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FINAL WORK PLAN FOR PRELIMINARY ASSESSMENT SITE INVESTIGATION AND REMEDIAL INVESTIGATION FEASIBILITY STUDY AT PLANT 4 VOLUME 3 OF 4 NAS FORT WORTH TX

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Air Force Plant 4

Preliminary Assessment/ Site Inspection and Remedial Investigations/ Feasibility Studies

Volume III

Final Quality Assurance Project Plan

Prepared for
U.S. Department of the Air Force
Headquarters Aeronautics Systems Division
Wright-Patterson Air Force Base, Ohio

Submitted by Geotech under
DOE Contract No. DE–AC07–86ID12584 for the
U. S. Department of Energy

PRELIMINARY ASSESSMENT/SITE INSPECTION

AND

REMEDIAL INVESTIGATIONS/FEASIBILITY STUDIES

QUALITY ASSURANCE PROJECT PLAN

FOR

U.S. AIR FORCE PLANT 4

Reviewed and Approved by:

Project Manager	John R. Ludlam	31 August 1990 Date
QA Manager (QA Officer)	Keith R. Rademacher	31 August 1990 Date
DOE/GJPO Project Manager	R. Eldon Bray	31 August 1990 Date
DOE/GJPO Environment, Safety, Health, and Quality Assurance Director	Bennett H. Young	31 August 1990 Date
ASD/DEV Project Officer	Surendra Joshi	17 September 1990 Date
EPA Region VI Chief of Superfund Enforcement Branch	Sam Becker	Date

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3.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) is specific to the work being performed by UNC Geotech (UNC) and their subcontractors for U.S. Air Force Plant 4 in Fort Worth, Texas.

The purpose of this Quality Assurance Project Plan is to provide an orderly assembly of the detailed and specific procedures and practices that delineate how data of known and acceptable quality will be produced for this project. In addition, this project plan describes the organizational structure and responsibilities of the project team.

A reference to the specific tables or sections will be made whenever information identified in this plan is described and provided in the project *Work Plan* (Volume I), *Sampling and Analysis Plan* (Volume II), or *Health and Safety Plan* (Volume IV). Reference will also be made to the appropriate UNC and subcontractor technical, administrative, and quality documents that are applicable to each of the 16 elements of this work.

To accomplish the various subtasks of this project work, a readiness review will be performed to assess the availability of adequate procedures, equipment, and properly trained, qualified, and certified personnel. These review requirements will be met prior to the start of project work to assure that identified quality is achieved during the collection, processing, analyzing, and reporting of data. Evaluations of administrative and technical systems approved for this project will be performed during the project activities and will be modified when necessary to meet regulatory requirements, project management, and other approved requests. Criterion 1 - Quality Assurance Program, Standard and "Q" Related Requirements, and Criterion 11 - Test Control, Standard Requirements, of the UNC *Quality Assurance Manual** (UNC Manual-101) are applicable to this element.

This QAPP is prepared by the Quality Assurance (QA) Coordinator for issue by the Program Manager. It is also reviewed by the U.S. Department of Energy under the auspices of DOE Contract No. DE-AC07-86ID12584. It will be revised by the QA Coordinator and the Program Manager, as required, to meet the needs of the Program. Revisions will require approvals at the same levels as the original document. Requests for copies of the QAPP should be sent to the QA Coordinator.

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*The UNC *Quality Assurance Manual,* UNC Manual-101, is presented as Appendix B to this *Quality Assurance Project Plan.*

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4.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

4.1 PROJECT MANAGER

The Project Manager is responsible for identifying the scope, schedule, budget, and resources needed to achieve project objectives. The Project Manager establishes, implements, and assures programmatic tasks, schedules, and budgets. The Project Manager reviews and approves all project tasks, coordinates the participation of UNC support organizations, and issues all formal reports. The Project Manager is responsible for the execution of all phases of field sampling and for ensuring the collection of valid data. The Project Manager is the principal point of contact between the Client (USAF personnel) and the Customer (DOE/GJPO).

Table 4-1 presents key UNC assignments for the U.S. Air Force Plant 4 Preliminary Assessment/Site Inspection and Remedial Investigations/Feasibility Studies.

Table 4-1

Assignment	Name
Project Manager	John Ludlam
Field Team Leader (Site Manager)	David Traub
Drilling Specialist	Jack McCaslin
Technical Specialists	(Assigned as required)
Quality Assurance Coordinator	Jerry Hall
Operations Health Physics	Syd Pincock

4.2 FIELD TEAM LEADER (Site Manager)

The Field Team Leader reports directly to the Project Manager and will be responsible for directing all field activities for UNC Geotech and its subcontractor(s) while on the facility. Duties include the following:

- Conduct daily health and safety briefings prior to start of work.
- Issue work assignments.
- Train personnel and verify that field personnel are properly trained.
- Coordinate with Air Force Plant 4 personnel for access, permits, supplies, and shipping.

- Perform daily Quality Assurance/Quality Control (QA/QC) evaluations of field data and logbooks for completeness and accuracy to detect and correct errors in a timely manner.

- Control documents and data and maintain project files.

- Ensure chain-of-custody is maintained.

4.3 DRILLING SPECIALIST

A UNC Geotech Drilling Specialist reports directly to the Project Manager and will be responsible for field management of all subsurface drilling activities at U.S. Air Force Plant 4.

Duties will include the following:

- Monitor drilling subcontractor activities for compliance with requirements and procedures specified in *Volume II, Sampling and Analysis Plan.*

- Manage and control all field personnel when they are working in the area of an active drilling site.

