed. After overdrilling is completed, the borehole must be grouted according to the procedures in Section 9.0 and the upper five feet of borehole must be restored according to the procedures in Section 10.0.

2.3 GROUTING IN-PLACE

Grouting in-place is the simplest decommissioning procedure, but offers the least long-term protection of all the methods. As discussed in Section 2.5, however, this method is preferred for the bedrock portion of bedrock wells, and is used for decommissioning cased wells in certain situations. For cased wells, the procedure involves filling the casing with grout to a level of five feet below the land surface, cutting the well casing at the five-foot depth, and removing the top portion of the casing and associated well materials from the ground. The casing must be grouted according to the procedures in Section 9.0. In addition, the upper five feet of the borehole is filled to land surface and restored according to the procedures described in Section 10.0.

For wells installed in bedrock, the procedure involves filling the casing (or open hole) with grout to the top of rock according to the procedures in Section 9.0. The grout mix, however, will vary according to the hydrogeological conditions as discussed in Section 2.5.

It should be noted that for wells located on landfills regulated under 6NYCRR Part 360, the screened interval of the well must be sealed separately and hydrostatically tested to ensure its adequacy before sealing the remaining borehole. The Standard Operating Procedure (SOP) for the hydrostatic test has been included under Appendix D.

2.4 CASING PERFORATION/GROUTING IN-PLACE

At this time, casing perforation is the preferred method for wells with four-inch or larger inside diameter which are designated to be grouted in-place in accordance with the selection flow chart. The procedure involves perforating the well casing and screen then grouting the well. A wide variety of commercial equipment is available for perforating casings and screens in wells with four-inch or larger inside diameters. Due to the diversity of application, experienced contractors must recommend a specific technique based on site-specific conditions. A minimum of four rows of perforations several inches long and a minimum of five perforations per linear foot of casing or screen is recommended (American Society for Testing and Materials, Standard D 5299-92, 1992).

After perforating is complete, the borehole must be grouted according to the procedures in Section 9.0 and the upper five feet of borehole must be restored according to the procedures in Section 10.0.

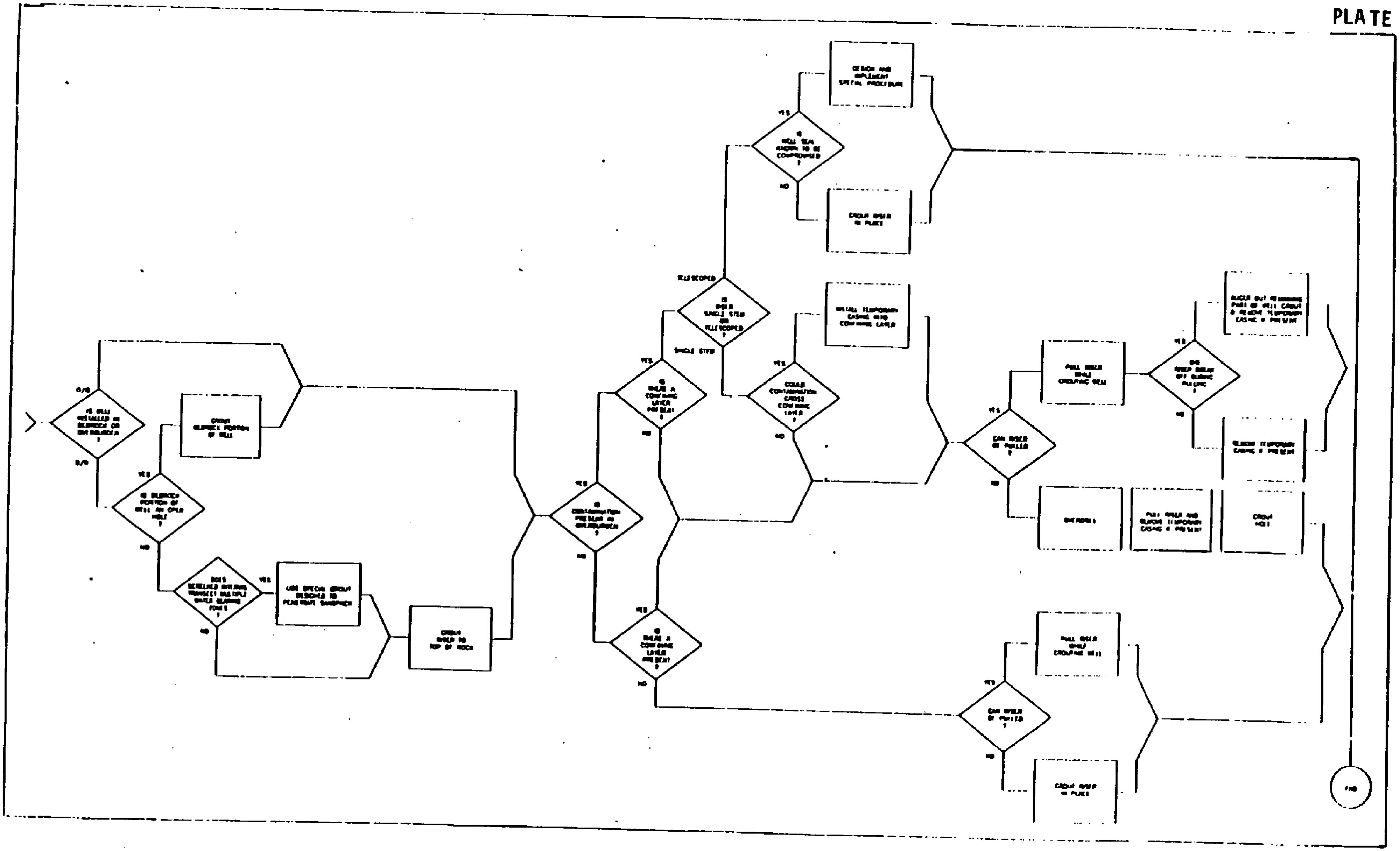
2.5 SELECTION PROCESS AND IMPLEMENTATION

Selection of the decommissioning method is governed by the flow chart presented as Plate 1. A discussion of the selection criteria and decommissioning methodology is presented below.

2.5.1 Contaminated Monitoring Wells/Piezometers

For wells and piezometers suspected or known to be contaminated with NAPL or DNAPL product, measurement of the product volume will be determined using a weighted cotton string or by using an interface probe. Subsequent to calculation of the product volume, the NAPL/DNAPL product will be removed from inside the well. Removal of the contaminant product will be accomplished by bailing, pumping or installing an absorbent passive recovery system. Subsequent to product recovery, all contaminated materials will

PLATE 1



MULTIPLE NPL SITES
WELL DECOMMISIONING
DECOMMISSIONING PROCEDURE SELECTION
FLOWCHART

NYSDEC

MARCH 19??

be disposed of in accordance with the segregation and containment procedures described in Section 4.1.2.

2.5.2 Bedrock Wells

As illustrated on Plate 1,if the well is constructed within a bedrock formation, the screened or the open hole portion of the well is grouted to the top of the bedrock. Prior to initiating any grouting procedure, the depth of the well will be measured to determine if any silt or debris infilling has plugged the well. If plugging has occurred, the well will be flushed with an appropriately sized roller bit or drill rods to remove or suspend the obstruction in the water column. The borehole will then be tremie grouted from the bottom of the well to the top of bedrock to insure a continuous grout column. Note that if the bedrock well is cased, the screen should be perforated to the top of the rock if the inside diameter of the casing is 4-inches or larger. Furthermore, if the screened interval transects multiple water bearing zones the special grout mix discussed in Section 9.1.3 should be used to ensure penetration of the sand pack.

After the rock hole is grouted, the overburden portion of the well is decommissioned in accordance with the following sections. If the borehole extends to the surface, no further decommissioning procedures are required; however, the boring should only be filled to within 5-feet of the ground surface and site restoration should be completed in accordance with Section 10.0.

2.5.3 Uncontaminated Overburden Wells

For overburden wells and the overburden portion of bedrock wells, the first decision point in determining the decommissioning method considers whether the overburden portion of the well exhibits evidence of contamination, as determined through historical groundwater and/or soil sampling results. If the overburden portion of the well is uncontaminated, the next criteria considers whether the well penetrates a confining layer. In the case that the overburden portion of the well does not penetrate a confining layer, the casing should be pulled (and tremie-grouted) if possible. As a general rule, PVC wells greater than 25-feet deep should not be pulled unless site-specific conditions or other factors indicate that the well can be pulled without breaking. If the well cannot be pulled, such as in the case that a bedrock portion of the well has already been grouted in place, or if the well materials and depth prohibit pulling or will likely result in breakage, the well should be grouted in-place as accordance with Section 2.3 (if the casing is less than 4-inch in diameter) or Section 2.4 (if the casing diameter is 4-inches or larger).

If the overburden portion of the well penetrates a confining layer, the casing should be removed by pulling (if possible) in accordance with Section 2.1. If the casing cannot be removed by pulling, the well should be removed by overdrilling. The overdrilling method used will depend on the site-specific conditions and requirements. If pulling is attempted and fails (i.e., a portion of the riser breaks) the remaining portion of the well should be removed by using the conventional augering procedure identified in Section 2.2. In all cases, after the well construction materials have been removed, the borehole will be grouted in accordance with Section 9.0 and the upper five feet will be restored in accordance with Section 10.0.

2.5.4 Contaminated Overburden Wells

If an overburden well or the overburden portion of a bedrock well is contaminated as evidenced by historical sampling results, the first decision point in selecting a decommissioning procedure is whether the well penetrates a confining layer. If the well does not penetrate a confining layer, the selection process follows the same pathway as for uncontaminated wells that penetrate a confining layer (i.e., the casing is pulled, if possible; otherwise the well is overdrilled - see Section 2.5.3). Plastic sheeting should be placed around the well surface to contain contaminated materials displaced during removal of the well.

For overburden wells that are contaminated and which penetrate a confining layer, the next selection criteria is whether the well riser is a single stem or is telescoped inside one or more outer casings. The procedures to be followed in determining the decommissioning method are presented for both situations below.

2.5.4.1 Single Stem Riser

If the riser is a single stem, the potential for cross-contamination between confining layers must be addressed. In particular, if the lower confining unit is contaminated, there is a potential that the contamination may be transferred to the upper unit as the well construction materials are removed to the ground surface. In this event, it will be necessary to install a temporary casing having a diameter larger than the original borehole into the top of the confining layer. This may be accomplished using a hollow stem auger or by employing a spin and flush technique to advance the casing. If the confining layer is less than 5 feet thick, the casing should be installed to the top of the confining layer. Otherwise, it is installed to a depth of 2 feet below the top of the confining layer. After the temporary casing has been set, the well can be removed and grouted through pulling (if possible) or through overdrilling if pulling is not feasible. Plastic sheeting should be placed around the well surface to contain contaminated materials displaced during removal of the well. As an alternative to installation of a temporary casing, the hollow-stem auger could serve the same purpose in that it would prevent the contamination from migrating to the upper unit. The hollow-stem auger would be advanced into the confining layer until the joint between the uppermost sections was nearly flush with the ground surface, and the sections would be disconnected to expose the riser prior to pulling or overdrilling.

After the casing and screen are removed and the well is grouted, the temporary casing (if used) is removed and the casing and/or hollow stem auger can be decontaminated for reuse. The upper 5 feet of the well surface should then be restored in accordance with Section 10.0.

2.5.4.2 Telescoped Riser

If the riser is telescoped in one or more outer casings, the decommissioning approach is dependent on the integrity of the well seal. For the purpose of the monitoring well decommissioning procedures, the well seal is defined as the bentonite seal above the sand pack. Although it is not possible to visually inspect or otherwise test the well seal to assess its condition, an indication of the well seal integrity may be obtained through review of the boring logs and/or a comparison of groundwater elevations if the well is part of a cluster. Any problems noted on the boring logs pertaining to the well seal, such as bridging of bentonite pellets or running sands, or disparities between field notes (if available) and the well log would indicate the potential for a poor well seal. Alternatively, if the well is part of a cluster a comparison of groundwater elevations between the shallow and deep wells should also be performed. By observing trends at other clusters it may be possible to identify inconsistencies in groundwater elevations at the well slated for decommissioning, thereby indicating a poor well seal.

If there is no evidence that the well seal integrity is compromised, the riser should be grouted in-place in accordance with Section 2.3 or 2.4, depending on the diameter of the well casing, and the upper 5 feet of the well surface should be restored in accordance with Section 10.0. If indications are that the well seal is not competent, it will be necessary to design and implement a special procedure to remove the well construction materials, as the presence and configuration of the outer casing(s) will be specific in the individual wells and will be a key factor in the decommissioning approach. The special procedure should be designed to mitigate the potential for cross-contamination during removal of the well construction materials, and should be designed prior to initiating field work.

3.0 PREPARATION OF A SITE-SPECIFIC HEALTH AND SAFETY PLAN

Prior to initiating decommissioning activities at a site, it is necessary to prepare a site-specific health and safety plan (HASP) in accordance with the requirements of 29 CFR 1910.120. Accordingly, the HASP should include:

- The names of key personnel responsible for site health and safety, including an appointed site health and safety officer.
- A safety and health risk analysis for each site task and operation.
- Employee training requirements.
- Personal protective equipment (PPE) to be used by employees for each of the site tasks and operations being conducted.

- Medical surveillance requirements.
- Frequency and types of air monitoring, personnel monitoring and environmental sampling techniques and instrumentation to be used.
- Site control measures.
- Decontamination procedures.
- Site standard operating procedures.
- A contingency plan for responses to emergencies.
- Confined space entry procedures.

An example of a health and safety plan is attached as Appendix A. This document provides a general framework for preparing a HASP. Examples of site-specific information, such as names of responsible personnel, contaminant data, and other information which must be developed to meet the OSHA requirements discussed above are included in Appendix A but will need to be modified in the site-specific HASP.

4.0 PREPARATION OF A MATERIALS HANDLING AND DISPOSAL PLAN

Materials handling and disposal procedures for each of the wells slated for decommissioning should be identified in a site-specific materials handling and disposal plan. This plan will be used as a guideline to ensure safe and efficient control of contaminated materials, and will promote conformance with the applicable regulatory requirements for storage, characterization, labeling, transportation and disposal of materials prior to off-site transport.

4.1 MATERIALS HANDLING PROCEDURES

The materials anticipated to be generated during well decommissioning activities include decontamination fluids, disposable safety equipment (including personal protective equipment), drill cuttings, groundwater, well construction materials (PVC and/or stainless steel casings, well screens, sand, bentonite/grout mixtures, etc.), and any spill-contaminated materials. Proper handling of these materials is effected through a series of steps, including: identification/pre-characterization of the waste materials; segregation/containment of the wastes including storage in proper containers; characterization of the waste materials through analytical testing to determine the absence/presence or nature of the contamination, and proper labeling in accordance with 49 CFR Part 172. Each of these steps is described in the following sections.

4.1.1 Identification/Pre-characterization

Prior to initiating well decommissioning activities at a site, the site history, most importantly historical analytical data from the monitoring wells, must be reviewed as well as the monitoring well construction details: number, type (overburden, bedrock), depth, diameter, and construction materials. This knowledge will aid in estimating the nature and quantities of waste materials which potentially may be generated as a result of decommissioning activities and will also assist in pre-determining the number of roll-off boxes, 55-gallon drums, and any other containers necessary to contain the wastes generated at each respective site.

4.1.2 Segregation and Containment

During well decommissioning activities, generated waste materials must be contained and segregated according to the nature of the suspected contamination. Well materials generated from decommissioning those wells with known contamination will be segregated from materials generated from those wells with little to no contamination (based on historical results). Contaminated materials will be further segregated according to contaminant type (e.g., well materials suspected of containing volatile organic contamination will be segregated from materials suspected of containing Polychlorinated Biphenyl (PCB) contamination).

For wells exhibiting contamination, all materials brought to the surface must either be decontaminated, disposed of at an appropriate Treatment, Storage and Disposal Facility

(TSDF), or properly containerized in a secure area for disposal by others. For all uncontaminated wells, the materials (except the casings) can be left at the surface near the former well unless the surrounding land use prohibits this disposal (e.g., if the well is located in an area where people could be exposed to the materials left on the surface; or if recovered decommissioning materials would not be consistent with the intended use of the land). In this case, the materials must be disposed of in a 6NYCRR Part 360 landfill. For contaminated wells, PVC and/or steel casing materials may be decontaminated for disposal in a Part 360 landfill, provided that the decontamination effort is thorough and cost effective. Requirements for characterization and disposal of contaminated materials are discussed in Sections 4.1.3 through 4.1.5.

Containment methods will be based on the estimated quantity of materials anticipated to be generated at each respective site. Solid waste materials (i.e., well construction materials, soils, drill cuttings, PPE), will typically be contained in roll-off boxes or 55-gallon drums. Since federal DOT regulations (49 CFR Part 177) generally limit the combined truck and cargo weight to 80,000 lbs, most hazardous waste transporters will limit the roll-off box capacity to 20 tons of hazardous waste per shipment. Thus, if the materials are to be transported off-site to a treatment, storage and disposal facility (TSDF) that accepts bulk waste, and if the anticipated quantity of waste will be large (greater than 5 tons), water-tight roll-off containers may be more practical and cost-effective for temporarily containing and transporting the waste in lieu or in combination with 55-gallon drums (e.g., 55-gallon drums may still be used for personal protective equipment or other articles not directly derived from the abandoned well). The roll-off containers should be lined with disposable HDPE liners to prevent contact with the container, and will be initially labeled according to the source(s) of the contained waste materials. Likewise, if drums are used they will be lined with a protective plastic sleeve, filled and the drum initially labeled according to the source of the contaminated materials. After the contents of the roll-offs and drums have been characterized, they should be labeled in accordance with 49 CFR Part 172. Roll-off containers will be covered with polyethylene covers and tarps with bows during temporary storage and transportation, and all drums will be sealed.

Fluids generated during the decommissioning program will generally be contained in 55-gallon drums unless extremely large volumes are expected; in this case 5,000-gallon tankers or other suitable temporary storage may be used. All drums will be initially labeled according to the wastewater source(s) and will be assumed to contain the same contaminants as the groundwater measured by the particular monitoring well being decommissioned. All 55-gallon drums containing fluids should be sealed and temporarily stored at the decontamination pad until final off-site disposal at an approved treatment facility.