- Monitor all well installations for compliance with procedures established in *Volume II, Sampling and Analysis Plan.*

- Responsible for assuring that subsurface drilling work is in accordance with all permits and access agreements.

4.4 TECHNICAL SPECIALISTS

Technical Specialists from UNC Geotech will include personnel qualified as:

- Chemists
- Hydrologists
- Geologists
- Geophysicists
- Field Technicians
- Land Surveyors

All personnel will be qualified and properly trained in the work tasks assigned. Copies of records of training and qualifications will be maintained by the Field Team Leader. The number and type of personnel on the site will vary according to the work schedule. All field personnel will report directly to the Field Team Leader except as noted in Paragraph 4.3 above.

The following lists the technical personnel required for each field task:

Task	Personnel Required
Groundwater Sampling	Field Technician
Surface-Water Sampling	Field Technician
Soil Gas Sampling	Chemist Field Technician
Soil Sampling	Geologist Field Technician
Geophysical Surveys	Geophysicist Field Technician
Borehole Logging	Geologist
Water-Level Measurements	Technician
Single-Well Aquifer Tests	Hydrologist Field Technician
Well-Location Survey	Land Surveyor
Monitoring-Well Installation	Drilling Specialist Hydrologist Geologist Field Technician

4.5 QUALITY ASSURANCE COORDINATOR

A Quality Assurance Coordinator from the UNC Geotech organization will be assigned to assist in planning, readiness review, and quality assurance audits and will overview field investigation, sample analysis, and data evaluation. The QA Coordinator will provide support to the UNC Geotech Project Manager for the project and will verify that Quality Assurance requirements have been included in planning documents and that quality assurance is implemented during the project activities.

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The coordinator is evaluated, trained, qualified, and certified in accordance with UNC *Quality Assurance Manual*, Quality Assurance Instruction (QAI) 1.9, Certification of Personnel, to perform the necessary monitoring and verification activities described in this plan. Criterion 2 - Organization, "Q" Related Requirements; Criterion 3 - Design Control, Standard Requirements; Criterion 4 - Procurement Document Control, Standard and"Q" Related Requirements; QAI 4.1 QA Review of Procurement Documents; Criterion 6 - Document Control, Standard Requirements; Criterion 7 - Control of Purchased Items and Services, Standard and "Q" Related Requirements; and Criterion 17 - Records, Standard Requirements of the UNC *Quality Assurance Manual* are applicable to define and implement the requirements of this element.

4.6 OPERATIONAL HEALTH PHYSICS PERSONNEL

The Operational Health Physics (OHP) Technician is responsible for performing necessary industrial hygiene, radiological and environmental sampling surveys and monitoring, and ensuring compliance with Occupational and Safety Health Administration (OSHA) standards. The OHP Technician will ensure that all UNC Geotech and subcontract personnel have proper medical, hazardous waste operations and emergency response, and site-specific training. Additionally, the OHP Technician will issue appropriate personal protective equipment and inspect employees required to wear personal protective equipment for proper fit and disposal; ensure that proper decontamination procedures are followed; ensure proper maintenance of instruments, and ensure all health physics and radiological survey records are complete, correct, and available for Field Team Leader review.

5.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF DATA

5.1 DATA QUALITY

The purpose of this section is to provide quality assurance for data measurement by assuring the accuracy of parameter identification and quantification. This is necessary to ensure data-quality objectives specified for each site in Volume II, *Sampling and Analysis Plan*, Section 3.0, are met. Analytical parameters are identified in Tables 4-1 and 4-2 of the same plan.

Acceptance criteria for laboratory analysis are specified in EPA SW-846[1], UNC *Analytical Chemistry Laboratory Handbook of Analytical and Sample Preparation Methods*, and UNC *Analytical Chemistry Laboratory Administrative Plan and Quality Control Procedures*. See Table 6-1 in the *Sampling and Analysis Plan* for reporting limits for laboratory analyses.

Good analytical methods related to reagent control, cleaning operations, and general operations such as weighing, preparing solutions, preserving samples, and recording and processing data will be employed. Documentation of all operations and records necessary to support the measurements and identify assignable causes in the event of measurement problems or to improve the accuracy will be kept. Proper maintenance of facilities and equipment will be performed, and the project personnel selected for measurement of data will maintain the educational requirements and skill level needed through continuing education and training in the techniques used. Criterion 9 - Control of Processes, "Q" Related Requirements, and Criterion 12 - Control of Measuring and Test Equipment, Standard Requirements, of UNC Manual-101, are applicable to this element.

5.2 DATA ACCURACY AND PRECISION

Accuracy is the nearness of a measurement or the mean (x) of a set of measurements to the true value (t), usually expressed as the difference between the two values(x-t), or the difference as a percentage of the reference or true value (100(x-t)/t), and is sometimes expressed as a ratio (x/t). Accuracy is the measure of the bias in a system. Analysis of spiked and blank sample data will be performed by the laboratory to provide a measure of the bias of each test method. Accuracy limits for each parameter in each sampling matrix are stated as percent recoveries of spiked analytes and are shown in Appendix D of this plan.

Precision is the agreement between a set of replicate measurements without assumption or knowledge of the true value. Repetitive measurements of analytical samples will be made by the use of replicate samples to judge precision of each measurement process.

[1]U.S. Environmental Protection Agency, 1986. Test Methods for Evaluating Solid Waste: SW-846, Third Edition, November.

5.3 DATA COMPLETENESS

Completeness is a measure of the amount of valid data expressed as a percentage obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions. Field and analytical data are specified at 90 percent completeness as stated in the CLP/RAS statement of work and CERCLA specifications. No data requirements have been set at 100 percent data recovery.

5.4 DATA REPRESENTATIVENESS

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Representativeness for Air Force Plant 4 will be accomplished by monitoring field activities and sampling extensively. For example, groundwater monitoring wells will determine representative migration and concentration of contamination and will supplement existing data. Monitoring well locations will be determined by review of existing data by UNC Geotech's professional hydrology staff who will consider depth to bedrock, thickness of alluvium, direction of hydraulic gradient of the aquifer, and sensitive receptor locations. Existing private well locations and their characteristics will be considered when monitoring well locations are selected. The depths will ensure complete and representative data if contaminant stratification exists. Repeated evacuation or purging of conventional monitoring wells before sampling ensures representative groundwater samples.

Analytical data representativeness is shown in the CLP/RAS statement of work.

5.5 DATA COMPARABILITY

Comparability is the confidence with which one data set can be compared to another. Comparability may be ensured by using approved sampling plans, standardized analytical methods, and identical units for reportable data. All data in a particular data set will be obtained by the same methods.

The comparability of the analytical results will be based upon acquisition of data through EPA or UNC approved procedures performed by experienced chemists using properly calibrated instruments. The quality control procedures prescribed will be used to provide analytical results of known quality.

Groundwater sampling locations, for example, will be selected according to location in regard to groundwater flow paths, depth of the well, and casing and screening material to ensure comparability. Rinsate samples collected after decontamination efforts will further ensure data comparability between each collection effort at Air Force Plant 4. Data will be grouped and evaluated according to similar sampling methods, sampling media, completion interval, and laboratory analytical methods.

5.6 QUALITY ASSURANCE OBJECTIVES

QA objectives for the RI/FS at AFP 4 were determined based on the data quality objectives (DQOs) established for RI field activities (see Section 3.0 of the Sampling and Analysis Plan, Volume II). DQOs were determined based on the intended uses of the data to be collected. DQOs were prepared for the collection of representative soil gas, soil, water quality, and water level data.

5.6.1 Data Quality Objectives for Field Investigation Activities

DQOs are qualitative and quantitative statements which specify the quality of data required to support decisions during RI and FS activities. DQOs are initially identified during project scoping and are incorporated into the project planning documents to provide implementable objectives that ensure that the data collected during RI work tasks are of adequate quality for their intended uses. The DQOs describe objectives for the various sampling efforts performed during the RI and provide rationale for selection of sampling locations, number of samples, and analytical parameters.

The following sections briefly summarize the general DQOs for each RI activity and the analytical procedures and detection limits required to meet each DQO. Site-specific DQOs are presented in Section 3.0 of the *Sampling and Analysis Plan (Volume II).*

5.6.1.1 Soil Gas Sampling and Analysis

Soil gas sampling will be used as a reconnaissance tool. The objective of this task is to delineate areas of volatile organic compounds (VOC) in soil gas and to identify concentrations which indicate VOC sources requiring additional investigation by soil or groundwater sampling.

5.6.1.2 Soil Sampling and Analysis

The collection of soil samples for chemical analysis, physical analysis, and lithologic description will be performed as part of the RI. The objectives of soil boring drilling and soil sample analysis are to provide data on the site lithology, determine the physical properties of each hydrogeologic unit, determine the presence or absence of chemical contaminants in the soil, and, if present, investigate the distribution of the contaminants in the vadose zone.

Soil samples will be analyzed for VOCs using EPA Method 624/8240 or 8260. Selected samples will also be analyzed for acid organic and base/neutral (semi-VOCs) compounds using EPA Method 625/8270, for oil and grease using UNC Method K-7, for priority pollutant metals using EPA Method 6010/EPA Method 7000 series, for radioisotopes by gamma spectroscopy and alpha spectrometry, and for total petroleum hydrocarbons by EPA Method 418-1. Concentrations of volatile organic compounds in soil samples will be reported in units of micrograms per kilogram (µg/kg). Concentrations of semi-volatile organic compounds and metals in soil samples will be reported in units of micrograms per liter (µg/L); concentrations of TPH and oil and grease will be in mg/kg; and concentrations of radioisotopes will be in pCi/g or µg/g. Detection limits required for organic compounds are defined by the Practical Quantitation Limits (PQL) for analysis of soil samples as approximately 5-50 µg/kg for VOCs and 660-5330 µg/L for semi-volatile organic compounds.

5.6.1.3 Monitoring Wells

The objectives of monitoring wells are to characterize groundwater conditions and aquifer hydraulic parameters at AFP 4. Sampling of existing and new monitoring wells will be performed as part of the RI. Monitoring wells will be sampled in the upper zone, and the upper Paluxy and lower Paluxy aquifers.

New monitoring wells will be designed according to the criteria in the Sampling and Analysis Plan (Section 4.7.3). These criteria determine when conventional nested wells or multiple-level wells, continuous wire-wrapped or slotted screens, and PVC or stainless steel casing and screens will be used.

5.6.1.4 Groundwater Sampling

Groundwater samples will be collected from soil borings and monitoring wells to characterize the chemical quality of groundwater in the vicinity of AFP 4.