4.1.3 Characterization

Hazardous waste characterization is necessary to determine the nature of the waste materials, to verify whether the materials are hazardous, and to determine proper disposition. Characterization of waste materials will be conducted at each of the sites to determine the appropriate disposal requirements. The decision as to the number, location and types of samples to be collected will be site specific and will depend on factors such as the quantity of waste generated and type of containers used, the nature of the waste, and the distribution of contaminant types across the site with respect to the origin of the waste materials. In general, the sample collection program will be designed to ensure that analytical data representative of all the materials to be disposed will be generated from the minimal number of samples. This may be accomplished by means such as:

- collection of composite samples for contaminants such as metals and PCBs (compositing is not typically acceptable for volatile organic compound analyses).
- collection of grab samples from select drums/containers suspected of elevated contaminant concentrations based on visual observation (e.g., soil staining, liquid sheen or non-aqueous product) or PID screening

Sample analysis will be based on site history and the requirements of the disposal facility. At a minimum, the samples should be analyzed for the parameters of concern indicated by past monitoring well analytical results, as well as the hazardous waste characteristic parameters: toxicity by TCLP; ignitability; reactivity; and corrosivity in accordance with 40 CFR Part 261.

4.1.4 Labeling

Depending on the nature of the materials, proper labeling of the storage containers (roll-offs and/or drums) must be completed according to 49 CFR Part 172.

4.1.5 Disposal

Disposal of waste materials will depend on whether the waste has been characterized as hazardous or non-hazardous. Non-hazardous waste will be disposed of on-site in accordance with NYSDEC TAGM #4032 with the prior consent of the owner and the Department, or may be landfilled at a permitted 6NYCRR Part 360 facility.

For wastes that exhibit contamination, the requirements for disposal or treatment will be dependent on the waste characteristics. To determine these requirements the following procedure should be followed upon receipt of the waste characterization results:

1) Determine if the waste is characteristically hazardous (by failure of any of the criteria for toxicity, corrosivity, reactivity, or ignitability) or if it is a listed hazardous waste per the classifications identified in 40 CFR Part 261.

2) Determine the EPA hazardous waste code(s) for the applicable waste classification(s) listed in 40 CFR Part 261.

3) Determine any treatment standards for the hazardous waste code(s) per 40 CFR Part 268. Depending on the waste classification, treatment standards may be based on final concentration in the waste/waste extract or may require a specific treatment technology (e.g., incineration).

4) If the hazardous waste contains other constituents that are not listed in the treatment standards, and if landfilling is a disposal option, it should be determined if the waste is a California List waste per the criteria in 40 CFR Part 268.32 (e.g., under these regulations, nonliquid wastes must not contain total halogenated organics at or in excess of 1,000 ppm).

5) If the hazardous waste meets all treatment standards including the California List Standards (if applicable), it may be disposed of at a permitted hazardous

waste land disposal facility. For each shipment the generator is required to provide the following manifest information:

- Hazardous Waste Code(s)
- Corresponding concentration-based or technology-based treatment standards.
- Manifest number.
- Waste analysis data.
- Certification Statement per 40 CFR 268.7(a)(2)(D)(ii).

In addition, the generator is required to maintain the records specified in 40 CFR Part 268.7(a)(7) for a minimum of 5 years.

6) If the waste fails to meet any of the treatment standards listed in 40 CFR Part 268, it must be sent to a treatment, storage, or recycling facility. If the waste's treatment standard is technology-based, it must be treated in accordance with the specified method. Land disposal is not allowable unless the waste is eligible for a National Capacity Variance (40 CFR Subpart C) and meets the California List standards. In all cases, the notification and recordkeeping requirements identified above must be fulfilled by the generator.

The hazardous waste will be transported in accordance with DOT regulations (49 CFR Parts 172-173) to either a secure hazardous waste landfill or TSDF, as appropriate. The contractor will be responsible for arranging for proper transportation and the disposal of the wastes. The Engineer will sign a hazardous waste manifest, as an agent of the Owner.

5.0 EQUIPMENT DECONTAMINATION REQUIREMENTS

Since the monitoring well decommissioning will involve multiple wells, there is a possibility of contamination from one well location to another. To avoid cross-contamination, procedures have been established for decontamination after operations at each well location is complete. The procedures for decontamination of personnel at the site will be specified in the site-specific Health and Safety Plan. Decontamination of equipment will follow established equipment cleaning protocols which are written in accordance with the Engineer's corporate policies and OSHA regulations.

The drilling and excavation equipment (i.e., drill rigs, cutting bits, and associated equipment) will be cleaned at a constructed decontamination facility. In general, the decontamination facility (i.e., decon pad or wash pad) will consist of plywood placed over a heavy synthetic liner. The pad will slope down to a sump that will collect all liquids. A detailed description and drawing of the decontamination facility that will be constructed is included in Appendix B as Item 1.

The drilling and excavation equipment will be prepared before it is brought to the decontamination facility and then cleaned at the facility. The preceding preparation includes removing gross soil/rock from the equipment to minimize losses during movement to the decon pad. At the decontamination facility, the equipment will be rinsed with low-volume water or steam, washed with phosphate-free detergent, and rinsed again with pressurized low-volume water or steam. The equipment will be inspected by the Engineer's field representative after cleaning. The detailed cleaning procedures are included in Appendix B as Item 2.

In the event that sampling equipment must be used, the decontamination guidelines included in Appendix B as Item 3 will be followed. In general, these guidelines describe cleaning with non-phosphate detergent, then performing rinsing cycles with water and acid. After the equipment is air-dried, it must be wrapped in aluminum foil to avoid accidental contamination after cleaning.

After all equipment is decontaminated, the solutions produced must be properly containerized and disposed of. All other disposable contaminated supplies/equipment such as disposable safety and sampling equipment will also need to be properly disposed of. Unless characterization of the decon fluids and disposable equipment is performed in accordance with Section 4.0, these materials will be handled in the same manner as the drill cuttings/fluids from the well locations. All materials must be temporarily stored in a secure area such as the fenced decon pad.

If sampling is necessary, the Engineer's personnel will be responsible for the decontamination of the sampling equipment. The decontamination of drilling and excavation equipment is the responsibility of the Contractor(s). The Engineer's field representative will make daily inspections to insure that decontamination procedures are being followed.

6.0 LOCATING AND SETTING-UP ON THE WELL

The following tasks shall be performed to locate the well to be decommissioned:

- Notify property owner and/or other interested parties including the governing regulatory agency prior to site mobilization whenever possible.
- Review information about the well contained in the site file. This information may include one or more of the following: the site map, well boring log, well construction diagram, field inspection log, well photograph, and proposed well decommissioning procedure.
- Verify the well location and identification by locating the identifying marker.
- Verify the depth of the well in the well construction log by sounding with a weighted tape.

After the well has been located, the decommissioning procedure should be selected in accordance with Section 2.0 based on the available boring and sampling data. The rig must be set up prior to initiating drilling to ensure proper alignment with the well (i.e., the drill string must be aligned with the monitoring well).

7.0 REMOVING THE PROTECTIVE CASING

7.1 GENERAL

Removal of the protective casing of a well must not interfere with or compromise the integrity of decommissioning activities performed at the well.

The procedure for removing the protective casing of a well depends upon the decommissioning method used. When a well is decommissioned by the overdrilling or casing pulling method, the protective casing may be removed either before or after the casing is removed. When the decommissioning procedure requires casing perforation or grouting in-place, the protective casing should be removed after grout is added to the well. The protective casing handling and disposal must be consistent with the methods used for the well materials, unless an alternate disposal method can be employed (e.g., steam cleaning followed by disposal as nonhazardous waste).

7.2 PRIOR TO SEALING THE WELL BORE

When overdrilling, the protective casing must be removed first, unless the drilling tools have an inside diameter larger than the protective casing. The variety of protective casings available preclude developing a specific removal procedure. In all cases, however, the specific procedure used must minimize the risk of:

- breaking the well casing off below ground and
- allowing foreign material to enter the well casing.

If the decommissioning method used is casing pulling, the decision of when to remove the protective casing is not critical.

An acceptable protective casing removal method involves breaking up the concrete seal surrounding the casing and jacking or hoisting the casing out of the ground. A check should be made during pulling to insure that the inner well casing is not being hoisted with the protective casing. If this occurs, the well casing should be cut off after the base of the protective casing is lifted above the land surface.

7.3 AFTER SEALING THE WELL

If the decommissioning method used allows well casing to remain in the ground, the protective casing should be removed after the well has been properly filled with grout. This will insure that the well is properly sealed regardless of problems with protective casing removal. During grouting in-place, the well casing must be removed to a depth of five feet below the land surface. The upper five feet of casing and the protective casing can be removed in one operation if a casing cutter is used. If the height of the protective casing makes working conditions at the well awkward, the casing can be cut off at a lower level. However, the inner well casing must remain aboveground and cannot be damaged in any way that prevents the well from being filled with grout.

8.0 DECOMMISSIONING OF SCREEN AND RISER

After setting up on the well and removing the protective casing (if necessary), the well screen and riser are decommissioned in accordance with the appropriate procedure and methodology as discussed in Section 2.0 (i.e., if the wells are overdrilled or pulled, the casing and riser are removed. Otherwise, they are perforated and/or grouted in-place). During the decommissioning activities the requirements of the site-specific health and safety plan, materials handling and disposal plan and equipment decontamination plan will be followed to ensure maximum protection of human health and the environment.

9.0 SELECTING, MIXING, AND PLACING GROUT

9.1 SELECTING GROUT MIXTURE

There are two types of grout mixes that may be used to seal wells: a standard mix and a special mix. Both mixes use Type 1 Portland cement and four percent bentonite by weight. However, the special mix uses a smaller volume of water and is used in situations where excessive loss of the standard grout mix is possible (e.g. highly-fractured bedrock or coarse gravels).

9.1.1 Standard Grout Mixture

For most boreholes, the following standard mixture will be used:

- One 94-pound bag Type I Portland cement
- 3.9 pounds powdered bentonite
- 7.8 gallons potable water

This mixture results in a grout with a bentonite content of four percent by weight, and will be used in all cases except in boreholes where excessive use of grout is anticipated. In these cases a special mixture will be used (see Section 9.1.2).

See Section 9.2 for grout mixing procedures.

9.1.2 Special Mixture

In cases where excessive use of grout is anticipated, such as high permeability formations and highly fractured or cavernous bedrock formations, the following special mixture will be used:

- One 94-pound bag type I Portland cement
- 3.9 pounds powdered bentonite
- 1 pound calcium chloride
- 6.0-7.8 gallons potable water (depending on desired thickness)

The special mixture results in a grout with a bentonite content of four percent by weight. It is thicker than the standard mixture because it contains less water. This grout is expected to set faster than the Standard Grout Mixture. The least amount of water that can be added for the mixture to be readily pumpable is six gallons per 94-pound bag of cement.

See Section 9.2 for grout mixing procedures.

9.1.3 Alternate Special Grout

In cases where the penetration of the sandpack is critical, such as bedrock wells with screens that transect multiple water-bearing zones, the following alternate mixture will be used:

- One 94 pound bag Type III Portland Cement.
- 3.9 pounds powdered bentonite.
- 7.8 gallons potable water.

Refer to Section 9.2 for grout mixing procedures. It should be noted that this grout is expected to set faster than the standard grout mixture.

9.2 GROUT MIXING PROCEDURE

To begin the grout-mixing procedure, calculate the volume of grout required to fill the borehole. If possible, the mixing basin should be large enough to hold all of the grout necessary for the borehole. Tall cylindrical and long shallow basins should not be used as it is difficult to obtain a homogeneous mixture in these types of basins.

Mix grout until a smooth, homogeneous mixture is achieved. No lumps or dry clots should be present. Grout can be mixed manually or with a mechanized mixer. One acceptable type of mixer is a vertical paddle grout mixer. Colloidal mixers should not be used as they tend to excessively decrease the thickness of the grout for the above recipes.

9.3 GROUT PLACEMENT

Grout will be placed in the borehole from the bottom to the top using a tremie pipe of not less than 1-inch diameter. Grout will then be pumped into the borehole until the grout appears at the land surface (when grouting open holes in bedrock, the grout level only needs to reach above the bedrock surface). Any groundwater displaced during grout placement will be pumped via suction lift to a 55-gallon drum for proper disposal.

At this time the rate of settling should be observed. When the grout level stabilizes, casing or augers will be removed from the hole. As each section is removed, grout will be added to keep the level between 0-feet and 5-feet below land surface. If the grout level drops below the land surface to an excessive degree, an alternate grouting method must be used. One possibility is to grout in stages; i.e., the first batch of grout is allowed to partially cure before a second batch of grout is added.

Upon completion of grouting, insure that the final grout level is approximately five feet below land surface. A ferrous metal marker will be embedded in the top of the grout to indicate the location of the former monitoring well.

10.0 BACKFILLING AND SITE RESTORATION

The uppermost five feet of the borehole at the land surface will be filled with a material appropriate to the intended use of the land. The materials will be physically similar to the natural soils. No materials will be used that limit the use of the property in any way. The surface of the borehole will be restored to the condition of the area surrounding the borehole. For example, concrete or asphalt will be patched with concrete or asphalt of the same type and thickness, grassed areas will be seeded, and topsoil will be used in other areas. All solid waste materials generated during the decommissioning process will be disposed of properly.

11.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCEDURES

This section describes the quality control/quality assurance (QA/QC) procedures necessary for monitoring and ensuring the Contractor's adherence to the Monitoring Well Decommissioning Project procedures, plans and specifications, prepared by the Engineer. This section will discuss the minimum inspection and documentation requirements necessary to facilitate proper well decommissioning procedures and also will:

- Review the general requirements specified in the Contract Documents.
- Define roles and responsibilities of all parties.
- Establish the key tasks to be monitored by the on-site construction inspector and the appropriate inspector forms and logs to be used for recording the Contractor's activities.
- Establish procedures for communicating change orders, field modifications and variations from the Contract Documents to the Owner.
- Establish scheduled meetings and briefings during the construction phase.

The overall goal of the project QA/QC program is to ensure that proper well decommissioning techniques and procedures are used in accordance with the requirements of the Contract Documents. The QA/QC procedures herein should be followed by QA personnel including: Construction Contractor personnel, the Contractor's subcontracted laboratory and field personnel, and the Engineer's on-site construction inspector.

11.1 RESPONSIBILITY AND AUTHORITY

The principal organizations involved in developing, designing and conducting well decommissioning activities are the Owner, Engineer, and the Construction Contractor.

11.1.1 Owner

The Owner will be responsible for reviewing the well decommissioning procedures to determine whether the documents meet their requirements, and to obtain approval of the procedures from the appropriate regulatory agencies. The Owner will have the responsibility and authority to review and accept or reject any design or procedural revisions or requests. The Owner also has the responsibility and authority to review and approve the Construction Monitoring Report and all QA documentation collected during well decommissioning activities.

11.1.2 Engineer

The Engineer will be responsible for reviewing and approving any engineering design changes, construction monitoring and quality assurance in accordance with this QA Plan. The Engineer will inform all parties involved with construction of their responsibilities, lines of communication, lines of authority, and QA/QC procedures. The Engineer's construction inspector (QA Engineer) will monitor decommissioning activities and will be assigned specific responsibilities and tasks. Most of the waste sample collection and testing will be conducted by the contractor at a frequency and manner specified in the site specific Materials Handling and Disposal Plan.

The person filling the construction inspector (QA Engineer) position will be trained and certified to operate an HNu organic vapor photoionization detector (PID), will be OSHA 40-hour Hazardous Waste Worker trained and will have a working knowledge of documents pertaining to well decommissioning activities, including this plan. The Engineer's field personnel will be instructed to contact the construction inspector (QA Engineer) in the event well decommissioning requirements are not being met, QA procedures are not being implemented, or construction problems have been encountered.

11.1.3 Construction Contractor

In addition to performing the monitoring well decommissioning in accordance with the design documents, the Contractor will be required to obtain the services of a qualified testing laboratory to perform the analytical testing of the waste materials and will also be responsible for procuring transportation and disposal/treatment services.

11.2 PROJECT MEETINGS

The Engineer's management of the monitoring well decommissioning project will include conducting periodic project meetings as described below:

11.2.1 Pre-construction Meeting

The Engineer will schedule and attend one (1) pre-construction meeting for the purpose of discussing the project approach and answering contractor questions. The Engineer will also prepare and distribute meeting minutes. The meeting will also:

- Provide each party (organization) with relevant QA documents and supporting information.
- Familiarize each organization with the QA Plan and its role relative to the well decommissioning criteria and construction documents.
- Review the responsibilities of each organization and review the lines of authority and communication for each organization.
- Discuss the established procedures for observations and tests including waste sampling.

- Discuss the established procedures for handling construction deficiencies, repairs, and/or retesting.

- Review methods for documenting and reporting inspection data.

11.2.2 Monthly Progress Meetings

Monthly project meetings will be held during the course of the work to discuss the project schedule and work performed to date, and to address and resolve any existing or anticipated problems.

A special meeting will be held when and if a major QA problem or deficiency is present or likely to occur. At a minimum, the meeting shall be attended by the Construction Contractor and the Engineer's on-site inspector (QA Engineer). The purpose of the meeting will be to define and resolve the problem(s) or deficiencies encountered. The meeting minutes will be documented by the Engineer.

11.3 KEY TASKS

The key tasks that the Engineer will conduct during the well decommissioning project are briefly summarized below.

11.3.1 Review of Contractor Submissions

Prior to well decommissioning activities, all written submissions required by the contract documents will be evaluated and forwarded to the Owner, together with written submissions regarding their suitability. The Engineer will also obtain and review all necessary shop drawings, material tests and as-built drawings submitted throughout the construction and will make recommendations for acceptance/rejection to the Owner. The contractor's progress will be continuously monitored during the construction period, and Owner will be informed of the schedule and any corrective measures planned or implemented.

Throughout the project, payment requests by the contractor will be reviewed for accuracy and completeness prior to making recommendations relative to payment. Review will involve comparing actual notes of field personnel to items contained in the payment request. Discrepancies will be discussed with the contractor and will be amended if necessary.

11.3.2 Construction Inspection

The Engineer will provide full-time inspection of the contractor during all critical well decommissioning activities at each of the sites. This will be accomplished by providing an experienced on-site inspector(s) to document the contractor's adherence to the contract specifications and monitoring the contractor's progress. The Engineer will notify the Owner in the event that the contractor fails to perform the decommissioning work as specified in the contract and recommend to the Owner the acceptance, conditional approval/disapproval or rejection of the contractor's work. The Engineer will issue instructions, field orders, interpretations and clarification of contract language to the contractor as required. In the event that a change order is necessary, the Engineer will submit the change order with a detailed cost estimate to the Owner. The Engineer will also document, evaluate and recommend a course of action for all disputes and claims with the contractor.

In addition, the Engineer will inspect, evaluate and document the monitoring well condition after the well has been removed.

11.4 DOCUMENTATION

The Engineer's on-site construction inspector will document all monitoring well decommissioning activities. Such documentation will include, at a minimum, daily reports of construction activities, photographs, and sketches as necessary. Field investigation reports will be completed by the construction inspector when major questions arise at the site. Forms to be used for this purpose are presented in Appendix C.