The monitoring wells for sampling were selected to provide the following information:

- Definition of the areal extent of contaminants in groundwater
- Definition and tracking of contaminants exceeding regulatory standards
- Monitoring of basic groundwater quality
- Baseline hydrologic data for new monitoring wells
- Confirmation of previous analytical results

5.6.1.5 Surface Water Sampling

Surface water samples will be collected from sampling stations in Meandering Road Creek, from seeps adjacent to the creek, and from Lake Worth to determine if contaminants have entered the surface water pathway from AFP 4. Samples will be collected from sampling locations both up gradient and down gradient from suspected sources of contaminants to determine surface water quality entering and leaving the AFP 4 area. Results will be compared with previous data to determine if changes in water quality have occurred over time as a result of activities at AFP 4.

5.6.1.6 Lake Worth Sediment Sampling

Sediment samples will be collected from Lake Worth to determine whether contaminants from the upper zone at AFP4 are being released to Lake Worth. Sediment and water samples will be collected at the same locations. Sediments from near the NARF area will be analyzed for radioisotopes. The analytical results from sediment samples will be used to assess potential risk associated with contaminated sediments (if present).

5.6.1.7 Water-Level Measurements

Groundwater levels will be measured to established groundwater flow directions at AFP 4. Water levels will be measured in all monitoring wells to be sampled at AFP 4. The resulting data will be compared with previous data and water-level contour maps will be generated to show groundwater flow directions at AFP 4 and adjacent properties (where information is available).

5.6.1.8 Aquifer Testing

Aquifer tests will be conducted on selected monitoring wells to estimate the hydraulic properties of the aquifer.

5.6.1.9 LNAPL Sampling

Floating product (LNAPL) will be sampled from monitoring wells in selected areas (such as Landfill Number 3) to determine the source of the product.

6.0 SAMPLING PROCEDURES AND TURNAROUND TIME

6.1 FIELD SAMPLING TECHNIQUES

Field sampling techniques for use by UNC Geotech and subcontractors are described in the *Sampling and Analysis Plan (Volume II).* In addition, critical turnaround times (holding times) from sample acquisition to analysis, are also identified in the *Sampling and Analysis Plan*, Table 5-1.

6.2 SHIPPING, HANDLING, AND STORAGE REQUIREMENTS

Care will be taken with samples acquired in the field to ensure that they are handled to prevent contamination of field personnel and in accordance with the approved field sampling techniques for minimal contamination of the samples. Samples will be immediately tested in the field for the physical and chemical parameters of interest, or procedurally transferred to a specified container (for conditioning or storage at reduced temperatures when applicable) to reduce loss of the measurable quantities present, prior to subsequent packaging and shipping to the laboratory for the PA/SI and RI/FS analysis. Criterion 5 - Instructions, Procedures, and Drawings, Standard Requirements, and Criterion 13 - Handling, Shipping, and Storage, Standard Requirements, of UNC Manual-101 are applicable to this element.

6.3 EQUIPMENT DECONTAMINATION/CROSS-CONTAMINATION PREVENTION

Equipment and tools used to sample and test field materials will be decontaminated prior to use, between uses, and at the end of the activity to prevent cross-contamination of samples. The *Sampling and Analysis Plan* describes the decontamination procedure and precautions in Section 4.9.

6.4 FIELD VARIANCE LOGS

A notation must be made on the Field Variance Log (Figure 6-1) whenever a sample is taken that does not fall within the specified requirements of the field sampling technique; the shipping, handling, and storage requirements; or equipment decontamination and cross-contamination prevention efforts. Comments describing the variance will be used during sample processing and data evaluation to assess the use of associated results and validity of the data.

UNC Geotech

Field Variance Lo
(see reverse side for instruction

1. Project ____________________ 2. Project Site ____________________

3. Variance No.	4. Variance Date ___/___/___	5. Initiated by (signature)	6. Reference Document	7. Description of Variance	8. Corrective Action (if applicable)

9. Distribution: Project File Project Manager QA Coordinator

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Figure 6.1 Example of Field Variance Log

Instructions

Any activity that does not meet the specified requirements of field activities must be noted on this Field Variance Log, for example:

- Sampling technique
- Shipping, handling, and storage of samples, equipment, or instruments
- Equipment decontamination and cross-contamination prevention efforts
- Drilling
- Procedure noncompliance or deviations associated with project activities

Informational copies of completed Field Variance Logs shall be sent to the Project Manager (PM) and Quality Assurance Coordinator (QAC) by the Project Team Leader. *(Note: Comments describing the variance will be used during data evaluation to assess the results and validity of the data.)*

(1) Project name or title

(2) Name or title of the project site (if applicable)

(3) Sequential numbering of the variance reported

(4) Date the variance(s) occurred

(5) Legal signature of the initiator of the Field Variance Log item

(6) Reference the procedure or document that was deviated

(7) Briefly describe the variance(s) and/or reference where the variance is fully described

(8) Describe the immediate corrective action taken (if applicable)

(9) Distribution (responsibility of Project Team Leader)

Figure 6-2 (continued). Example of Field Variance Log

6.5 COLLECTION OF FIELD DATA

The procedures presented in this section are designed to ensure that all samples and measurements are collected in a manner consistent with QA objectives. Samples will be identified, preserved, and transported in such a manner that data are representative of actual AFP 4 site conditions and no information is lost in sample transfer. Procedures may be revised in the field when necessary to reflect changes in practice or technology by use of the Program Directives Procedure, Appendix C.

6.5.1 Types, Locations, and Number of Samples

Soil gas, soil, groundwater, and surface water samples will be collected during the RI. The types, locations and numbers of samples to be collected for specific sites are presented in Table 4-1 of the *Sampling and Analysis Plan* (Volume II). The following presents a general summary of the types of sampling and testing activities to be conducted.

Soil gas samples will be collected from shallow soils to determine the presence of VOCs in the vadose zone. Results of soil gas sampling will be used to help define the extent of fuel-related contamination associated with leaking underground storage tanks, fuel spills, groundwater plumes, or abandoned pipelines.

Seep samples will be collected from fluid emanating from seeps or springs along Meandering Road Creek. This method will be used to determine if upper zone contaminants are entering the surface water pathway. Refer to Sections 3.3.18.6.3 and Appendix A6.13 of the *Sampling and Analysis Plan* for additional information.

Lake Worth sediment samples will be collected with a stainless-steel barrel auger from a depth of two feet below the lake bottom surface. Grab samples from 1-foot intervals will be collected immediately for VOC analysis. The remainder of the sample material from each 1-foot interval will be composited and analyzed for semi-VOCs, oil and grease, total petroleum hydrocarbons, and metals. Any sample collected in the vicinity of the NARF area will be analyzed for radionuclides by gamma spectroscopy and alpha spectrometry. Refer to Section 3.3.18.1.3 and Appendix A5.1 of the *Sampling and Analysis Plan* for additional information.

Air sampling will be conducted in accordance with the procedures contained in Appendix A8.1 of the *Sampling and Analysis Plan* to measure the suspended particulates in the air for a given amount of time. Results of air sampling will be used to determine compliance with ambient air quality standards and occupational health monitoring and particulate studies.

During drilling activities, soil samples will be collected at selected intervals. Samples will be collected with split-tube drive samplers during hollow-stem auger drilling or wire-line core samplers during rotary drilling. Refer to Section 4.2.2 and Appendix A of the *Sampling and Analysis Plan*. Samples will be analyzed for VOCs, semi-VOCs, metals, total petroleum hydrocarbons, and oil and grease using EPA methods shown in Tables 4-2 and 5-1 of the *Sampling and Analysis Plan*. Additionally, laboratory tests will be performed on selected Paluxy core samples to determine the hydraulic characteristics.

Groundwater samples will be taken from some boreholes drilled for the collection of subsurface soil samples as indicated in Appendix A5 of the *Sampling and Analysis Plan*. This procedure is intended as a reconnaissance method to quickly determine the need for further, more accurate, sampling efforts.

Initial groundwater sampling of newly constructed monitor wells will be performed following well development. A second water sample will be collected from each well approximately one month after the initial sampling. A third water sample may be collected from each well approximately one month after the second sampling round if necessary.

Surface water samples will be collected from Meandering Road Creek, from seeps adjacent to the creek, and Lake Worth. Surface water samples will be analyzed for VOCs, semi-VOCs, total metals, and oil and grease.

6.5.2 <u>Soil Gas Sampling</u>

6.5.2.1 Soil Gas Sample Collection

Shallow soil gas sampling will be used as a reconnaissance tool to characterize the distribution of VOCs in the subsurface in selected locations. Shallow soil gas samples will be collected at grid locations throughout the study areas. Shallow soil gas samples will be collected at depths less than 10 feet below land surface (bls) by driving steel sampling probes into the ground and evacuating them with a sampling pump.

The following section outlines the general procedures which will be used during soil gas sample collection:

- Record the following information in a field notebook each time a soil gas sample is collected:
    - sample location/identifier;
    - depth at which sample was collected;
    - date and time sample was collected;
    - analyses performed;
    - project number;
    - sampler's initials;

- any other pertinent information, including any difficulties in sampling or unusual occurrences.

■ Place an expendable sampling point on the bottom of the soil gas sampling probe.

■ Insert the probe into the soil using a hydraulic or manual pushing mechanism. A 2-inch diameter access hole is required through any paved surface.

■ Connect a sampling port to the top of the soil gas probe.

■ Connect Teflon® tubing from the port to a sorbent tube.

■ Connect a vacuum pump onto the other end of the sorbent tube, and purge a minimum of one probe volume.

■ At the Fuel Saturation Areas, a calibrated Photovac TIP will be connected to the sample probe and a measurement taken and recorded. Following the TIP measurement, a hand vacuum pump and a specific indicating detector (Dräger tube) sensitive to petroleum hydrocarbons will be attached. Following these measurements, at approximately ten percent of the locations, a sorbent tube will be collected and sent to an analytical laboratory for VOC analysis.

■ For the Assembly Building/Parts Plant perimeter soil gas survey, TIP measurements will be taken at each location followed by the collection of a sorbent tube which will be sent to an analytical laboratory for VOC analysis.

■ Collect a duplicate sample after every 10 samples.

■ Collect an equipment blank after every 10 samples.

6.5.2.2 Equipment Decontamination and Waste Disposal Procedures

The following equipment decontamination and disposal procedures will be used during and after soil gas sampling activities:

■ Probes will be cleaned using laboratory soap, tap water rinse, and de-ionized (DI) water rinse. They will then be air dried and vented with ultra-pure zero air prior to sampling.

■ Sample probes from locations with hydrocarbon contamination will also undergo a methanol rinse before the DI rinse and allowed to air dry for 24 hours.

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6.5.3 Soil and Core Sampling

Soil samples will be collected from selected intervals in soil borings and monitoring well borings. For borings drilled by hollow-stem auger methods, soil samples will be collected using a stainless-steel split-tube sampler driven ahead of the hollow-stem auger. The split-tube sampler will have a 3-inch outside diameter (OD) to provide sufficient sample material for multiple analyses.