The Engineer will maintain complete and detailed records associated with all construction and related activities during the duration of the project. These records will be maintained at the Engineer's office(s) and will include but not be limited to the following:

- Daily work completed and important conversations.
- Contractor's daily use of personnel, material and equipment.
- Records documenting the contractor's deviation from work as specified in the contract documents, and any instructions issued regarding deviations.
- Unusual circumstances (weather conditions, labor disputes, environmental problems, health and safety hazards encountered, etc.).
- General files including correspondence and other documentation related to the project.
- Job meeting minutes with documentation on resolution of issues raised.
- Records of contractor's submittals including shop drawings, modifications/change orders, soil tests, material tests and action taken (e.g.,Owner approval/disapproval, further information needed).
- Construction photos.
- Telephone conversation

In addition, the Engineer will submit monthly Project Summary Reports to the Owner. These reports will identify the work which has been accomplished and will document the status of each monitoring well at each site where decommissioning work has occurred.

Upon substantial completion of the decommissioning activities at each site, the Engineer will prepare a detailed list of any work remaining unfinished. The Engineer will then prepare and submit a written notice to the Owner which will include a determination as to whether the completed work meets the requirements of the contract documents. Following satisfactory completion of the work, the Engineer will perform a final inspection of the site and submit a notice to the Owner that decommissioning activities were performed in accordance with the contract documents as revised by any approved change orders or modifications to the scope of work.

Documentation on the condition of the removed wells with respect to the impacts of hazardous waste, minerals and other pertinent environmental factors, or discernable through direct observation, will be presented to Owner along with any recommendations for future well installation techniques and materials.

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FINAL

GROUNDWATER MONITORING REPORT

for the November 2000 Sampling Event
at Air Force Plant 3

Prepared for:

Air Force Center for Environmental Excellence
and
Aeronautical Systems Center

Prepared by:

Earth Tech, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314

Contract No. F41624-97-D-8018
Delivery Order No. 0070

February 2001

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DISCLAIMER

This *Final Groundwater Monitoring Report for the November 2000 Sampling Event* has been prepared for the United States Air Force (USAF) by Earth Tech for the purpose of satisfying the groundwater monitoring requirements defined in the Class 3 Modification to the Resource Conservation and Recovery Act Part B Permit for Air Force Plant 3. Acceptance of this report in performance of the contract under which it is prepared does not mean that the USAF adopts the conclusions, recommendations or other views expressed herein, which are those of Earth Tech only and do not necessarily reflect the official position of the USAF.

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PREFACE

This *Final Groundwater Monitoring Report for the November 2000 Sampling Event* was prepared by Earth Tech to describe field and laboratory operations conducted as part of the November 2000 groundwater sampling event at Air Force Plant 3 (AFP 3), Tulsa, Oklahoma. Fieldwork followed guidelines set forth in the Class 3 Modification to the Resource Conservation and Recovery Act (RCRA) Part B Permit for AFP 3; Subtitle C of RCRA (42 United States Code Sections 6921-6939b); the March 1994 *Final RCRA Facility Investigation Work Plan* (Earth Tech, 1994); the Air Force Center for Environmental Excellence (AFCEE) *Model Work Plan* (United States Air Force [USAF], 1996); and the AFCEE *Model Field Sampling Plan, Version 1.1* (USAF, 1997).

The groundwater monitoring program includes the sampling of 20 monitoring wells defined in the Class 3 Modification to the RCRA Part B Permit for AFP 3 (United States Environmental Protection Agency No. OK9570000001). The sampling was conducted on a semiannual basis for one year, and will be conducted on an annual basis thereafter. The monitoring program will continue for a minimum of five years. The November 2000 sampling event represents the second year of the groundwater monitoring program and the first year of annual sampling.

The AFCEE Restoration Team Chief is John McCown. The Air Force Aeronautical Systems Center Integrated Product Team Chief is John Doepker. The Earth Tech Project Manager is Dave Parse.

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Program Manager

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LIST OF ACRONYMS AND ABBREVIATIONS

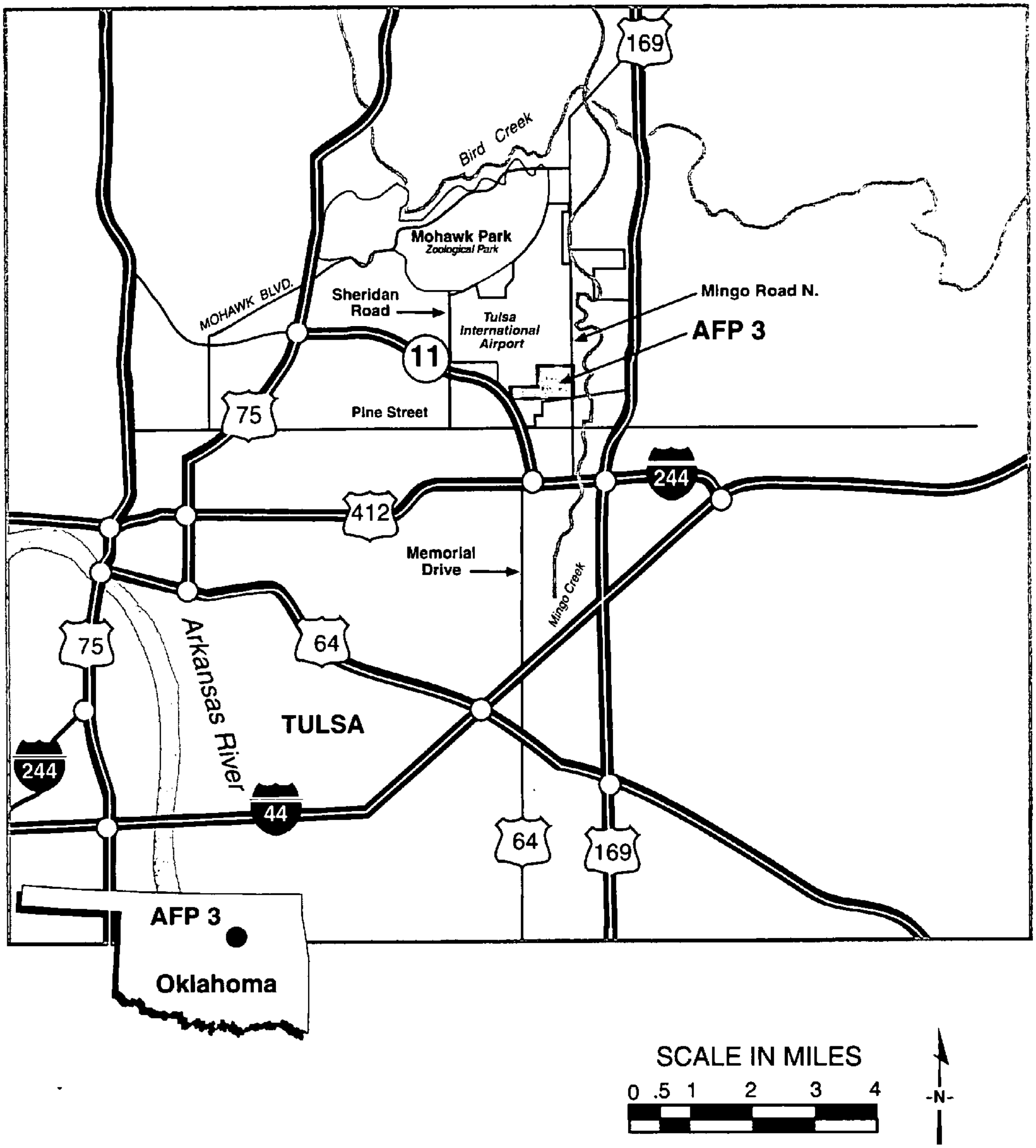
AFCEE	Air Force Center for Environmental Excellence
AFP 3	Air Force Plant 3
AOC	Area of Concern
1,1-DCA	1,1-Dichloroethane
1,2-DCA	1,2-Dichloroethane
1,1-DCE	1,1-Dichloroethene
cis-1,2-DCE	cis-1,2-Dichloroethene
IRP	Installation Restoration Program
µg/L	Micrograms per Liter
MDL	Method Detection Limit
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting Limit
SWMU	Solid Waste Management Unit
1,1,1-TCA	1,1,1-Trichloroethane
TCE	Trichloroethene
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1.0 INTRODUCTION

This *Final Groundwater Monitoring Report for the November 2000 Sampling Event* was prepared by Earth Tech to describe field and laboratory operations during the November 2000 groundwater sampling event at Air Force Plant 3 (AFP 3). The November 2000 sampling event represents the second year of the groundwater monitoring program and the first year of annual sampling. The groundwater monitoring was conducted to partially satisfy the groundwater monitoring requirements defined in the Class 3 Modification to the Resource Conservation and Recovery Act (RCRA) Part B Permit (herein referred to as the Permit) for AFP 3. Figure 1-1 shows the general location of AFP 3.

This report was developed in accordance with guidelines set forth in the Permit and Subtitle C of RCRA (42 United States Code Sections 6921-6939b). The report also follows the format and content requirements of the United States Air Force (USAF) document *Handbook for the Installation Restoration Program (IRP), Remedial Investigations and Feasibility Studies (RI/FS)* (USAF, 1993). All sampling activities followed protocols presented in the *Work Plan for Groundwater Monitoring at AFP 3* (Earth Tech, 1999); the *Final RCRA Facility Investigation Work Plan* (Earth Tech, 1994); the Air Force Center for Environmental Excellence (AFCEE) *Model Work Plan* (USAF, 1996); and the AFCEE *Model Field Sampling Plan, Version 1.1* (USAF, 1997).

This report contains the following four sections: Section 1 provides the objectives of the semiannual sampling events; Section 2 provides a summary of the activities conducted during the November 2000 sampling event; Section 3 summarizes the analytical results; and Section 4 presents conclusions from the sampling event.



EARTH TECH

FIGURE 1-1

GENERAL LOCATION OF AIR FORCE PLANT 3 TULSA, OKLAHOMA

GF/1034/AFP3

2.0 PROJECT ACTIVITIES

This section summarizes activities conducted during the November 2000 sampling event. Section 2.1 identifies the monitoring wells that were sampled and the analyses that were performed during the investigation. Section 2.2 outlines the groundwater sampling procedures.

2.1 Sample Analysis Summary

As per requirements defined in the Permit, the groundwater monitoring program at AFP 3 includes the collection of samples from the following monitoring wells:

- Monitoring wells 5-5, 5-14, 5-16, 5-19, 5-20, 5-21, and 5-22 for Solid Waste Management Unit (SWMU) 5;
- Monitoring wells 5-2, 5-13, 8-8, 8-15, 8-DG2, and 8-DG4 for SWMU 8; and
- Monitoring wells 8-17, 8-18, 8-20, 8-21, 8-22, 8-23, and 1-1 for Area of Concern (AOC) 1.

Monitoring wells 1-1 and 8-18 were destroyed during construction activities at the plant and were not sampled during the November 1999 sampling event (Earth Tech, 2000); monitoring well 8-19 was sampled during the November 1999 sampling event in place of monitoring well 8-18. Monitoring wells 1-1 and 8-18 were abandoned and replaced in April 2000, and were then sampled during the May 2000 sampling event. Monitoring well 8-18 was again damaged by construction activities at the plant and was not sampled during the November 2000 sampling event.

Because volatile organic compounds (VOCs) represent the only chemicals of potential concern in groundwater at AFP 3, the groundwater samples were analyzed for VOCs by United States Environmental Protection Agency (USEPA) Method SW8260B. Table 2.1-1 lists the total number of groundwater samples collected for each sample type (e.g., environmental sample, duplicate sample) during the November 2000 sampling event, and Figure 2.1-1 shows the locations of the on-site monitoring wells sampled during the November 2000 sampling event.

Table 2.1-1. Sample Analysis Summary

Method	Matrix	Number of Samples	Number of Equipment Blanks	Number of Ambient Blanks	Number of Trip Blanks	Number of Field Duplicates	Total Number of Samples
SW8260B Volatile Organics	Groundwater	19	0[1]	1	2	1	23

[1] No equipment blanks were collected because disposable bailers were used during groundwater sampling.

2.2 Field Activities

The primary field activity was sampling of the monitoring wells shown in Figure 2.1-1. Groundwater sampling methods followed protocols presented in the *Work Plan for Groundwater Monitoring at AFP 3* (Earth Tech, 1999). The primary objective of the groundwater sampling event was to provide an additional round of analytical data to characterize the extent of VOCs in site groundwater and compare the data to previous sampling results from the groundwater monitoring program.

Groundwater sampling procedures included:

1. Measuring groundwater levels in all on-site monitoring wells;

2. Purging select on-site monitoring wells prior to sampling;

3. Measuring field-derived parameters (including temperature, pH, specific conductance, and turbidity) during monitoring well purging; and

4. Collecting groundwater samples from the purged monitoring wells.

Refer to the *Work Plan for Groundwater Monitoring at AFP 3* (Earth Tech, 1999) for a detailed description of all sampling activities and protocols.

Static water levels were measured each time a monitoring well was sampled and before any equipment entered the monitoring well. If the casing cap was airtight, the air pressure within the monitoring well was allowed to equilibrate after the cap was removed and prior to measurement of the water level.

3.0 INVESTIGATION RESULTS

The results of the November 2000 sampling event at AFP 3 are summarized in this section. Section 3.1 summarizes the analytical results and Section 3.2 provides conclusions concerning the analytical data. Field data are provided in Appendix B, chain-of-custody forms are provided in Appendix C, and analytical data are provided in Appendix D.

3.1 Sampling and Analysis Results

This section summarizes the data collection activities completed during the November 2000 sampling event and presents the laboratory analytical results.

3.1.1 Review of Field and Laboratory Data

All field procedures, sample handling documentation, and laboratory procedures followed protocols presented in the *Work Plan for Groundwater Monitoring at AFP 3* (Earth Tech, 1999). All analytical data generated as a result of the November 2000 sampling event were reported as AFCEE definitive data. Analytical protocols utilized in sample preparation, analysis, and reporting were in accordance with the specific analytical method and the guidelines given in the AFCEE *Quality Assurance Project Plan (QAPP), Version 3.0* (USAF, 1998). Laboratory analyses were performed by Southwest Laboratory of Oklahoma in Broken Arrow, Oklahoma. Analytical methods and Southwest Laboratory's associated reporting limits (RLs) are provided in Appendix D. No data validation was performed by Earth Tech.

Data flags were applied to the analytical data by the laboratory. During the data review process, Earth Tech reviewed the analytical data and associated data flags and assigned data qualifiers as per the guidelines given in the AFCEE *QAPP, Version 3.0* (USAF, 1998); the Data Quality Review is provided in Appendix D. The following data qualifiers were assigned to the data as a result of the data review process and are defined below.

- **R** The data are unusable due to deficiencies in the ability to analyze the sample and meet quality control criteria.
- **M** A matrix effect is present.
- **F** The analyte was positively identified, but the associated numerical value is below the reporting limit (RL).
- **J** The analyte was positively identified, but the quantitation is an estimation.
- **B** The analyte was found in the associated blank as well as in the sample. It indicates possible/probable blank contamination.
- **U** The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit (MDL).

The number and locations of groundwater samples are outlined below. Figure 3.1-1 shows the locations of the monitoring wells sampled during the November 2000 sampling event.

The following monitoring wells were sampled:

- Monitoring wells 5-5, 5-14, 5-16, 5-19, 5-20, 5-21, and 5-22 for SWMU 5;
- Monitoring wells 5-2, 5-13, 8-8, 8-15, 8-DG2, and 8-DG4 for SWMU 8; and
- Monitoring wells 8-17, 8-20, 8-21, 8-22, 8-23, and 1-1 for AOC 1.

3.1.2 VOCs Detected in Groundwater Samples

This section discusses the VOCs that were detected in the groundwater samples. The analytical results for groundwater samples collected from the three separate areas outlined above are discussed separately below. The analytical results for all groundwater samples collected during the November 2000 sampling event are summarized in Table 3.1-1. Appendix D provides a complete listing of all groundwater analytical results.

3.1.2.1 SWMU 5

VOCs detected in groundwater samples collected from SWMU 5 are shown in Figure 3.1-2. Table 3.1-2 summarizes all VOCs detected in one or more of the groundwater samples collected from SWMU 5, the number of samples above the laboratory MDL, the minimum and maximum concentrations detected, and the location of the maximum concentration.

VOCs were detected in the groundwater samples collected from monitoring wells 5-5, 5-14, 5-16, and 5-22; no VOCs were detected in the groundwater samples collected from 5-19, 5-20, and 5-21. All of the VOCs detected were chlorinated hydrocarbons. The following maximum concentrations were detected in the groundwater samples: trichloroethene (TCE) at 1,200 micrograms per liter (µg/L) in monitoring well 5-14; 1,1,1-trichloroethane (1,1,1-TCA) at 150 µg/L in the monitoring well 5-5; 1,1-dichloroethene (1,1-DCE) at 1,300 M µg/L in monitoring well 5-5; 1,1-dichloroethane (1,1-DCA) at 1,100 µg/L in monitoring well 5-5; cis-1,2-dichloroethene (cis-1,2-DCE) at 58 F µg/L in monitoring well 5-14; acetone at 4,000 M µg/L in monitoring well 5-14; and chloroform at 65 F µg/L in monitoring well 5-14.

3.1.2.2 SWMU 8

VOCs detected in groundwater samples collected from SWMU 8 are shown in Figure 3.1-2. Table 3.1-3 summarizes all VOCs detected in one or more of the groundwater samples collected from SWMU 8, the number of samples above the laboratory MDL, the minimum and maximum concentrations detected, and the location of the maximum concentration.