Core samples will be collected during drilling by rotary coring methods. Core samples will be collected by using a diamond bit core barrel.

The following general procedure will be used during soil sample collection:

- Attach a precleaned stainless-steel split-tube sampler to the center rod of the auger rig and lower the sampler to the top of the interval to be sampled. Drive the sampler into the formation to the desired sample depth or to a depth of refusal. Number of hammer "blows" for each six inches of sampler penetration will be recorded.

- After the desired sample depth is reached, retrieve the sampler, remove the ends and carefully separate the split-tube sampler, exposing the sample material. The sample will be screened with a photoionization detector (Hnu, TIP, or SIP) immediately upon opening the sampler. Sections of the sample to be analyzed for VOCs will be removed and placed in sample containers immediately. Discard the top portion (slough) in an appropriate container. Place the remaining sample in a stainless-steel or aluminum mixing bowl or bucket and homogenize prior to bottling to provide a composite sample of the sampling interval.

- Place the sample in precleaned sample bottles, label, place in ziplock plastic bags, and store as specified in Table 5-1 of the *Sampling and Analysis Plan* (Volume II),

- Record the following information in a field logbook each time a soil or core sample is collected:

  - sample location/identifier;
  - depth of collection;
  - date and time of collection;
  - photoionization detector readings if above background;
  - analyses to be performed;
  - lithologic description of sample or core;
  - any other pertinent information that might affect data interpretation.

One soil sample of every 10 samples will be designated and collected for duplicate analysis.

6.5.3.1 Equipment Decontamination and Waste Disposal Procedures

Prior to collection of each soil sample, the sampling equipment will be washed with a non-phosphate detergent, followed by a tap water rinse, a methanol rinse, and a final distilled water rinse. After cleaning, the split-barrel sampler will be wrapped in plastic or stored in plastic bags until next use. Excess soil and decontamination fluids will be contained and properly disposed of by the responsible on-base group.

For drilling wastes, the drilling contractor will provide Department of Transportation (DOT) approved 55-gallon drums or other approved containers with lids, rings, and seals. The drums will be clearly marked with the monitoring well or soil boring identification number and the type and estimated quantity of waste (i.e. VOC contaminated auger cuttings). The drums will be stored on pallets in a secure area pending sampling and ultimate disposal.

For borings that exhibit elevated concentrations of contaminants, a sample will be collected from the corresponding barrel cuttings and analyzed for TCLP metals.

Purge water will be placed in drums or a tank truck and will be disposed of by the site contractor.

6.5.4 <u>Lithologic Logging</u>

During soil boring drilling, a complete log of conditions encountered during drilling will be maintained. The log will include lithologic and hydrogeologic descriptions along with notations on drilling conditions. The on-site hydrogeologist will be responsible for recording the following information:

- Description of soil samples, including:
  - depth interval;
  - color or staining;
  - moisture content (if applicable);
  - grain size distribution, angularity, density and consolidation;
  - additional descriptive comments, such as degree of cementation;
  - organic vapor measurement reading.
- Notation of drilling conditions.

6.5.5 Groundwater Sampling

Groundwater samples will be collected from monitoring wells by using submersible pumps, positive displacement pumps, or by bailing. Three to five bore volumes of water will be evacuated from the monitoring well before sampling. The temperature, pH, and conductivity will be measured to ensure that these parameters have stabilized prior to sampling. On 20 percent of the samples, Eh, dissolved oxygen, and alkalinity will be measured at the time of sampling.

Groundwater samples for Quality Control (QC), which include field duplicates, trip blanks, equipment blanks, and field blanks, will be collected during the sampling event. Field duplicates will consist of the filling of two identical containers from the same monitoring well during a sampling event. The trip blanks will consist of organic-free water placed in a container by field personnel for each sample shipment containing water samples to be analyzed for VOCs. Field blanks will be prepared at the sampling location by field personnel using organic-free water to help identify any possible contamination associated with sample collection and transport activities. Equipment blanks will be prepared using organic-free water to help identify any possible contamination associated with the sampling equipment. Locations for QC sample collection will be determined prior to the start of sampling.

The following general procedures will be used to collect groundwater samples:

- Determine the diameter of the well and calculate the volume of water to be removed prior to sampling.

- Measure the depth to water.

- Evacuate the well until three to five bore volumes have been removed and the field parameters pH, conductivity, and temperature have stabilized.

- Record the following information on the field data sheet:

    - static depth to groundwater;
    - time that pumping or bailing begins;
    - time of sample collection;
    - number and types of containers used and analyses to be performed;
    - field water quality parameters at time of sampling;
    - discharge rate or total gallons removed;
    - time that pumping or bailing stops;
    - pumping water level, if possible.

- Collect a water sample in an appropriate precleaned sample container from the discharge at the well head or from a bailed sample.

- Label sample bottles immediately after sampling.

- When sampling for VOCs, make sure the 40-ml glass sample vials have no headspace. To avoid aeration, the glass vial should be held at an angle so that the stream of water flows down the side. Add concentrated HCl to the vial before sampling to obtain a pH <2 to preserve sample. Fill the vial until it overflows to eliminate any air bubbles and replace the Teflon[R]-lined cap.

- Turn the vial upside down and tap it to check for air bubbles. If there is any headspace, refill the vial and check for air bubbles again. Repeat until a sample without headspace has been collected. Two vials will be collected for VOC analyses from each well sampled.

- Collect samples for semi-volatile organics, anions, metals, total petroleum hydrocarbons, and oil and grease in containers specified and properly preserve according to Table 5-1 of the *Sampling and Analysis Plan*.

- Prepare one field duplicate for every set of 10 samples collected for each analytical method, excluding common ions.

- Prepare a minimum of two field blanks of laboratory-prepared organic-free water for VOC analysis per sampling event. The blank will be prepared at the sampling site.

- Prepare one equipment blank of laboratory-prepared organic-free water for each analytical method for every 10 samples collected.

- Record all pertinent data concerning each sample on the field data sheet.

- Prepare chain-of-custody documentation at the end of each sampling event.

- Package, store, and transport samples to the laboratory at the end of each sampling day.

Groundwater samples collected from monitor wells will be analyzed for the following groups of water quality parameters:

- metals and inorganics;
- volatile organic compounds;
- semi-volatile organic compounds;
- total petroleum hydrocarbons;
- oil and grease.

These groups were selected based on historical groundwater quality data obtained at AFP 4.

6.5.5.1 Equipment Decontamination and Waste Disposal Procedures

Groundwater discharged during monitoring well purging and sample collection will be contained and disposed of in an appropriate manner. The appropriate method of disposal will be determined from analytical results obtained from the groundwater samples.

Sampling equipment which comes into contact with potentially contaminated water will be decontaminated after each sampling event. Outside surfaces will be wiped off with paper towels or clean rags. The surfaces will then be scrubbed with soapy water followed by a clean potable water rinse, a methanol rinse, and deionized or distilled water rinse.

For pumps, hoses, or other equipment that may become contaminated internally, soapy water will be placed in buckets or barrels and the soapy water will be pumped through the system. The same procedure will be followed using clean potable water to clear the system of the soapy rinse. If the equipment is to be used for the collection of VOCs, a small amount of methanol will be pumped through the system followed by a deionized or distilled water rinse. All decontamination fluids will be collected and disposed of in an appropriate manner.

6.5.5.2 Measurements of pH, Conductivity, and Temperature

The field parameters pH, conductivity, and temperature will be measured in groundwater at each sampling location by using a pH meter, conductivity meter, and field thermometer, respectively. The probes for each type of measurement will be thoroughly rinsed with distilled water prior to use. The pH meter will be recalibrated at specified intervals throughout the sampling day using pH 4, 7, and 10 buffer solutions to bracket the expected range of pH in groundwater samples at AFP 4. The conductivity meters will be calibrated daily using check solutions consisting of 0.001N, 0.01N, and 0.1N KCl to calibrate the instrument in the full range of the expected sample conductance.

Measurements will be made directly at the well discharge point using a flow-through sample bath cell. Field parameters will be measured using the following procedures:

- Compare pH, conductivity, and temperature to previous data, when possible, and note variations. If variations greater than 10 percent exist that cannot be accounted for by changes in field conditions and/or water quality stabilization, the measuring instrument will be recalibrated and the measurements repeated. If large discrepancies from previous measurements exist, an alternate measuring device such as another thermometer, pH meter, or conductivity meter will be used to verify the data.

- Record all field measurements including groundwater temperature, pH, and conductivity in a field notebook along with the following information:

  - sample location/identifier;
  - date and time sample was collected;
  - sampler's initials.

- Decontaminate flow-through cell and measurement probe with distilled water after each sampling event.

6.5.5.3 Well Discharge Measurements

Accurate discharge measurements from groundwater monitoring wells are required to ensure that sufficient groundwater volumes are purged from the well prior to sample collection and to control discharge variations during aquifer testing.

During groundwater sampling and aquifer testing, the rate of discharge from those wells will be measured using the following technique:

- Prepare a 5- to 10-gallon container and a stopwatch for use during discharge measurements.

- Direct discharge from the well into the container and start the stopwatch.

- Turn off the stop watch when the container is full. This will give the time, in minutes and seconds, that it took to discharge that volume of water from the well.

- Convert the rate of discharge to gallons-per-minute (GPM). Record the time of measurement, the discharge rate, and well head conditions that might affect the discharge measurement on the appropriate form.

- Repeat discharge measurement periodically. If significant variations exist between the replicate measurements, additional measurements will be taken. The most accurate measurement(s) will be determined and recorded on the appropriate form.

6.5.6 Surface Water Collection

Surface water sampling locations will include streams, seeps, and a lake. Samples will be collected from surface water sampling locations using grab techniques. Results of analyses will be used to determine the chemical characteristics of the surface water source. Surface water samples will be collected, preserved, transported, and documented in a manner similar to that used for samples collected from a groundwater source.

Information to be used to select the most representative sampling locations are as follows:

- Accessibility to all potential sampling locations
- Stream flow records
- Sources of potential point and nonpoint contamination
- Mixing characteristics

Surface water samples will be collected using a simple hand grab sampling procedure. The following procedure will be used during surface water sample collection:

- Use only precleaned sample containers
- Submerse the sample container just below the surface of the water with the bottle opening pointing upstream.
- When sampling for VOCs, add HCl to the vial before immersing the container. Make sure the 40-ml glass sample vial is filled with no headspace. With the bottle still submerged, place the Teflon-lined cap on the bottle and screw on tight. Remove the bottle from the water and turn upside down, tap and check for air bubbles. If bubbles are present, repeat until no headspace is present. Collect two vials for VOC analysis at each location. Label the samples, place in ziplock bags, and store in a cooler at 4°C.
- Prepare one field duplicate sample from every set of 10 samples or fewer collected for VOC analysis. These will be sent along with the sample batch to the laboratory. The location of the duplicate sample collection will be determined prior to the sampling round.
- Record all pertinent data concerning each sample on the field data sheet. Prepare chain-of-custody documentation at the conclusion of the sampling event. Package, store, and transport the samples to the laboratory at the conclusion of each sampling day.