Table 3.1-1. Groundwater Data Summary for VOCs

Parameters	1MNW1	5MNW2	5MNW5	5MNW13	5MNW14	5MNW16	5MN19	5MN20	5MN21	5MNW22
1,1,1-Trichloroethane	1U	25 U	150	1 U	100 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	0.4 F	210	1,100	0.7 F	100 U	1	1 U	1 U	1 U	1
1,1-Dichloroethene	1U	1,200 M	1,300 M	4 M	270 M	12 M	1 U	1 U	1 U	7 M
Acetone	5U	120 U	500 U	5 U	4,000 M	5 U	5 U	5 U	5 U	5 U
Carbon disulfide	0.4 F	25 U	100 U	1 U	100 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1U	14 F	63 F	1 U	65 F	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1U	590	100 U	9	58 F	1 U	1 U	1 U	1 U	1 U
Methylene Chloride	1U	25 U	110 B	1 U	100 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1U	690	100 U	17	1,200	1 U	1 U	1 U	1 U	8
Vinyl Chloride	1U	97	100 U	1 U	100 U	1 U	1 U	1 U	1 U	1 U

Parameters	8MNW8	8MNW15	8MNW17	8MNW20	8MNW20 Duplicate	8MNW21	8MNW22	8MNW23	8MNWDG2	8MNWDG4
1,1,1-Trichloroethane	200 U	200 U	3,100	1,200 U	1,000 U	1 U	1 U	1 U	50 U	1 U
1,1-Dichloroethane	420	200 U	1,000 U	1,200 U	1,000 U	1 U	1 U	0.5 F	1,400	1 U
1,1-Dichloroethene	780 M	200 U	14,000 M	2,500 M	1,800 M	1 U	1 U	4 M	1,300 M	1 U
Acetone	1,000 U	1,000 U	5,000 U	6,200 U	5,000 U	6 M	5 U	5 U	250 U	5 U
Carbon disulfide	200 U	200 U	1,000 U	1,200 U	1,000 U	1 U	1 U	1 U	50 U	1 U
Chloroform	150 F	140 F	470 F	280 F	640 F	1 U	1 U	1 U	34 F	1 U
Cis-1,2-Dichloroethene	3,300	250	1,000U	1,200 U	1,000 U	1 U	1 U	0.8 F	690	1 U
Methylene Chloride	440 B	1,000 B	1,900 B	2,300 B	1,700 B	0.9 F	1 U	1 B	260 B	1 U
Trichloroethene	3,300	4,200	31,000	23,000 J	15,000 J	1 U	1 U	1	800	1 U
Vinyl Chloride	200 U	200 U	1,000 U	1,200 U	1,000 U	1 U	1 U	1 U	560	1 U

Key: U = Analyte was analyzed for but not detected. The associated numerical value is at or below the method detection limit (MDL).
Qualifiers: F = The analyte was positively identified, but the associated numerical value is below the reporting limit (RL).
M = A matrix effect is present.
B = An analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination.
J = The analyte was positively identified, but the quantitation is an estimation.

Table 3.1-2. VOCs Detected in SWMU 5 Groundwater Samples

Analyte	Number of Samples Above MDL	Range (µg/L)		Location of Maximum Detection
		Minimum Detected	Maximum Detected	
Trichloroethene	2 of 7	8	1,200	5-14
1,1,1-Trichloroethane	1 of 7	150	150	5-5
1,1-Dichloroethene	4 of 7	7 M	1,300 M	5-5
1,1-Dichloroethane	3 of 7	1	1,100	5-5
cis-1,2-Dichloroethene	1 of 7	58 F	58 F	5-14
Acetone	1 of 7	4,000 M	4,000 M	5-14
Chloroform	2 of 7	63 F	65 F	5-14

Key: µg/L = Micrograms per liter
MDL = Method detection limit
F = The analyte was positively identified, but the associated numerical value is below the reporting limit (RL).
M = A matrix effect is present.

Notes: Only analytes detected in one or more of the groundwater samples are included in this summary table.

Table 3.1-3. VOCs Detected in SWMU 8 Groundwater Samples

Analyte	Number of Samples Above MDL	Range (µg/L)		Location of Maximum Detection
		Minimum Detected	Maximum Detected	
Trichloroethene	5 of 6	17	4,200	8-15
1,1-Dichloroethene	4 of 6	4 M	1,300 M	8-DG2
1,1-Dichloroethane	4 of 6	0.7 F	1,400	8-DG2
cis-1,2-Dichloroethene	5 of 6	9	3,300	8-8
Vinyl Chloride	2 of 6	97	560	8-DG2
Chloroform	4 of 6	14 F	150 F	8-8

Key: µg/L = Micrograms per liter
MDL = Method detection limit
F = The analyte was positively identified, but the associated numerical value is below the reporting limit (RL).
M = A matrix effect is present.

Notes: Only analytes detected in one or more of the groundwater samples are included in this summary table.

VOCs were detected in groundwater samples collected from monitoring wells 5-2, 5-13, 8-8, 8-15, and 8-DG2; no VOCs were detected in the groundwater sample collected from 8-DG4. All of the VOCs detected were chlorinated hydrocarbons. The following maximum concentrations were detected in the groundwater samples: TCE at 4,200 μg/L in monitoring well 8-15; 1,1-DCE at 1,300 M μg/L in monitoring well 8-DG2; 1,1-DCA at 1,400 μg/L in monitoring well 8-DG2; cis-1,2-DCE at 3,300 μg/L in monitoring well 8-8; vinyl chloride at 560 μg/L in monitoring well 8-DG2; and chloroform at 150 F μg/L in monitoring well 8-DG2.

3.1.2.3 AOC 1

VOCs detected in groundwater samples collected from AOC 1 are shown in Figure 3.1-2. Table 3.1-4 summarizes all VOCs detected in one or more of the groundwater samples collected from AOC 1, the number of samples above the laboratory MDL, the minimum and maximum concentrations detected, and the location of the maximum concentration.

VOCs were detected in the groundwater samples collected from monitoring wells 1-1, 8-17, 8-20, 8-21, and 8-23; no VOCs were detected in the groundwater sample collected from 8-22. The following maximum concentrations were detected in the groundwater samples (including the duplicate sample collected at monitoring well 8-20): TCE at 31,000 μg/L in monitoring well 8-17; 1,1,1-TCA at 3,100 μg/L in monitoring well 8-17; 1,1-DCE at 14,000 M μg/L in monitoring well 8-17; 1,1-DCA at 0.5 F μg/L in monitoring well 8-23; cis-1,2-DCE at 0.8 F μg/L in monitoring well 8-23; methylene chloride at 0.9 F μg/L in monitoring well 8-21; chloroform at 640 F μg/L in monitoring well 8-20 (duplicate sample); acetone at 6 M μg/L in monitoring well 8-21; and carbon disulfide at 0.4 F μg/L in monitoring well 1-1.

3.1.3 Trend Analysis

Table 3.1-5 presents concentrations of chlorinated hydrocarbons (except methylene chloride and chloroform) detected in groundwater samples collected at AFP 3 in November 1999, May 2000, and November 2000. Concentrations of chlorinated hydrocarbons have generally increased in monitoring wells 5-2, 8-17, and 8-DG2, and concentrations of chlorinated hydrocarbons have remained relatively constant in monitoring wells 1-1, 5-5, 5-13, 5-14, 5-16, 5-22, 8-8, 8-15, 8-20, and 8-23. No chlorinated hydrocarbons were detected in groundwater samples from monitoring wells 5-19, 5-20, 5-21, 8-21, 8-22, and 8-DG4. Monitoring well 8-18 has only been sampled once during the groundwater monitoring program; therefore, it was not possible to evaluate concentration trends.

Table 3.1-4. VOCs Detected in AOC 1 Groundwater Samples

Analyte	Number of Samples Above MDL	Range (µg/L)		Location of Maximum Detection
		Minimum Detected	Maximum Detected	
Trichloroethene	2 of 7	0.4F	0.5F	8-23
1,1,1-Trichloroethane	1 of 7	3,100	3,100	8-17
1,1-Dichloroethene	4 of 7	4 M	14,000 M	8-17
1,1-Dichloroethane	2 of 7	0.4 F	0.5 F	8-23
cis-1,2-Dichloroethene	1 of 7	0.8 F	0.8 F	8-23
Methylene Chloride	1 of 7	0.9 F	0.9 F	8-21
Chloroform	3 of 7	280 F	640 F	8-20
Acetone	1 of 7	6 M	6 M	8-21
Carbon Disulfide	1 of 7	0.4 F	0.4 F	1-1

Key:
µg/L = Micrograms per liter
MDL = Method detection limit
F = The analyte was positively identified, but the associated numerical value is below the reporting limit (RL).
M = A matrix effect is present.

Notes: Only analytes detected in one or more of the groundwater samples are included in this summary table.

Table 3.1-5. Trend Analysis of Chlorinated Hydrocarbons in Groundwater at AFP 3

Well I.D.	Date Sampled	Concentration of Compound in Groundwater (µg/L)						
		1,1-DCA	1,2-DCA	1,1-DCE	cis-1,2-DCE	1,1,1-TCA	TCE	Vinyl Chloride
1-1*	November 1999	NS	NS	NS	NS	NS	NS	NS
	May 2000	--	--	--	--	--	--	--
	November 2000	0.4 F	--	--	--	--	--	--
5-2	November 1999	130	--	920	--	--	640	77
	May 2000	120	--	940	510	--	680	53
	November 2000	210	--	1,200 M	590	--	690	97
5-5	November 1999	850	--	1,000	--	--	--	--
	May 2000	1,400	--	1,200	--	230	700	--
	November 2000	1,100	--	1,300 M	--	150	--	--
5-13	November 1999	0.6 J	--	3	--	--	23	1
	May 2000	0.4 F	--	2	9	--	22	--
	November 2000	0.7 F	--	4 M	9	--	17	--
5-14	November 1999	--	--	--	--	--	1,500	--
	May 2000	27 F	--	290	45 F	--	1,700	--
	November 2000	--	--	270 M	58 F	--	1,200	--
5-16	November 1999	1	--	16	--	--	--	--
	May 2000	--	--	10	--	--	--	--
	November 2000	1	--	12 M	--	--	--	--
5-19	November 1999	--	--	--	--	--	--	--
	May 2000	--	--	--	--	--	--	--
	November 2000	--	--	--	--	--	--	--
5-20	November 1999	--	--	--	--	--	--	--
	May 2000	--	--	--	--	--	--	--
	November 2000	--	--	--	--	--	--	--
5-21	November 1999	--	--	--	--	--	--	--
	May 2000	--	--	--	--	--	--	--
	November 2000	--	--	--	--	--	--	--
5-22	November 1999	2	--	10	--	--	15	--
	May 2000	0.4F	--	3 J	--	--	4 J	--
	November 2000	1	--	7 M	--	--	8	--
8-8	November 1999	370	210	930	--	--	4,500	58 J
	May 2000	350	270	690	3,300	--	4,500	--
	November 2000	420	--	780 M	3,300		3,300	--
8-15	November 1999	--	--	--	--	--	4,300	--
	May 2000	--	--	--	240	--	3,700	--
	November 2000	--	--	--	250	--	4,200	--

Table 3.1-5. Trend Analysis of Chlorinated Hydrocarbons in Groundwater at AFP 3 (Continued)

Well I.D.	Date Sampled	Concentration of Compound in Groundwater (µg/L)						
		1,1-DCA	1,2-DCA	1,1-DCE	cis-1,2-DCE	1,1,1-TCA	TCE	Vinyl Chloride
8-17	November 1999	--	--	1,800	--	--	4,600	--
	May 2000	--	--	2,900	--	940	12,000	--
	November 2000	--	--	14,000 M	--	3,100	31,000	--
8-18*	November 1999	NS	NS	NS	NS	NS	NS	NS
	May 2000	5	--	17	0.8 F	--	15	--
	November 2000	NS	NS	NS	NS	NS	NS	NS
8-20	November 1999	--	--	2,000	1,700	--	23,000	--
	May 2000	--	--	1,400	1,700	--	24,000	--
	November 2000	--	--	2,500 M	--	--	23,000 J	--
8-21	November 1999	--	--	--	--	--	--	--
	May 2000	--	--	--	--	--	--	--
	November 2000	--	--	--	--	--	--	--
8-22	November 1999	--	--	--	--	--	--	--
	May 2000	--	--	--	--	--	--	--
	November 2000	--	--	--	--	--	--	--
8-23	November 1999	--	--	3	--	--	2	--
	May 2000	--	--	2	0.9 F	--	2	--
	November 2000	0.5 F	--	4M	0.8 F	--	1	--
8-DG2	November 1999	1,600	--	1,600	--	--	600	430
	May 2000	1,200	--	1,000	580	--	780	270
	November 2000	1,400	--	1,300M	690	--	800	560
8-DG4	November 1999	--	--	--	--	--	--	--
	May 2000	--	--	--	--	--	--	--
	November 2000	--	--	--	--	--	--	--

Key: NS = Not sampled

Qualifiers:
J = The analyte was positively identified, but the quantitation is an estimation.
F = The analyte was positively identified, but the associated numerical value is below the RL.
M = A matrix effect is present.

* This monitoring well was not sampled during the November 1999 sampling event because the well was damaged during construction activities in the area. The well was abandoned and replaced in April 2000, then sampled during the May 2000 sampling event. Well 8-18, again damaged during construction activities, was not sampled during the November 2000 sampling event and will be abandoned.

4.0 CONCLUSIONS

A separate groundwater plume is associated with each of the three areas of concern (i.e., SWMU 5, SWMU 8, and AOC 1). The plume at SWMU 5 is related to a former surface impoundment at the Hardfill Area, the plume at SWMU 8 is related to underground waste lines beneath Building 3, and the plume at AOC 1 is related to the former vapor degreaser at Column 97 in Building 1.

At SWMU 5, monitoring wells 5-5, 5-14 and 5-16 are in the body of the plume, and monitoring wells 5-19, 5-20, 5-21, and 5-22 are downgradient of the plume. VOC concentrations were greatest in the samples collected from monitoring wells 5-5 and 5-14, including the following maximum concentrations: TCE at 1,200 µg/L in monitoring well 5-14; 1,1,1-TCA at 150 µg/L in monitoring well 5-5; 1,1-DCE at 1,300 M µg/L in monitoring well 5-5; and 1,1-DCA at 1,100 µg/L in monitoring well 5-5; and cis-1,2-DCE at 58 F µg/L in monitoring well 5-14. No VOCs were detected in downgradient monitoring wells 5-19, 5-20, and 5-21. The following concentrations were detected in downgradient monitoring well 5-22: TCE at 8 µg/L; 1,1-DCE at 7 M µg/L; and 1,1-DCA at 1 µg/L. The concentrations detected in the downgradient monitoring wells are similar to concentrations detected in the groundwater samples collected in May 2000.

At SWMU 8, monitoring wells 5-2, 8-8, 8-15, and 8-DG2 are in the body of the plume, and monitoring wells 5-13 and 8-DG4 are downgradient of the plume. VOC concentrations were greatest in the samples collected from monitoring wells 8-8, 8-15, and 8-DG2, including the following maximum concentrations: TCE at 4,200 µg/L in monitoring well 8-15; 1,1-DCE at 1,300 M µg/L in monitoring well 8-DG2; 1,1-DCA at 1,400 µg/L in monitoring well 8-DG2; cis-1,2-DCE at 3,300 µg/L in monitoring well 8-8; and vinyl chloride at 560 µg/L in monitoring well 8-DG2. No VOCs were detected in downgradient monitoring well 8-DG4. The following concentrations were detected in downgradient monitoring well 5-13: TCE at 17 µg/L; 1,1-DCE at 4 M µg/L; 1,1-DCA at 0.7 F µg/L; and cis-1,2-DCE at 9 µg/L. The concentrations detected in the downgradient monitoring wells are similar to concentrations detected in the groundwater samples collected in May 2000.

At AOC 1, monitoring wells 8-17 and 8-20 are in the body of the plume, monitoring well 8-18 is cross-gradient of the plume, and monitoring wells 8-21, 8-22, and 8-23 are downgradient of the plume. VOC concentrations were greatest in the sample collected from monitoring well 8-17, including the following maximum concentrations: TCE at 31,000 µg/L; 1,1,1-TCA at 3,100 µg/L; and 1,1-DCE at 14,000 M µg/L. No VOCs were detected in downgradient monitoring well 8-22. Methylene chloride (0.9 F µg/L) and acetone (6 M µg/L), both common laboratory contaminants, were the only VOCs detected in downgradient monitoring well 8-21. The following concentrations were detected in downgradient monitoring well 8-23: TCE at 1 µg/L; 1,1-DCE at 4 M µg/L; 1,1-DCA at 0.5 F µg/L; and cis-1,2-DCE at 0.8 F µg/L. These concentrations are similar to concentrations detected in the groundwater sample collected in May 2000.

APPENDIX A. REFERENCES

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APPENDIX A. REFERENCES

Earth Tech, 1994. *Final Resource Conservation and Recovery Act Facility Investigation Work Plan.*

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United States Air Force (USAF), 1996. *Model Work Plan.*

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APPENDIX B. FIELD DATA

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Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number: AFP 3 / 40216.06.05	Sampler(s): DN + GC
Date: 11/29/00	Well Diameter (inches): 2
Well Number: HE5 (5-5)	3 Well Volumes (gallons): 7.8
Total Well Depth (feet): 24.21	Purging Time Initiated: 1602
Depth to Water (feet): 8.10	Purging Time Completed:
Water Column Thickness (feet): 16.11	Total Gallons Purged:

1 vol = 2.6 g

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1602	Initial	18.6	6.37	1.10	999	Cloudy then clear
1604	2	19.0	6.24	0.98	700	Clear
1605	4	19.4	6.20	0.93	999	"
1606	6	19.2	6.19	0.94	663	"
1607	8	19.8	6.19	0.92	908	"

MS + MSD Samples Collected here

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
5MNW5WG1	1610	VOC	3-40 mL VOA	HCl
5MNW5WG1MS	"	"	"	"
5MNW5WG1MSD		"	"	"

Sample Shipped By: EARTH TECH
Laboratory: SW Laboratory
Sampler(s): DN + GC
Date: 11/29/00
Checked By:
Date:

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number:	AFP 3 / 40216.06.05	Sampler(s):	DN + GC
Date:	11/30/00	Well Diameter (inches):	4
Well Number:	5-14	3 Well Volumes (gallons):	26
Total Well Depth (feet):	26.29	Purging Time Initiated:	0839
Depth to Water (feet):	12.83	Purging Time Completed:	0852
Water Column Thickness (feet):	13.46	Total Gallons Purged:	25

1 vol = 8.7

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
0839	initial	19.3	6.22	0.76	999	Cloudy, brown
0842	5	20.4	6.03	0.65	222	clear
0846	10	21.1	5.98	0.65	30	"
0848	15	21.4	5.98	0.65	21	"
0850	20	21.5	6.01	0.65	27	"
0852	25					

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
5MNW14WG1	0855	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH
Sampler(s): DN + GC
Checked By:

Laboratory: SW Laboratory
Date: 11/30/00
Date:

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Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number: AFP 3 / 40216.06.05		Sampler(s):	DN + GC
Date:	11/28/00	Well Diameter (inches):	4
Well Number:	5-16	3 Well Volumes (gallons):	20
Total Well Depth (feet):	17.19	Purging Time Initiated:	1500
Depth to Water (feet):	6.80	Purging Time Completed:	1513
Water Column Thickness (feet):	10.39	Total Gallons Purged:	20

1 vol = 6.7 gal

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1500	initial	17.4	6.00	0.28	999	Cloudy then clear
1504	5	17.2	5.71	0.28	259	clear
1507	10	17.4	5.67	0.27	369	"
1510	15	17.9	5.59	0.28	670	"
1513	20	17.9	5.62	0.28	932	"

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
5MNW16WG1	1515	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH

Sampler(s): DN + GC

Checked By:

Laboratory: SW Laboratory

Date: 11/28/00

Date:

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number: AFP 3 / 40216.06.05	Sampler(s): DN + GC
Date: 11/28/00	Well Diameter (inches): 4
Well Number: 5-19	3 Well Volumes (gallons): 33
Total Well Depth (feet): 19.78	Purging Time Initiated: 1415
Depth to Water (feet): 2.85	Purging Time Completed:
Water Column Thickness (feet): 16.93	Total Gallons Purged:

1 vol = 11

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1415	initial	17.9	7.03	0.74	560	Clear
1418	5	17.0	6.18	0.53	305	"
1420	10	15.9	6.17	0.52	6	"
1422	15	17.1	6.21	0.54	2	"
1424	20	17.5	6.37	0.66	186	"
1438	25	17.4	6.57	0.73	621	"
	~~30~~	Dry	@ 27	gallons		

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
5MNW19WG1	1442	VOC	3-40 mL VOA	HCL

Sample Shipped By: EARTH TECH

Sampler(s): DN + GC

Checked By:

Laboratory: SW Laboratory

Date: 11/28/00

Date:

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number:	AFP 3 / 40216.06.05	Sampler(s):	DN + GC
Date:	11/28/00	Well Diameter (inches):	4
Well Number:	5-20	3 Well Volumes (gallons):	23
Total Well Depth (feet):	20.26	Purging Time Initiated:	1225
Depth to Water (feet):	8.48	Purging Time Completed:	
Water Column Thickness (feet):	11.78	Total Gallons Purged:	18

1 Vol = 7.7 g.

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1225	initial	17.0	7.33	1.04	782	Clear
1229	5	17.0	7.36	0.93	17	"
1234	10	17.1	7.22	0.93	102	"
1237	15	17.1	7.03	0.96	172	"
1241	~~20~~ 18	17.1	7.05	0.96	206	dry @ 18 gal
~~1244~~	~~23~~ DH					

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
5MNW20-WG1	1250	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH
Laboratory: SW Laboratory
Sampler(s): DN + GG
Date:
Checked By:
Date:

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number: AFP 3 / 40216.06.05	Sampler(s): DN + GC
Date: 11/28/00	Well Diameter (inches): 4
Well Number: 5-21	3 Well Volumes (gallons): 17.9
Total Well Depth (feet): 16.46	Purging Time Initiated: 1135
Depth to Water (feet): 7.30	Purging Time Completed: ~~osn~~ 1200
Water Column Thickness (feet): 9.16	Total Gallons Purged: ~~18~~ 15 gals (pumped dry)

1 vol = 5.9

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1135	initial	16.7	7.30	1.27	999	Grey, muddy
1138	3	16.9	7.01	0.93	299	clear
1141	6	17.0	6.91	0.98	999	"
1144	9	17.3	6.86	1.30	999	"
1147	12	17.5	6.86	1.40	502	"
1150	15	17.5	6.85	1.38	239	"
1153	18	→				Dry @ 15 gal

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
5MNW21WA	1200	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH

Laboratory: SW Laboratory

Sampler(s): DN + GC

Date:

Checked By:

Date:

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Well Sampling/Purge Log

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(703) 549-8728

Job Name/Number:	AFP 3 / 40216.06.05	Sampler(s):	DN & GC
Date:	11/29/00	Well Diameter (inches):	4
Well Number:	5-22	3 Well Volumes (gallons):	7
Total Well Depth (feet):	17.30	Purging Time Initiated:	0902
Depth to Water (feet):	13.67	Purging Time Completed:	0912
Water Column Thickness (feet):	3.63	Total Gallons Purged:	6

1 vol = 2.4 g

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
0902	initial	15.1	6.55	0.570	965	clear
0903	3	15.9	6.18	0.418	343	"
0912	6	15.9	6.28	0.540	364	"
	7		Dry @	6 gallons		

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
5MNW22WG1	0920	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH
Sampler(s): DN & GC
Checked By:

Laboratory: SW Laboratory
Date: 11/29/00
Date:

Well Sampling/Purge Log	EARTH TECH, Inc. 1420 King Street, Suite 600 Alexandria, Virginia 22314 (703) 549-8728
Job Name/Number: AFP 3 / 40216.06.05	Sampler(s): DN & GC
Date: 11/29/00	Well Diameter (inches): 2
Well Number: 5-2	3 Well Volumes (gallons): 3.3
Total Well Depth (feet): 22.72 (Top of Yellow metal casing)	Purging Time Initiated:
Depth to Water (feet): 16.20 "	Purging Time Completed:
Water Column Thickness (feet): 6.52	Total Gallons Purged:

1 vol = 1.1 gal

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1026	initial	17.2	6.18	1.50	999	Dk. gray
1027	1	17.4	6.23	1.09	327	Clear
1029	2	18.1	6.18	1.09	394	"
1030	3	18.5	6.15	1.06	279	"

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
5MNW2-WG1	1035	VOC	3-40 mL VOA	HCL

Sample Shipped By: EARTH TECH

Sampler(s): DN & GC

Checked By:

Laboratory: SW Laboratory

Date: 11/29/00

Date:

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Well Sampling/Purge Log

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Job Name/Number:	AFP 3 / 40216.06.05	Sampler(s):	DN & GC
Date:	11/29/00	Well Diameter (inches):	4
Well Number:	5-13	3 Well Volumes (gallons):	25
Total Well Depth (feet):	24.80	Purging Time Initiated:	1128
Depth to Water (feet):	12.04	Purging Time Completed:	1145
Water Column Thickness (feet):	12.76	Total Gallons Purged:	25

1 vol = 8.3

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1128	initial	19.3	6.33	0.91	308	Clear
1131	5	20.7	6.30	0.89	0	"
1134	10	21.3	6.28	0.87	0	"
1138	15	21.6	6.31	0.92	14	"
1141	20	21.3	6.35	0.91	11	"
1145	25	21.0	6.33	0.88	11	"

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
5MNW13-WG1	1150	VOC	3-40 mL VOA	HCL

Sample Shipped By: EARTH TECH

Laboratory: SW Laboratory

Sampler(s): DN & GC

Date: 11/29/00

Checked By: ____

Date: ____

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number:	AFP 3 / 40216.06.05	Sampler(s):	DN + GC
Date:	11/30/00	Well Diameter (inches):	4
Well Number:	8-8	3 Well Volumes (gallons):	20
Total Well Depth (feet):	24.95	Purging Time Initiated:	0917
Depth to Water (feet):	14.40	Purging Time Completed:	0928
Water Column Thickness (feet):	10.55	Total Gallons Purged:	20

1 vol = 6.8 gal

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
0917	initial	19.7	6.89	1.45	537	Brown then clear
0921	5	20.3	6.78	1.44	61	clear
0924	10	20.8	6.85	1.36	49	"
0926	15	21.3	6.80	1.45	23	"
0928	20	20.5	6.79	1.47	9	"

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
8MNW8WG1	0935	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH
Laboratory: SW Laboratory
Sampler(s): DN & GC
Date: 11/30/00
Checked By:
Date:

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Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number: AFP 3 / 40216.06.05		Sampler(s):	DN + GC
Date:	11/30/00	Well Diameter (inches):	4
Well Number:	8-15	3 Well Volumes (gallons):	21
Total Well Depth (feet):	20.37	Purging Time Initiated:	1014
Depth to Water (feet):	9.62	Purging Time Completed:	
Water Column Thickness (feet):	10.75	Total Gallons Purged:	~~20~~ 15

1 vol = 7 gal

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1014	initial	19.4	6.75	0.92	624	Clear
1017	5	20.6	6.58	0.92	471	"
1019	10	20.8	6.60	0.92	98	"
	15	20.3	6.67	0.92	995	"
	~~20~~	Dry @ 15 gallons				

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
8MNW15	1030	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH

Laboratory: SW Laboratory

Sampler(s): DN + GC

Date: 11/30/00

Checked By:

Date:

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number:	AFP 3 / 40216.06.05	Sampler(s):	DN & GC
Date:	11/30/00	Well Diameter (inches):	4
Well Number:	8DG2	3 Well Volumes (gallons):	18
Total Well Depth (feet):	22.60	Purging Time Initiated:	0806
Depth to Water (feet):	13.35	Purging Time Completed:	0818
Water Column Thickness (feet):	9.25	Total Gallons Purged:	18

1 vol=6 gal

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
0806	initial	18.6	6.60	1.48	999	Lt. grey
0809	5	21.1	6.50	1.45	41	clear/strong odor
0812	10	21.3	6.55	1.52	9	" "
0815	15	21.2	6.66	1.43	50	" "
0818	18	20.9	6.62	1.44	27	" "

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
8MNWDG2-WG1	0820	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH
Sampler(s): DN & GC
Checked By:

Laboratory: SW Laboratory
Date:
Date:

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number: AFP 3 / 40216.06.05	Sampler(s): DN + GC
Date: 11/29/00	Well Diameter (inches): 4
Well Number: 8-DG4	3 Well Volumes (gallons): 12
Total Well Depth (feet): 21.21	Purging Time Initiated: 1516
Depth to Water (feet): 15.00	Purging Time Completed: 1523
Water Column Thickness (feet): 6.21	Total Gallons Purged: 9

1 vol = 4 g

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1516	initial	18.7	6.73	1.28	15	Clear
1518	3	19.4	6.75	1.32	304	"
1520	6	19.5	6.65	1.31	43	"
1523	9	18.9	6.66	1.33	43	"
	~~12~~	DRY @ 9 Gallons				

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
8MNWDGA-W61	1530	VOC	3-40 mL VOA	HCL

Sample Shipped By: EARTH TECH
Laboratory: SW Laboratory
Sampler(s): DN + GC
Date: 11/29/00
Checked By:
Date:

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number: AFP 3 / 40216.06.05	Sampler(s): DN + GC
Date: 11/30/00	Well Diameter (inches): 4
Well Number: 8-17	3 Well Volumes (gallons): 26
Total Well Depth (feet): 23.95	Purging Time Initiated: 1418
Depth to Water (feet): 10.54	Purging Time Completed: 1431
Water Column Thickness (feet): 13.41	Total Gallons Purged: 25

1 vol = 8.7

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1418	initial	20.1	7.21	1.41	999	Cloudy, red
1421	5	20.9	6.86	1.25	355	Clear
1423	10	21.0	6.84	1.23	252	"
1425	15	20.9	6.82	1.25	60	"
1428	20	21.1	6.81	1.25	164	"
1431	25	20.6	6.79	1.24	204	"

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
8MNW17	1435	VOC	3-40 mL VOA	HCL

Sample Shipped By: EARTH TECH
Sampler(s): DN + GC
Checked By:

Laboratory: SW Laboratory
Date: 11/30/00
Date:

#P:\40216 AFP3 GW MON & WELL ABANDONMENT\PROJECT MANAGEMENT\WELL SAMPLE LOG.DOC

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number:	AFP 3 / 40216.06.05	Sampler(s):	DN + GC
Date:	11/30/00	Well Diameter (inches):	4
Well Number:	8-20	3 Well Volumes (gallons):	24
Total Well Depth (feet):	22.65	Purging Time Initiated:	1055
Depth to Water (feet):	10.30	Purging Time Completed:	1105
Water Column Thickness (feet):	12.35	Total Gallons Purged:	24

1 vol = 8 gz

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1055	initial	18.4	6.85	1.76	999	Cloudy then clear
1057	5	19.2	6.92	1.81	110	Clear
1059	10	19.4	6.85	1.80	36	"
1101	15	19.6	6.82	1.83	23	"
1103	20	19.7	6.82	1.80	16	"
1105	24	19.8	6.77	1.80	76	"

Duplicate Sample taken

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
8MNW20	1110	VOC	3-40 mL VOA	HCL
Duplicate samples also taken				

Sample Shipped By: EARTH TECH

Laboratory: SW Laboratory

Sampler(s): DN + GC

Date: 11/30/00

Checked By:

Date:

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number: AFP 3 / 40216.06.05	Sampler(s): DN/GC
Date: 11/28/00	Well Diameter (inches): 4
Well Number: 8-21	3 Well Volumes (gallons): 19.5
Total Well Depth (feet): 16.77	Purging Time Initiated: 0730
Depth to Water (feet): 6.73	Purging Time Completed: 0750
Water Column Thickness (feet): 10.04	Total Gallons Purged: 20

1 vol = 6.5 g

Time	Volume Purged (gallons)	Temperature (°F) (°C)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
0735	initial	21.5	6.34	1.46	999	Red, opaque
0737	2.5	22.5	6.65	1.36	395	clear
0739	5.0	22.5	6.70	1.33	125	"
0741	7.5	23.3	6.65	1.37	98	"
0743	10.0	23.7	6.73	1.30	151	"
0745	12.5	23.9	6.64	1.38	175	"
0746	15.0	23.9	6.73	1.28	277	"
0748	17.5	23.9	6.76	1.28	324	"
0750	20.0	23.9	6.74	1.28	256	"

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
8MNW21-WG1	0750	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH

Laboratory: SW Laboratory

Sampler(s):

Date:

Checked By:

Date:

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number:	AFP 3 / 40216.06.05	Sampler(s):	DN + GG
Date:	11/28/00	Well Diameter (inches):	4
Well Number:	8MNW22	3 Well Volumes (gallons):	24
Total Well Depth (feet):	18.10	Purging Time Initiated:	0915
Depth to Water (feet):	5.61	Purging Time Completed:	0935
Water Column Thickness (feet):	12.49	Total Gallons Purged:	

1 vol = 8 gal

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
0915	initial	19.9	7.01	0.99	999	Clear
0919	5	22.2	6.44	0.82	16	"
0923	10	21.0	6.49	0.80	30	"
0927	15	21.6	6.74	0.93	119	"
0931	20	23.7	6.45	0.86	45	"
0935	25	23.6	6.46	0.85	87	"

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
8MNW22WG1	0940	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH

Laboratory: SW Laboratory

Sampler(s): DN + GC

Date:

Checked By:

Date:

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number:	AFP 3 / 40216.06.05	Sampler(s):	DN, GC
Date:	11/28/00	Well Diameter (inches):	4
Well Number:	8-23	3 Well Volumes (gallons):	20.2
Total Well Depth (feet):	~~18.10~~ 19.3	Purging Time Initiated:	0825
Depth to Water (feet):	7.72	Purging Time Completed:	0844
Water Column Thickness (feet):	10.38	Total Gallons Purged:	20

1 vol = 6.7g

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
0828	initial	20.1	6.70	1.64	877	Clear
0830	2.5	21.8	6.52	1.57	31	"
0832	5.0	21.9	6.58	1.53	1	"
0834	7.5	21.4	6.82	1.61	11	"
0836	10.0	22.7	6.58	1.54	18	"
0838	12.5	22.6	6.63	1.49	18	"
0840	15.0	22.8	6.59	1.42	24	"
0842	17.5	22.1	6.74	1.52	56	"
0844	20	22.3	6.64	1.47	26	"

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
BMNW23-WG1 23	0845	VOC	3-40 mL VOA	

Sample Shipped By: EARTH TECH   Laboratory: SW Laboratory

Sampler(s): ____   Date: ____

Checked By: ____   Date: ____

Well Sampling/Purge Log

EARTH TECH, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314
(703) 549-8728

Job Name/Number: AFP 3 / 40216.06.05	Sampler(s): DN + GC
Date: 11/29/00	Well Diameter (inches): 4
Well Number: 1-1	3 Well Volumes (gallons): 17.7
Total Well Depth (feet): 17.25	Purging Time Initiated:
Depth to Water (feet): 8.20	Purging Time Completed:
Water Column Thickness (feet): 9.05	Total Gallons Purged:

1 vol = 5.9 g

Time	Volume Purged (gallons)	Temperature (°F)	pH	Specific Conductance (ms/cm)	Turbidity (NTU)	Comments (water color, odor, pump used, sediment, cloudy, etc.)
1350	initial	22.2	6.67	1.01	999	Clear, swampy odor
1354	5	22.5	6.35	0.99	100	" "
1356	10	23.0	6.33	0.96	66	"
1358	15	23.0	6.52	0.98	110	"
1400	18	22.5	6.61	0.97	570	"

Groundwater Sampling Order and Record

Sample Number	Collection Time	Parameter	Container	Preservative
1MNW1WG1	1410	VOC	3-40 mL VOA	HCl

Sample Shipped By: EARTH TECH
Sampler(s): DN + GC
Checked By:

Laboratory: SW Laboratory
Date: 11/29/00
Date:

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APPENDIX C. CHAIN-OF-CUSTODY FORMS

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Earth Tech
1420 King Street, Suite 600
Alexandria, Virginia 22314
Phone No. (703) 549-8728; Fax No. (703) 549-8134

Chain of Custody

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PAGE ___ OF ___

Chain of Custody No. № 0019

Laboratory: Southwest Lab
Address: 1700 West Albany
City: Broken Arrow State: OK Zip Code: 74012

Project Name: PARID-44-AFP3
Point of Contact / Phone No.: Dave Parse / 703.706.0508
Site Contact / Phone No.: Dave Naleid / 703.706.0513

Analysis: 8260 (VOCs)

LOCID	SBD	SED	SACODE	SAMPNO	Sample I.D.	Date	Time	Matrix	No. of Con.	Cooler No.	VOCs (8260)	Comment
DG-2	0	0	N	1	8MNWDG2-WG-1	11/30/00	0820	WG	3	1	X	
5MNW14	0	0	N	1	5MNW14-WG-1	11/30/00	0855	WG	3	1	X	
8MNW8	0	0	N	1	8MNW8-WG-1	11/30/00	0935	WG	3	1	X	
8MNW15	0	0	N	1	8MNW15-WG-1	11/30/00	1030	WG	3	1	X	
8MNW20	0	0	N	1	8MNW20-WG-1	11/30/00	1110	WG	3	1	X	
8MNW20	0	0	FD	19	8MNW20-WG-9	11/30/00	1110	WG	3	1	X	
8MNW17	0	0	N	1	8MNW17-WG-1	11/30/00	1435	WG	3	1	X	
Field QC	0	0	TB	1	TB01-113000	11/30/00	?	WG	2	1	X	
MW-84WLB												

Relinquished By / Company	Date	Time	Received By / Company	Date	Time
1. Dave Naleid / Earth Tech	11/30/00	4:24	1. [signature]	11/30/00	4:24
2.			2.		
3.			3.		
4.			4.		
5.			5.		

Comments: ?

Shipment Method/Airbill No.

12.6°C

DISTRIBUTION: W... with sample; CANARY - Returned to Client with Report; PINK - Field Copy

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Chain of Custody

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PAGE __ OF __

Chain of Custody No. № 0018

Laboratory: SOUTHWEST LAB
Address: 1700 WEST ALBANY
City: Broken Arrow | State: OK | Zip Code: 74012

Project Name: PARD-44-AFP3
Point of Contact / Phone No.: Dave Parse 703.706.0508
Site Contact / Phone No.: Dave Naleid 703.626.3086

Analysis: VOCs (SW8260B)

LOCID	SBD	SED	SACODE	SAMPNO	Sample I.D.	Date	Time	Matrix	No. of Con.	Cooler No.	VOCs (SW8260B)	Comment
Field QC	0	0	TB	1	TB1-112900	11/29/00	0845	WG	2	1	X	
8MNW21	0	0	N	1	8MNW21-WG-1	11/28/00	0750	WG	3	1	X	
8MNW23	0	0	N	1	8MNW23-WG-1	11/28/00	0845	WG	3	1	X	
8MNW22	0	0	N	1	8MNW22-WG-1	11/28/00	0940	WG	3	1	X	
5MNW21	0	0	N	1	5MNW21-WG-1	11/28/00	1200	WG	3	1	X	
5MNW20	0	0	N	1	5MNW20-WG-1	11/28/00	1250	WG	3	1	X	
5MNW19	0	0	N	1	5MNW19-WG-1	11/28/00	1442	WG	3	1	X	
5MNW16	0	0	N	1	5MNW16-WG-1	11/28/00	1515	WG	3	1	X	
5MNW22	0	0	N	1	5MNW22-WG-1	11/29/00	0920	WG	3	1	X	
HF-2	0	0	N	1	5MNW2-WG-1	11/29/00	1035	WG	3	1	X	
~~5MNW22~~	~~0~~	~~0~~	~~N~~	~~1~~	~~5MNW22-WG-1~~	~~11/29/00~~						
5MNW13	0	0	N	1	5MNW13-WG-1	11/29/00	1150	WG	3	1	X	

	Date	Time		Date	Time
1. Relinquished By / Company: DNAPOD/EARTH TECH	11/29/00	1700	1. Received By / Company: [signature]		
2. Relinquished By / Company:			2. Received By / Company:	11-29-00	1200
3. Relinquished By / Company:			3. Received By / Company:		
4. Relinquished By / Company:			4. Received By / Company:		
5. Relinquished By / Company:			5. Received By / Company:		

Comments:

Shipment Method/Airbill No:

DISTRIBUTION: WHITE - Stays with sample; CANARY - Returned to Client with Report; PINK - Field Copy

201

Earth Tech
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Alexandria, Virginia 22314
Phone No. (703) 549-8728; Fax No. (703) 549-9134

Chain of Custody

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PAGE ___ OF ___

Chain of Custody No. № 0021

Laboratory: Southwest LAB
Address: 1700 West Albany
City: Broken Arrow
State: OK
Zip Code: 74012

Project Name: PARD-44-AFP3
Point of Contact / Phone No.: Dave Parse 703·706·0588
Site Contact / Phone No.: Dave Nateid 703·626·3086

Analysis: VOCs (SW8260B)

LOCID	SBD	SED	SACODE	SAMPNO	Sample I.D.	Date	Time	Matrix	No. of Con.	Cooler No.	VOCs (SW8260B)	Comment
DG-4	0	0	N	1	8MNWDG4-WG-1	11/29/00	1530	WG	3	1	X	
HF5	0	0	N	1	5MNW5-WG-1	11/29/00	1610	WG	3	1	X	
HF5	0	0	MS	MS1	5MNW5-WG-MS	11/29/00	1610	WG	3	1	X	
HF5	0	0	MSD	MSD1	5MNW5-WG-MSD	11/29/00	1610	WG	3	1	X	
	~~0~~	~~0~~										
~~1MNW1~~ 1MNW01	0	0	N	1	1MNW1-WG1	11/29/00	1410	WG	3	1	X	

	Relinquished By / Company	Date	Time	Received By / Company	Date	Time
1.	D. Naleid / Earth Tech	11/29/00	1700	[signature] SWLO	11-29-00	17:00
2.						
3.						
4.						
5.						

Comments:

Shipment Method/Airbill No:

DISTRIBUTION: W___ go with sample; CANARY - Returned to Client with Report; PINK - Field Copy

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APPENDIX D. DATA QUALITY REVIEW SUMMARY AND GROUNDWATER ANALYTICAL DATA

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Data Quality Review
Air Force Plant 3, Tulsa, OK
Contract F41624-97-D-8018, Delivery 0070

Volatile Organic Analysis by Method SW8260B

This data quality review pertains to nineteen samples, one duplicate and two MS/MSD collected on November 28, 29, and 30, 2000 at Air Force Plant 3 (AFP 3). The samples were analyzed following *EPA Test Methods for Evaluating Solid Waste (SW-846)* Method 8260B for volatile organic compounds (VOCs) at Southwest Laboratory in Broken Arrow, Oklahoma. All samples were packaged and hand-carried to Southwest Laboratory of Oklahoma in Broken Arrow, OK to be analyzed for a modified list of volatile constituents included in the method.

Recommendations for quality control limits and data flagging criteria were taken from the AFCEE *Quality Assurance Project Plan, Version 3.0* (USAF, 1998)

Table DQR-1 provides a cross-reference list for field sample IDs and lab sample IDs from Southwest Laboratory.

Table DQR-1. Field Sample ID/Lab Sample ID Cross Reference

Field Sample ID	Lab Sample ID	Field Sample ID	Lab Sample ID
1MNW01-WG-1	45212.16	8MNW8-WG-1	45230.03
5MNW2-WG-1	45212.10	8MNW15-WG-1	45230.04
5MNW5-WG-1	45212.03	8MNW17-WG-1	45230.07
5MNW13-WG-1	45212.11	8MNW20-WG-1	45230.05
5MNW16-WG-1	45212.08	8MNW20-WG-9	45230.06
5MNW19-WG-1	45212.07	8MNW21-WG-1	45212.02
5MNW20-WG-1	45212.06	8MNW22-WG-1	45212.04
5MNW21-WG-1	45212.05	8MNW23-WG-1	45212.03
5MNW22-WG-1	45212.09	TB01-112900	45212.01
8MNWDG2-WG-1	45230.01	TB01-113000	45230.08
8MNWDG4-WG-1	45212.12		

Note: No Ambient blank was collected and only one duplicate sample was collected for nineteen samples.

During the data quality review process, laboratory data are verified against available supporting documentation. Based on this review, qualifier codes may be added, deleted, or modified by the validator. Final results are therefore either qualified or unqualified. A summary of the data quality review flags is presented in Table DQR-2, listed in order of most severe to least severe. In cases where multiple qualifiers could apply, only the most severe qualifier is applied. The data quality review process includes a review of sample holding times, calibrations, blanks (preparation and trip blanks), matrix spike/matrix spike duplicates (MS/MSD), surrogate recoveries, and field duplicates. Changes to the data are reflected on the Form Is in Attachment 1. Chain-of-custody forms are provided in Attachment 2.

Table DQR-2: AFCEE Data Qualifiers

Qualifier	Description
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet quality control criteria.
M	A matrix effect is present.
F	The analyte was positively identified, but the associated numerical value is below the reporting limit (RL).
J	The analyte was positively identified, but the quantitation is an estimation.
B	An analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination.
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit (MDL).

Holding Times

All the groundwater samples were analyzed within the recommended holding time of 14 days. Therefore, qualification of the data due to holding times was not necessary. However, samples 8MNWDG2-WG-1, 5MNW14-WG-1, 8MNW8-WG-1, 8MNW15-WG-1, 8MNW20-WG-1, 8MNW20-WG-9, 8MNW17-WG-1, and TB01-113000 were received at 12.6 °C and no qualifiers were added.

Calibration Criteria

All calibrations and calibration verifications met method and project specific quality control criteria. Standards were run at concentrations of 1.0, 4.0, 10, 20, and 40 micrograms per liter (µg/L). Calibration verifications were performed at the required frequency and all target analytes were detected within 20 percent of the expected value or they had a five-point regression coefficient that must be equal to or greater than 0.990. Multiple analyses appear in the data package for samples 5MNW2-WG-1 and 5MNW14-WG-1 due to analytes being above the established linear range of the initial calibration. The results of the analyses were evaluated and combined so that only the results within the established calibration range appear on a single Form I.

Blanks

Two trip blanks were collected and analyzed. TB-112900 contained methylene chloride at 2 µg and carbon disulfide at 0.1µL. TB01-113000 contained methylene chloride at 2µL. Samples 5MNW5-WG1, 8MNW17-WG1, and 8MNW23-WG1 associated with TB-112900 with methylene chloride detects above the reporting limit were qualified B as a result of field blank contamination. Samples 8MNW20-WG-1, 8MNW20-WG-9, 8MNWDG2-WG1, 8MNW15-WG1, and 8MNW8-WG1 associated with TB01-113000 with methylene chloride detects above the reporting limit were also qualified B as a result of field blank contamination. No qualification was necessary due to the carbon disulfide contamination.

Two method blanks were also run. No analytes were detected in the method blanks. Therefore, qualification was not considered necessary.

Matrix Spike/Matrix Spike Duplicate

The relative percent difference (RPD) of 1,1-dichloroethene, acetone, and 4-methyl-2-pentanone for the matrix spike/duplicate sample 5MNW5-WG-1 was above established recovery criteria. The relative percent difference (RPD) of 2-butanone and 4-methyl-2-pentanone for matrix spike/duplicate sample 8MNWDG2 was also above established recovery criteria. As a result, 1,1-dichloroethene, acetone, 2-butanone, and 4-methyl-2-pentanone results for associated samples were qualified **M**. No further qualification was necessary.

Surrogate Recovery

Four surrogates were used for the monitoring of volatile organic compounds (VOCs). Surrogate spike recovery percentages were within the laboratory and AFCEE established quality control limits for all samples. No data required qualification. However, samples 5MNW5-WG-1MS and 5MNW5-WG-1MSD each contained surrogates outside QC recovery limits. They were within limits in the original sample analysis. No analyses were done per protocol.

Field Duplicates

A field duplicate was collected for sample 8MNW20. One of two criteria was followed when evaluating field duplicates, depending on the amount detected. If the amount detected was greater than five times the reporting limit (RL), then the relative percent difference (RPD) should have been less than 25 percent. If the amount detected was less than five times the RL, then the difference between the duplicate and the sample concentrations should have been less than the RL. The results for 8MNW20-WG-1 AND 8MNW20-WG-9 did not meet the above criteria for trichloroethene, and therefore qualified **J**. Methylene chloride and 1,1-dichloroethene were previously qualified and additional qualification was not necessary. A comparison of field sample and duplicate is presented in Table DQR-3.

Table DQR-3: Duplicate Comparison (µg/L)

Analyte	Reporting Limit (RL)	8MNW20-WG-1	8MNW20-WG-9	Relative Percent Difference (RPD)
Chloroform	1200	280F	640F	78%
1,1-Dichloroethene	1200	2500	1800	32%
Methylene Chloride	1200	2300	1700	30%
Trichloroethene	1200	23000	15000	43%

Sample Quantification

Analytes detected in between the method detection limit (MDL) and the reporting limit (RL) have been qualified, **F** as detected, but below the associated reporting limit.

Summary

The data completeness is 100%. All of the data points for the volatile analysis of groundwater samples are useable with the appropriate qualifiers.

Table DQR-4
Summary of Detected Chemicals at Former Air Force Plant 3
Ground Water Sampling - November 2000 Event

SAMPLE ID Date Sampled	1MNW01 11/29/00	5MNW2 11/29/00	5MNW5 11/29/00	5MNW13 11/29/00	5MNW14 11/30/00	5MNW16 11/28/00	5MNW19 11/28/00
Analyte	**Volatiles by EPA SW-846 Method 8260 (ug/L)**						
1,1,1-Trichloroethane	1 U	25 U	**150**	1 U	100 U	1 U	1 U
1,1-Dichloroethane	**0.4 F**	**210**	**1100**	**0.7 F**	100 U	**1**	1 U
1,1-Dichloroethene	1 U	**1200 M**	**1300 M**	**4 M**	**270 M**	**12 M**	1 U
Acetone	5 U	120 U	500 U	5 U	**4000 M**	5 U	5 U
Carbon disulfide	**0.4 F**	25 U	100 U	1 U	100 U	1 U	1 U
Chloroform	1 U	**14 F**	**63 F**	1 U	**65 F**	1 U	1 U
cis-1,2-Dichloroethene	1 U	**590**	100 U	**9**	**58 F**	1 U	1 U
Methylene chloride	1 U	25 U	**110 B**	1 U	100 U	1 U	1 U
Trichloroethene	1 U	**690**	100 U	**17**	**1200**	1 U	1 U
Vinyl chloride	1 U	**97**	100 U	1 U	100 U	1 U	1 U

Table DQR-4
Summary of Detected Chemicals at Former Air Force Plant 3 (continued)
Ground Water Sampling - November 2000 Event

SAMPLE ID Date Sampled	5MNW20 11/28/00	5MNW21 11/28/00	5MNW22 11/29/00	8MNWDG2 11/30/00	8MNWDG4 11/29/00	8MNW8 11/30/00	8MNW15 11/30/00
Analyte	**Volatiles by EPA SW-846 Method 8260 (ug/L)**						
1,1,1-Trichloroethane	1 U	1 U	1 U	50 U	1 U	200 U	200 U
1,1-Dichloroethane	1 U	1 U	**1**	**1400**	1 U	**420**	200 U
1,1-Dichloroethene	1 U	1 U	**7 M**	**1300 M**	1 U	**780 M**	200 U
Acetone	5 U	5 U	5 U	250 U	5 U	1000 U	1000 U
Carbon disulfide	1 U	1 U	1 U	50 U	1 U	200 U	200 U
Chloroform	1 U	1 U	1 U	**34 F**	1 U	**150 F**	**140 F**
cis-1,2-Dichloroethene	1 U	1 U	1 U	**690**	1 U	**3300**	**250**
Methylene chloride	1 U	1 U	1 U	**260 B**	1 U	**440 B**	**1000 B**
Trichloroethene	1 U	1 U	**8**	**800**	1 U	**3300**	**4200**
Vinyl chloride	1 U	1 U	1 U	**560**	1 U	200 U	200 U

Table DQR-4
Summary of Detected Chemicals at Former Air Force Plant 3 (continued)
Ground Water Sampling - November 2000 Event

SAMPLE ID Date Sampled	8MNW17 11/30/00	8MNW20 11/30/00	8MNW20 (DUP) 11/30/00	8MNW21 11/28/00	8MNW22 11/28/00	8MNW23 11/28/00
Analyte	**Volatiles by EPA SW-846 Method 8260 (ug/L)**					
1,1,1-Trichloroethane	**3100**	1200 U	1000 U	1 U	1 U	1 U
1,1-Dichloroethane	1000 U	1200 U	1000 U	1 U	1 U	**0.5 F**
1,1-Dichloroethene	**14000 M**	**2500 M**	**1800 M**	1 U	1 U	**4 M**
Acetone	5000 U	6200 U	5000 U	**6 M**	5 U	5 U
Carbon disulfide	1000 U	1200 U	1000 U	1 U	1 U	1 U
Chloroform	**470 F**	**280 F**	**640 F**	1 U	1 U	1 U
cis-1,2-Dichloroethene	1000 U	1200 U	1000 U	1 U	1 U	**0.8 F**
Methylene chloride	**1900 B**	**2300 B**	**1700 B**	**0.9 F**	1 U	**1 B**
Trichloroethene	**31000**	**23000 J**	**15000 J**	1 U	1 U	**1**
Vinyl chloride	1000 U	1200 U	1000 U	1 U	1 U	1 U

Key:

F = The analyte was positively identified, but the associated numerical value is below the reporting limit (RL).
U = The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit (MDL).
B = An analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination.
M = A matrix effect was present.
J = The analyte was positively identified, but the quantitation is an estimation.
DUP = Duplicate sample taken in the field.

Notes: Bolded values indicate the analyte was detected above the associated MDL.

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ATTACHMENT 1
FORM I's

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1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.: 1MNW1-WG-1

Lab Name: SWL-TULSA   Contract: GWMONITOR3

Lab Code: SWOK   Case No.: EARTHTE   SAS No.:   SDG No.: 45212

Matrix: (soil/water) WATER   Lab Sample ID: 45212.16

Sample wt/vol: 25 (g/mL) ML   Lab File ID: K34200.D

Level: (low/med) LOW   Date Received: 11/29/00

% Moisture: not dec. ____   Date Analyzed: 12/06/00

GC Column: DB-624   ID: 0.53 (mm)   Dilution Factor: 1.0

Soil Extract Volume: ______(uL)   Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	1	U
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	0.4	F ~~J~~
75-09-2	Methylene Chloride	1	U
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	0.4	F ~~J~~
156-59-2	cis-1,2-Dichloroethene	1	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	1	U
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

1/23/01
DB

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

| 5MNW2-WG-1 |

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45212.10

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34197.D

Level: (low/med) LOW Date Received: 11/29/00

% Moisture: not dec. _____ Date Analyzed: 12/06/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 25.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	25	U
75-01-4	Vinyl Chloride	97 ~~68~~	
74-83-9	Bromomethane	25	U
75-00-3	Chloroethane	25	U
75-35-4	1,1-Dichloroethene	1200 M	E
67-64-1	Acetone	120	U
75-15-0	Carbon Disulfide	25	U
75-09-2	Methylene Chloride	25	U
156-60-5	trans-1,2-Dichloroethene	25	U
75-34-3	1,1-Dichloroethane	210 ~~170~~	
156-59-2	cis-1,2-Dichloroethene	590 ~~560~~	
78-93-3	2-Butanone	120	U
67-66-3	Chloroform	14 F	J
71-55-6	1,1,1-Trichloroethane	25	U
56-23-5	Carbon Tetrachloride	25	U
71-43-2	Benzene	25	U
107-06-2	1,2-Dichloroethane	25	U
79-01-6	Trichloroethene	690 ~~650~~	
78-87-5	1,2-Dichloropropane	25	U
75-27-4	Bromodichloromethane	25	U
10061-01-5	cis-1,3-Dichloropropene	25	U
108-10-1	4-Methyl-2-pentanone	120	U
108-88-3	Toluene	25	U
10061-02-6	trans-1,3-Dichloropropene	25	U
79-00-5	1,1,2-Trichloroethane	25	U
127-18-4	Tetrachloroethene	25	U
591-78-6	2-Hexanone	120	U
124-48-1	Dibromochloromethane	25	U
108-90-7	Chlorobenzene	25	U
100-41-4	Ethylbenzene	25	U
13-302-07	m,p-Xylenes	25	U
95-47-6	o-Xylene	25	U
100-42-5	Styrene	25	U
75-25-2	Bromoform	25	U
79-34-5	1,1,2,2-Tetrachloroethane	25	U

1/23/01 DS

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

5MNW2-WG-1DL

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45212.10DL

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34208.D

Level: (low/med) LOW Date Received: 11/29/00

% Moisture: not dec. _____ Date Analyzed: 12/08/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 50.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	50	U
75-01-4	Vinyl Chloride	97	D
74-83-9	Bromomethane	50	U
75-00-3	Chloroethane	50	U
75-35-4	1,1-Dichloroethene	1200	D
67-64-1	Acetone	250	U
75-15-0	Carbon Disulfide	50	U
75-09-2	Methylene Chloride	290	D
156-60-5	trans-1,2-Dichloroethene	50	U
75-34-3	1,1-Dichloroethane	210	D
156-59-2	cis-1,2-Dichloroethene	590	D
78-93-3	2-Butanone	250	U
67-66-3	Chloroform	33	DJ
71-55-6	1,1,1-Trichloroethane	50	U
56-23-5	Carbon Tetrachloride	50	U
71-43-2	Benzene	50	U
107-06-2	1,2-Dichloroethane	50	U
79-01-6	Trichloroethene	690	D
78-87-5	1,2-Dichloropropane	50	U
75-27-4	Bromodichloromethane	50	U
10061-01-5	cis-1,3-Dichloropropene	50	U
108-10-1	4-Methyl-2-pentanone	250	U
108-88-3	Toluene	50	U
10061-02-6	trans-1,3-Dichloropropene	50	U
79-00-5	1,1,2-Trichloroethane	50	U
127-18-4	Tetrachloroethene	50	U
591-78-6	2-Hexanone	250	U
124-48-1	Dibromochloromethane	50	U
108-90-7	Chlorobenzene	50	U
100-41-4	Ethylbenzene	50	U
13-302-07	m,p-Xylenes	50	U
95-47-6	o-Xylene	50	U
100-42-5	Styrene	50	U
75-25-2	Bromoform	50	U
79-34-5	1,1,2,2-Tetrachloroethane	50	U

1/23/01 DD

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

5MNW5-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45212.13

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34187.D

Level: (low/med) LOW Date Received: 11/29/00

% Moisture: not dec. _____ Date Analyzed: 12/06/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 100.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	100	U
75-01-4	Vinyl Chloride	100	U
74-83-9	Bromomethane	100	U
75-00-3	Chloroethane	100	U
75-35-4	1,1-Dichloroethene	1300	M
67-64-1	Acetone	500	U
75-15-0	Carbon Disulfide	100	U
75-09-2	Methylene Chloride	110	B
156-60-5	trans-1,2-Dichloroethene	100	U
75-34-3	1,1-Dichloroethane	1100	
156-59-2	cis-1,2-Dichloroethene	100	U
78-93-3	2-Butanone	500	U
67-66-3	Chloroform	63	F J
71-55-6	1,1,1-Trichloroethane	150	
56-23-5	Carbon Tetrachloride	100	U
71-43-2	Benzene	100	U
107-06-2	1,2-Dichloroethane	100	U
79-01-6	Trichloroethene	100	U
78-87-5	1,2-Dichloropropane	100	U
75-27-4	Bromodichloromethane	100	U
10061-01-5	cis-1,3-Dichloropropene	100	U
108-10-1	4-Methyl-2-pentanone	500	U
108-88-3	Toluene	100	U
10061-02-6	trans-1,3-Dichloropropene	100	U
79-00-5	1,1,2-Trichloroethane	100	U
127-18-4	Tetrachloroethene	100	U
591-78-6	2-Hexanone	500	U
124-48-1	Dibromochloromethane	100	U
108-90-7	Chlorobenzene	100	U
100-41-4	Ethylbenzene	100	U
13-302-07	m,p-Xylenes	100	U
95-47-6	o-Xylene	100	U
100-42-5	Styrene	100	U
75-25-2	Bromoform	100	U
79-34-5	1,1,2,2-Tetrachloroethane	100	U

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

5MNW13-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45212.11

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34198.D

Level: (low/med) LOW Date Received: 11/29/00

% Moisture: not dec. _____ Date Analyzed: 12/06/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	4	M
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	1	U
75-09-2	Methylene Chloride	1	U
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	0.7	F J
156-59-2	cis-1,2-Dichloroethene	9	
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	17	
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

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1/23/01
DS

FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

| 5MNW14-WG-1 |

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45230.02

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34209.D

Level: (low/med) LOW Date Received: 11/30/00

% Moisture: not dec. _____ Date Analyzed: 12/08/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 100.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	100	U
75-01-4	Vinyl Chloride	100	U
74-83-9	Bromomethane	100	U
75-00-3	Chloroethane	100	U
75-35-4	1,1-Dichloroethene	~~310~~ 270	M
67-64-1	Acetone	4000	~~E~~ M
75-15-0	Carbon Disulfide	100	U
75-09-2	Methylene Chloride	100	U
156-60-5	trans-1,2-Dichloroethene	100	U
75-34-3	1,1-Dichloroethane	100	U
156-59-2	cis-1,2-Dichloroethene	58	~~J~~ F
78-93-3	2-Butanone	500	U
67-66-3	Chloroform	65	~~J~~ F
71-55-6	1,1,1-Trichloroethane	100	U
56-23-5	Carbon Tetrachloride	100	U
71-43-2	Benzene	100	U
107-06-2	1,2-Dichloroethane	100	U
79-01-6	Trichloroethene	~~1100~~ 1250	
78-87-5	1,2-Dichloropropane	100	U
75-27-4	Bromodichloromethane	100	U
10061-01-5	cis-1,3-Dichloropropene	100	U
108-10-1	4-Methyl-2-pentanone	500	U
108-88-3	Toluene	100	U
10061-02-6	trans-1,3-Dichloropropene	100	U
79-00-5	1,1,2-Trichloroethane	100	U
127-18-4	Tetrachloroethene	100	U
591-78-6	2-Hexanone	500	U
124-48-1	Dibromochloromethane	100	U
108-90-7	Chlorobenzene	100	U
100-41-4	Ethylbenzene	100	U
13-302-07	m,p-Xylenes	100	U
95-47-6	o-Xylene	100	U
100-42-5	Styrene	100	U
75-25-2	Bromoform	100	U
79-34-5	1,1,2,2-Tetrachloroethane	100	U

1/23/01 DB

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

5MNW14-WG-1DL

Lab Name: SWL-TULSA   Contract: GWMONITOR3

Lab Code: SWOK   Case No.: EARTHTE SAS No.:   SDG No.: 45212

Matrix: (soil/water) WATER   Lab Sample ID: 45230.02DL

Sample wt/vol: 25 (g/mL) ML   Lab File ID: K34216.D

Level: (low/med) LOW   Date Received: 11/30/00

% Moisture: not dec. _____   Date Analyzed: 12/08/00

GC Column: DB-624   ID: 0.53 (mm)   Dilution Factor: 500.0

Soil Extract Volume: ________(uL)   Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	500	U
75-01-4	Vinyl Chloride	500	U
74-83-9	Bromomethane	500	U
75-00-3	Chloroethane	500	U
75-35-4	1,1-Dichloroethene	270	DJ
67-64-1	Acetone	6800	D
75-15-0	Carbon Disulfide	500	U
75-09-2	Methylene Chloride	1000	D
156-60-5	trans-1,2-Dichloroethene	500	U
75-34-3	1,1-Dichloroethane	500	U
156-59-2	cis-1,2-Dichloroethene	500	U
78-93-3	2-Butanone	2500	U
67-66-3	Chloroform	250	DJ
71-55-6	1,1,1-Trichloroethane	500	U
56-23-5	Carbon Tetrachloride	500	U
71-43-2	Benzene	500	U
107-06-2	1,2-Dichloroethane	500	U
79-01-6	Trichloroethene	1200	D
78-87-5	1,2-Dichloropropane	500	U
75-27-4	Bromodichloromethane	500	U
10061-01-5	cis-1,3-Dichloropropene	500	U
108-10-1	4-Methyl-2-pentanone	2500	U
108-88-3	Toluene	500	U
10061-02-6	trans-1,3-Dichloropropene	500	U
79-00-5	1,1,2-Trichloroethane	500	U
127-18-4	Tetrachloroethene	500	U
591-78-6	2-Hexanone	2500	U
124-48-1	Dibromochloromethane	500	U
108-90-7	Chlorobenzene	500	U
100-41-4	Ethylbenzene	500	U
13-302-07	m,p-Xylenes	500	U
95-47-6	o-Xylene	500	U
100-42-5	Styrene	500	U
75-25-2	Bromoform	500	U
79-34-5	1,1,2,2-Tetrachloroethane	500	U

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FORM I VOA

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

5MNW16-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45212.08

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34195.D

Level: (low/med) LOW Date Received: 11/29/00

% Moisture: not dec. _____ Date Analyzed: 12/06/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	12	M
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	1	U
75-09-2	Methylene Chloride	1	U
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	1	
156-59-2	cis-1,2-Dichloroethene	1	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	1	U
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

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FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

5MNW19-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45212.07

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34194.D

Level: (low/med) LOW Date Received: 11/29/00

% Moisture: not dec. _____ Date Analyzed: 12/06/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	1	U
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	1	U
75-09-2	Methylene Chloride	1	U
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	1	U
156-59-2	cis-1,2-Dichloroethene	1	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	1	U
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

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DB

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

5MNW20-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45212.06

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34193.D

Level: (low/med) LOW Date Received: 11/29/00

% Moisture: not dec. _____ Date Analyzed: 12/06/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	1	U
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	1	U
75-09-2	Methylene Chloride	1	U
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	1	U
156-59-2	cis-1,2-Dichloroethene	1	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	1	U
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

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FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

SMNW21-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45212.05

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34192.D

Level: (low/med) LOW Date Received: 11/29/00

% Moisture: not dec. ____ Date Analyzed: 12/06/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	1	U
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	1	U
75-09-2	Methylene Chloride	1	U
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	1	U
156-59-2	cis-1,2-Dichloroethene	1	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	1	U
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

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FORM I VOA

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

5MNW22-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45212.09

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34196.D

Level: (low/med) LOW Date Received: 11/29/00

% Moisture: not dec. _____ Date Analyzed: 12/06/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	7	M
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	1	U
75-09-2	Methylene Chloride	1	U
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	1	
156-59-2	cis-1,2-Dichloroethene	1	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	8	
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

8MNWDG2-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45230.01

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34207.D

Level: (low/med) LOW Date Received: 11/30/00

% Moisture: not dec. _____ Date Analyzed: 12/08/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 50.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	50	U
75-01-4	Vinyl Chloride	560	
74-83-9	Bromomethane	50	U
75-00-3	Chloroethane	50	U
75-35-4	1,1-Dichloroethene	1300	M
67-64-1	Acetone	250	U
75-15-0	Carbon Disulfide	50	U
75-09-2	Methylene Chloride	260	B
156-60-5	trans-1,2-Dichloroethene	50	U
75-34-3	1,1-Dichloroethane	1400	
156-59-2	cis-1,2-Dichloroethene	690	
78-93-3	2-Butanone	250	U
67-66-3	Chloroform	34	F ~~J~~
71-55-6	1,1,1-Trichloroethane	50	U
56-23-5	Carbon Tetrachloride	50	U
71-43-2	Benzene	50	U
107-06-2	1,2-Dichloroethane	50	U
79-01-6	Trichloroethene	800	
78-87-5	1,2-Dichloropropane	50	U
75-27-4	Bromodichloromethane	50	U
10061-01-5	cis-1,3-Dichloropropene	50	U
108-10-1	4-Methyl-2-pentanone	250	U
108-88-3	Toluene	50	U
10061-02-6	trans-1,3-Dichloropropene	50	U
79-00-5	1,1,2-Trichloroethane	50	U
127-18-4	Tetrachloroethene	50	U
591-78-6	2-Hexanone	250	U
124-48-1	Dibromochloromethane	50	U
108-90-7	Chlorobenzene	50	U
100-41-4	Ethylbenzene	50	U
13-302-07	m,p-Xylenes	50	U
95-47-6	o-Xylene	50	U
100-42-5	Styrene	50	U
75-25-2	Bromoform	50	U
79-34-5	1,1,2,2-Tetrachloroethane	50	U

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

8MNWDG4-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45212.12

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34199.D

Level: (low/med) LOW Date Received: 11/29/00

% Moisture: not dec. _____ Date Analyzed: 12/06/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	1	U
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	1	U
75-09-2	Methylene Chloride	1	U
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	1	U
156-59-2	cis-1,2-Dichloroethene	1	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	1	U
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

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FORM I VOA

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

8MNW8-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45230.03

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34217.D

Level: (low/med) LOW Date Received: 11/30/00

% Moisture: not dec. _____ Date Analyzed: 12/08/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 200.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	200	U
75-01-4	Vinyl Chloride	200	U
74-83-9	Bromomethane	200	U
75-00-3	Chloroethane	200	U
75-35-4	1,1-Dichloroethene	780	M
67-64-1	Acetone	1000	U
75-15-0	Carbon Disulfide	200	U
75-09-2	Methylene Chloride	440	B
156-60-5	trans-1,2-Dichloroethene	200	U
75-34-3	1,1-Dichloroethane	420	
156-59-2	cis-1,2-Dichloroethene	3300	
78-93-3	2-Butanone	1000	U
67-66-3	Chloroform	150 F	J
71-55-6	1,1,1-Trichloroethane	200	U
56-23-5	Carbon Tetrachloride	200	U
71-43-2	Benzene	200	U
107-06-2	1,2-Dichloroethane	200	U
79-01-6	Trichloroethene	3300	
78-87-5	1,2-Dichloropropane	200	U
75-27-4	Bromodichloromethane	200	U
10061-01-5	cis-1,3-Dichloropropene	200	U
108-10-1	4-Methyl-2-pentanone	1000	U
108-88-3	Toluene	200	U
10061-02-6	trans-1,3-Dichloropropene	200	U
79-00-5	1,1,2-Trichloroethane	200	U
127-18-4	Tetrachloroethene	200	U
591-78-6	2-Hexanone	1000	U
124-48-1	Dibromochloromethane	200	U
108-90-7	Chlorobenzene	200	U
100-41-4	Ethylbenzene	200	U
13-302-07	m,p-Xylenes	200	U
95-47-6	o-Xylene	200	U
100-42-5	Styrene	200	U
75-25-2	Bromoform	200	U
79-34-5	1,1,2,2-Tetrachloroethane	200	U

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DS

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

| 8MNW15-WG-1 |

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45230.04

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34211.D

Level: (low/med) LOW Date Received: 11/30/00

% Moisture: not dec. _____ Date Analyzed: 12/08/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 200.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	200	U
75-01-4	Vinyl Chloride	200	U
74-83-9	Bromomethane	200	U
75-00-3	Chloroethane	200	U
75-35-4	1,1-Dichloroethene	200	U
67-64-1	Acetone	1000	U
75-15-0	Carbon Disulfide	200	U
75-09-2	Methylene Chloride	1000	B
156-60-5	trans-1,2-Dichloroethene	200	U
75-34-3	1,1-Dichloroethane	200	U
156-59-2	cis-1,2-Dichloroethene	250	
78-93-3	2-Butanone	1000	U
67-66-3	Chloroform	140	F J
71-55-6	1,1,1-Trichloroethane	200	U
56-23-5	Carbon Tetrachloride	200	U
71-43-2	Benzene	200	U
107-06-2	1,2-Dichloroethane	200	U
79-01-6	Trichloroethene	4200	
78-87-5	1,2-Dichloropropane	200	U
75-27-4	Bromodichloromethane	200	U
10061-01-5	cis-1,3-Dichloropropene	200	U
108-10-1	4-Methyl-2-pentanone	1000	U
108-88-3	Toluene	200	U
10061-02-6	trans-1,3-Dichloropropene	200	U
79-00-5	1,1,2-Trichloroethane	200	U
127-18-4	Tetrachloroethene	200	U
591-78-6	2-Hexanone	1000	U
124-48-1	Dibromochloromethane	200	U
108-90-7	Chlorobenzene	200	U
100-41-4	Ethylbenzene	200	U
13-302-07	m,p-Xylenes	200	U
95-47-6	o-Xylene	200	U
100-42-5	Styrene	200	U
75-25-2	Bromoform	200	U
79-34-5	1,1,2,2-Tetrachloroethane	200	U

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FORM I VOA

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VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

8MNW17-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45230.07

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34214.D

Level: (low/med) LOW Date Received: 11/30/00

% Moisture: not dec. _____ Date Analyzed: 12/08/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1000.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1000	U
75-01-4	Vinyl Chloride	1000	U
74-83-9	Bromomethane	1000	U
75-00-3	Chloroethane	1000	U
75-35-4	1,1-Dichloroethene	14000	M
67-64-1	Acetone	5000	U
75-15-0	Carbon Disulfide	1000	U
75-09-2	Methylene Chloride	1900	B
156-60-5	trans-1,2-Dichloroethene	1000	U
75-34-3	1,1-Dichloroethane	1000	U
156-59-2	cis-1,2-Dichloroethene	1000	U
78-93-3	2-Butanone	5000	U
67-66-3	Chloroform	470	F J
71-55-6	1,1,1-Trichloroethane	3100	
56-23-5	Carbon Tetrachloride	1000	U
71-43-2	Benzene	1000	U
107-06-2	1,2-Dichloroethane	1000	U
79-01-6	Trichloroethene	31000	
78-87-5	1,2-Dichloropropane	1000	U
75-27-4	Bromodichloromethane	1000	U
10061-01-5	cis-1,3-Dichloropropene	1000	U
108-10-1	4-Methyl-2-pentanone	5000	U
108-88-3	Toluene	1000	U
10061-02-6	trans-1,3-Dichloropropene	1000	U
79-00-5	1,1,2-Trichloroethane	1000	U
127-18-4	Tetrachloroethene	1000	U
591-78-6	2-Hexanone	5000	U
124-48-1	Dibromochloromethane	1000	U
108-90-7	Chlorobenzene	1000	U
100-41-4	Ethylbenzene	1000	U
13-302-07	m,p-Xylenes	1000	U
95-47-6	o-Xylene	1000	U
100-42-5	Styrene	1000	U
75-25-2	Bromoform	1000	U
79-34-5	1,1,2,2-Tetrachloroethane	1000	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

8MNW20-WG-1

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45230.05

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34212.D

Level: (low/med) LOW Date Received: 11/30/00

% Moisture: not dec. _____ Date Analyzed: 12/08/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1250.0

Soil Extract Volume: ________(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1200	U
75-01-4	Vinyl Chloride	1200	U
74-83-9	Bromomethane	1200	U
75-00-3	Chloroethane	1200	U
75-35-4	1,1-Dichloroethene	2500	~~J~~ M
67-64-1	Acetone	6200	U
75-15-0	Carbon Disulfide	1200	U
75-09-2	Methylene Chloride	2300	B
156-60-5	trans-1,2-Dichloroethene	1200	U
75-34-3	1,1-Dichloroethane	1200	U
156-59-2	cis-1,2-Dichloroethene	1200	U
78-93-3	2-Butanone	6200	U
67-66-3	Chloroform	280 F	~~J~~
71-55-6	1,1,1-Trichloroethane	1200	U
56-23-5	Carbon Tetrachloride	1200	U
71-43-2	Benzene	1200	U
107-06-2	1,2-Dichloroethane	1200	U
79-01-6	Trichloroethene	23000	J
78-87-5	1,2-Dichloropropane	1200	U
75-27-4	Bromodichloromethane	1200	U
10061-01-5	cis-1,3-Dichloropropene	1200	U
108-10-1	4-Methyl-2-pentanone	6200	U
108-88-3	Toluene	1200	U
10061-02-6	trans-1,3-Dichloropropene	1200	U
79-00-5	1,1,2-Trichloroethane	1200	U
127-18-4	Tetrachloroethene	1200	U
591-78-6	2-Hexanone	6200	U
124-48-1	Dibromochloromethane	1200	U
108-90-7	Chlorobenzene	1200	U
100-41-4	Ethylbenzene	1200	U
13-302-07	m,p-Xylenes	1200	U
95-47-6	o-Xylene	1200	U
100-42-5	Styrene	1200	U
75-25-2	Bromoform	1200	U
79-34-5	1,1,2,2-Tetrachloroethane	1200	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

8MNW20-WG-9

Lab Name: SWL-TULSA Contract: GWMONITOR3

Lab Code: SWOK Case No.: EARTHTE SAS No.: SDG No.: 45212

Matrix: (soil/water) WATER Lab Sample ID: 45230.06

Sample wt/vol: 25 (g/mL) ML Lab File ID: K34213.D

Level: (low/med) LOW Date Received: 11/30/00

% Moisture: not dec. ____ Date Analyzed: 12/08/00

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1000.0

Soil Extract Volume: ______(uL) Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1000	U
75-01-4	Vinyl Chloride	1000	U
74-83-9	Bromomethane	1000	U
75-00-3	Chloroethane	1000	U
75-35-4	1,1-Dichloroethene	1800	M
67-64-1	Acetone	5000	U
75-15-0	Carbon Disulfide	1000	U
75-09-2	Methylene Chloride	1700	B
156-60-5	trans-1,2-Dichloroethene	1000	U
75-34-3	1,1-Dichloroethane	1000	U
156-59-2	cis-1,2-Dichloroethene	1000	U
78-93-3	2-Butanone	5000	U
67-66-3	Chloroform	640	F J
71-55-6	1,1,1-Trichloroethane	1000	U
56-23-5	Carbon Tetrachloride	1000	U
71-43-2	Benzene	1000	U
107-06-2	1,2-Dichloroethane	1000	U
79-01-6	Trichloroethene	15000	J
78-87-5	1,2-Dichloropropane	1000	U
75-27-4	Bromodichloromethane	1000	U
10061-01-5	cis-1,3-Dichloropropene	1000	U
108-10-1	4-Methyl-2-pentanone	5000	U
108-88-3	Toluene	1000	U
10061-02-6	trans-1,3-Dichloropropene	1000	U
79-00-5	1,1,2-Trichloroethane	1000	U
127-18-4	Tetrachloroethene	1000	U
591-78-6	2-Hexanone	5000	U
124-48-1	Dibromochloromethane	1000	U
108-90-7	Chlorobenzene	1000	U
100-41-4	Ethylbenzene	1000	U
13-302-07	m,p-Xylenes	1000	U
95-47-6	o-Xylene	1000	U
100-42-5	Styrene	1000	U
75-25-2	Bromoform	1000	U
79-34-5	1,1,2,2-Tetrachloroethane	1000	U

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

| 8MNW21-WG-1 |

Lab Name: SWL-TULSA   Contract: GWMONITOR3

Lab Code: SWOK   Case No.: EARTHTE SAS No.:   SDG No.: 45212

Matrix: (soil/water) WATER   Lab Sample ID: 45212.02

Sample wt/vol: 25 (g/mL) ML   Lab File ID: K34189.D

Level: (low/med) LOW   Date Received: 11/29/00

% Moisture: not dec. _____   Date Analyzed: 12/06/00

GC Column: DB-624   ID: 0.53 (mm)   Dilution Factor: 1.0

Soil Extract Volume: ________(uL)   Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	1	U
67-64-1	Acetone	6	M
75-15-0	Carbon Disulfide	1	U
75-09-2	Methylene Chloride	0.9	F J
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	1	U
156-59-2	cis-1,2-Dichloroethene	1	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	1	U
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

8MNW22-WG-1

Lab Name: SWL-TULSA   Contract: GWMONITOR3

Lab Code: SWOK   Case No.: EARTHTE SAS No.:   SDG No.: 45212

Matrix: (soil/water) WATER   Lab Sample ID: 45212.04

Sample wt/vol: 25 (g/mL) ML   Lab File ID: K34191.D

Level: (low/med) LOW   Date Received: 11/29/00

% Moisture: not dec. _____   Date Analyzed: 12/06/00

GC Column: DB-624   ID: 0.53 (mm)   Dilution Factor: 1.0

Soil Extract Volume: ________(uL)   Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	1	U
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	1	U
75-09-2	Methylene Chloride	1	U
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	1	U
156-59-2	cis-1,2-Dichloroethene	1	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	1	U
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

8MNW23-WG-1

Lab Name: SWL-TULSA   Contract: GWMONITOR3

Lab Code: SWOK   Case No.: EARTHTE SAS No.:   SDG No.: 45212

Matrix: (soil/water) WATER   Lab Sample ID: 45212.03

Sample wt/vol: 25 (g/mL) ML   Lab File ID: K34190.D

Level: (low/med) LOW   Date Received: 11/29/00

% Moisture: not dec. _____   Date Analyzed: 12/06/00

GC Column: DB-624   ID: 0.53 (mm)   Dilution Factor: 1.0

Soil Extract Volume: ________(uL)   Soil Aliquot Volume: ____(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl Chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	4	M
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	1	U
75-09-2	Methylene Chloride	1	B
156-60-5	trans-1,2-Dichloroethene	1	U
75-34-3	1,1-Dichloroethane	0.5 F	J
156-59-2	cis-1,2-Dichloroethene	0.8 F	J
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	1	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon Tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	1	U
79-01-6	Trichloroethene	1	
78-87-5	1,2-Dichloropropane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
13-302-07	m,p-Xylenes	1	U
95-47-6	o-Xylene	1	U
100-42-5	Styrene	1	U
75-25-2	Bromoform	1	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U

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FORM I VOA

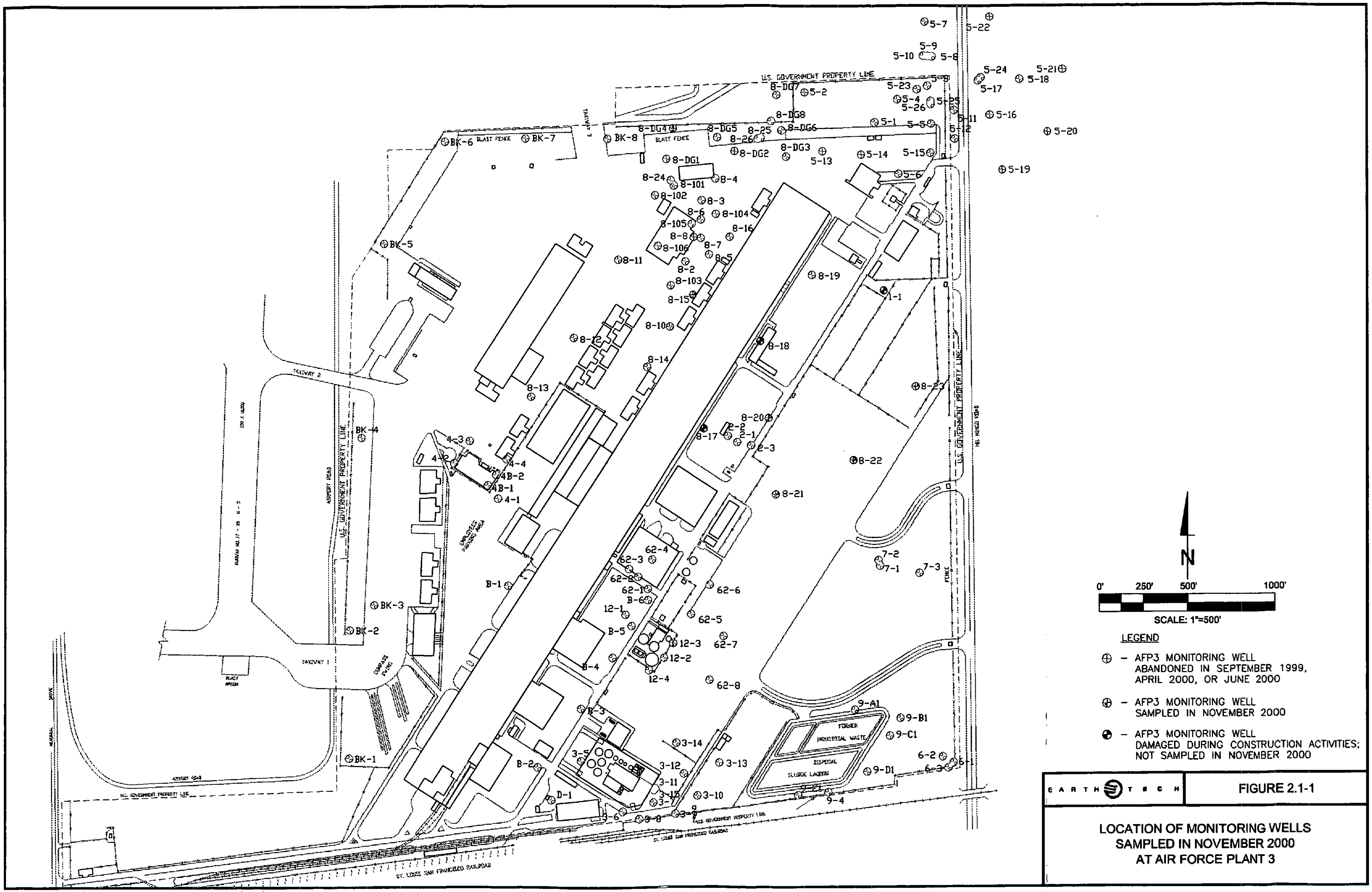
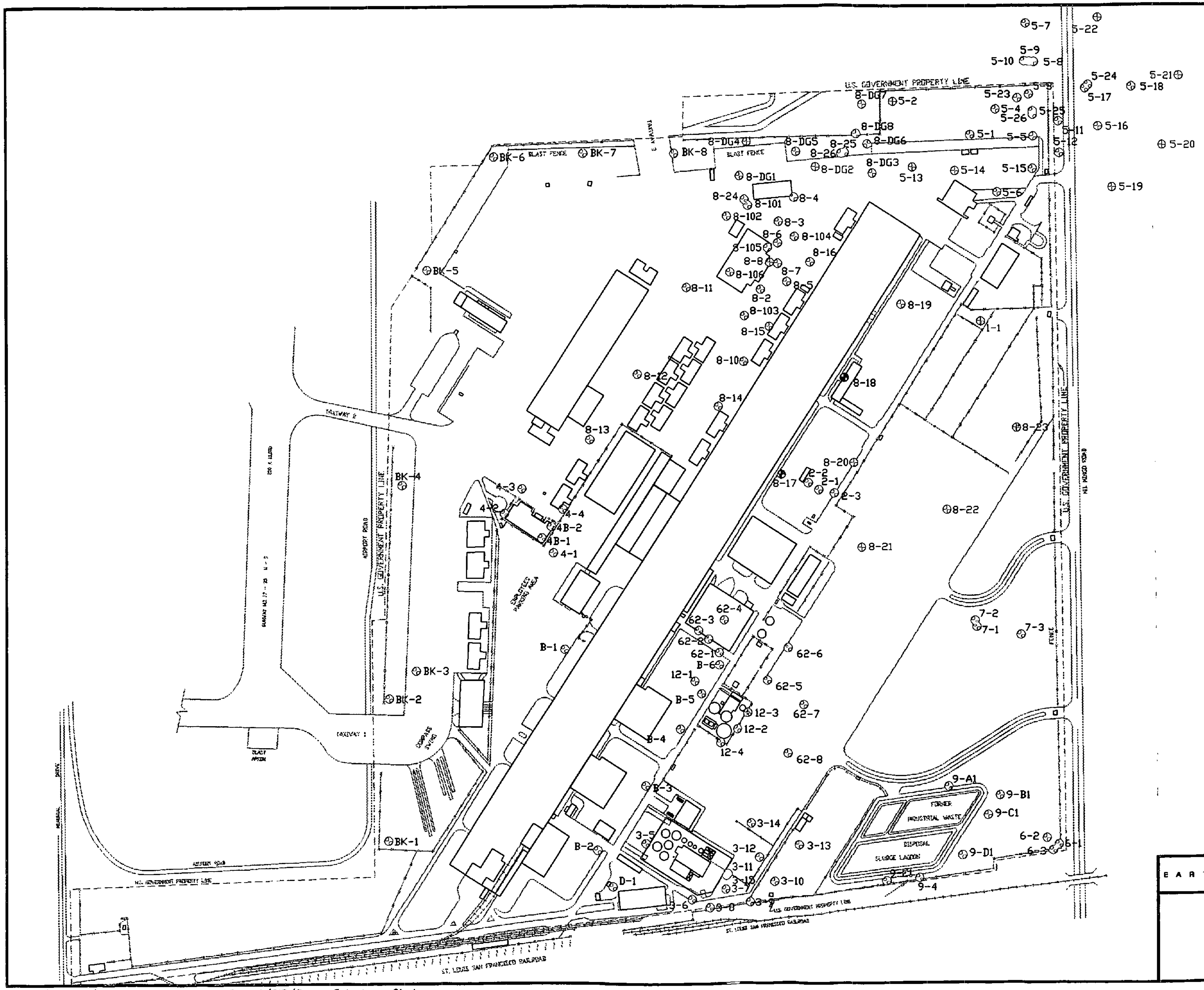


FIGURE 2.1-1

LOCATION OF MONITORING WELLS SAMPLED IN NOVEMBER 2000 AT AIR FORCE PLANT 3

40216/Reports/Nov 00 GW Monitoring Report/GIS/figure 2.1-1 nov2k.dwg



LEGEND

⊕ – AFP3 MONITORING WELL ABANDONED IN SEPTEMBER 1999, APRIL 2000, OR JUNE 2000

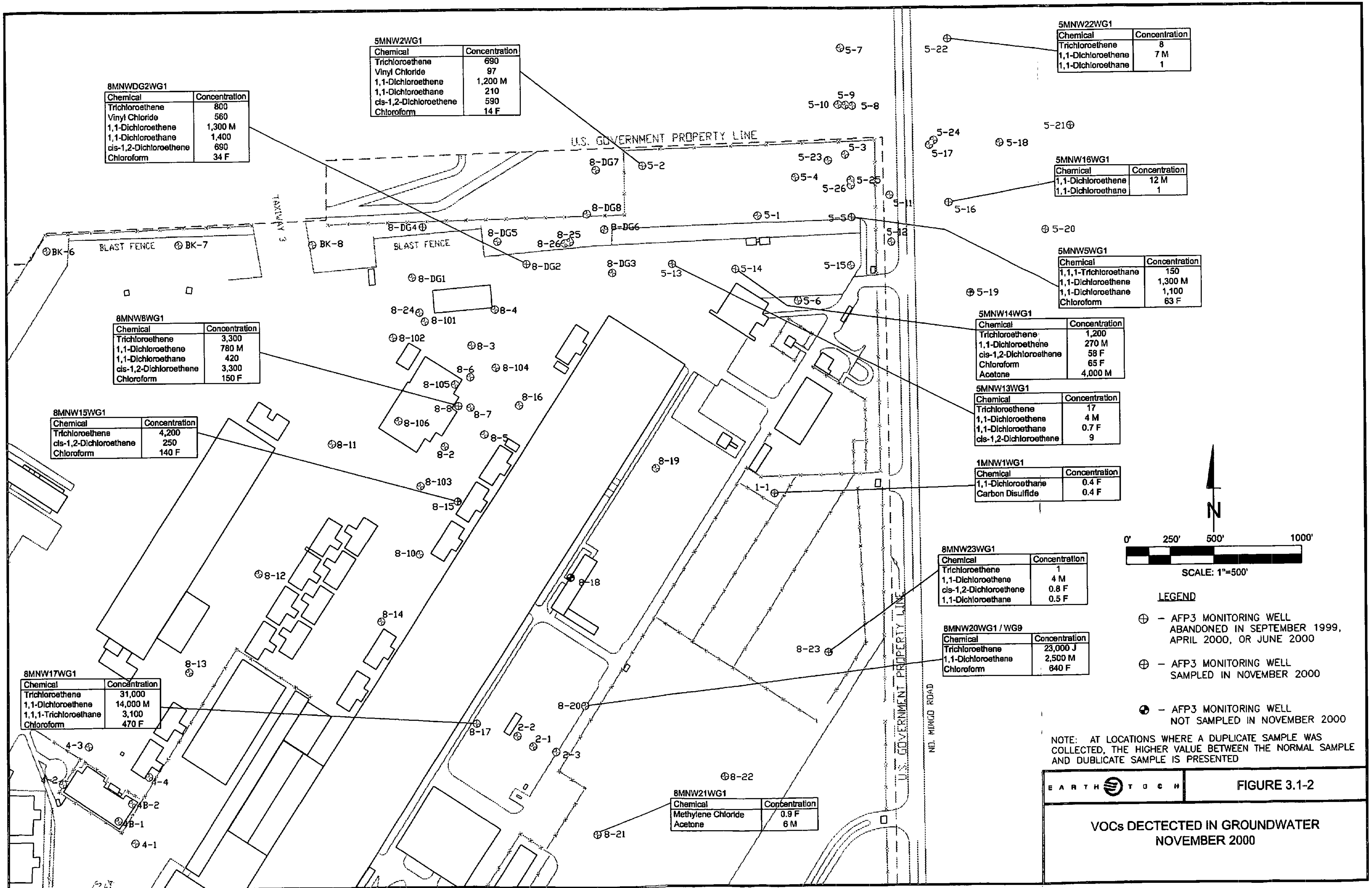
⊕ – AFP3 MONITORING WELL SAMPLED IN NOVEMBER 2000

● – AFP3 MONITORING WELL DAMAGED DURING CONSTRUCTION ACTIVITIES; NOT SAMPLED IN NOVEMBER 2000

EARTH TECH

FIGURE 3.1-1

LOCATION OF MONITORING WELLS SAMPLED IN NOVEMBER 2000 AT AIR FORCE PLANT 3



40216/Reports/Nov 00 GW Monitoring Report/GIS/figure 3_1-2 nov2k.dwg