6.5.6.1 Equipment Decontamination and Waste Disposal

No equipment decontamination or waste disposal is required as a result of the lake and stream surface water sampling technique to be used at AFP 4. The stainless steel scoop used to sample surface seeps or springs will be decontaminated with a lab soap scrub, tap water, methanol, DI, or distilled water rinses.

6.5.7 LNAPL, DNAPL, and Water-Level Measurements

Groundwater levels will be measured to establish groundwater flow directions at AFP 4. All water levels will be recorded on standard forms. Reported data will include the depth to water in feet below the established measuring point, the initials of the person taking the measurement, the calculated water-level elevation, and any comments. Water-level measurements will be reported to the nearest ±0.01 foot.

Liquid levels (LNAPLs, water, and DNAPLs) will be measured using an interface probe. The interface probe will have an accuracy of 0.01 foot. Submersible pumps will be removed from those existing wells from which water samples will be collected.

The following procedure will be used for measuring water levels in monitoring wells:

- Decontaminate the interface probe with distilled water. If the interface probe has come into contact with floating product, rinse with methanol followed by a distilled water rinse.

- Sound each monitoring well twice for depth to water. The variation between the two measurements must be less than ±0.01 foot.

- Record the depth to water, date, and time of measurement on the appropriate form. Examine data from previous water-level measurements taken at the well. If a large discrepancy exists between current measurements and previous measurements, repeat the measurement. If original measurements are correct, note the discrepancy on the form to assist in data interpretation.

- If possible, the total depth of the well should be measured to allow interpretation of water level versus well screen, etc. Accurately note the location of the well head measuring point for future measurements. If an accurate elevation is not available for the measuring point, a survey will be conducted to establish the elevation.

6.5.8 Aquifer Testing

Multiple-well aquifer tests (pumping tests) and single-well aquifer tests (slug tests) will be conducted at AFP4. Slug tests will be conducted to provide point measurements of hydraulic conductivity for use in designing pumping tests and in modeling groundwater flow and contaminant transport. Pumping tests will be conducted to provide more accurate measurement of transmissivities and storage coefficients that describe the hydraulic characteristics of the aquifer materials over a relatively large area.

Prior to conducting either pumping or slug tests, existing water quality data and hydrogeological data will be reviewed so as to maximize the usefulness of the hydrologic data obtained and minimize the potential for pumping contaminated groundwater.

6.5.8.1 Slug Testing

Slug tests will be conducted using the slug-withdrawal method.

The test apparatus consists of a capped, weighted bailer and an electronic pressure transducer connected to an automatic electronic data logger. Both the transducer and the bailer are lowered into the well. The transducer cable will be measured in 1-foot increments to allow proper positioning within the well.

The transducer is lowered to a position as far below the static water level as its maximum submersion rating will allow (check transducer specifications). The transducer cable is then taped to the exterior of the casing at the top of the well. The bailer is lowered into the fluid until the top is approximately 6 inches below the fluid level. The data logger is turned on and observed until the water level in the well stabilizes (data logger reading will be constant). The recording interval is set to "continuous" and the bailer is rapidly and smoothly removed from the well.

Continuous recording is maintained for the first five minutes of the test. At 5 minutes, the recording interval is set to 30 seconds; at 10 minutes, the recording interval is set to 1 minute; at 20 minutes, the recording interval is set to 2 minutes; and at 40 minutes, the recording interval is set to 5 minutes. The maximum recording interval of 10 minutes is set at 2 hours into the test and maintained until the water-level recovery rate has become negligible.

The data from each slug test will be entered into individual data files on a microcomputer. The first column of the file will be "time in seconds" and the second column will be "hydraulic head in feet." The computer program BAIL will be used to calculate the hydraulic conductivity from the slug-test data. The program plots the log of the normalized drawdown versus time. Well-conductivity is calculated using the method of Hvorslev (1951) as described in Freeze and Cherry (1979).

Alternatively, if the hydrogeologic conditions of the slug-test site do not fit the assumptions inherent in Hvorslev's method, some other appropriate method may be used.

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6.5.8.2 Pumping Test

The selection of wells for pumping tests will be made so as to maximize the usefulness of the hydrogeologic data collected and minimize the potential for pumping contaminated groundwater. Depending upon the chemical quality of the groundwater at a particular pumping test site, one of three discharge alternatives will be used. These include the following:

(1) Discharge groundwater to a surface drainage course such as a storm sewer or drainage ditch (monitor water quality using a portable field gas chromatograph to ensure effluent standards of NPDES and SPDES are met). Terminate test (or alter discharge point to one the following two categories) within specified time period if permit standards are exceeded during test. Notify permit administrators if standards are exceeded.

(2) Discharge groundwater to either General Dynamics' industrial wastewater treatment system or directly to sanitary sewer system. Obtain permission from director of local public wastewater treatment facility prior to conducting pump tests. Monitor water quality during the pump test with a portable gas chromatograph to ensure compliance with standards set by operators of General Dynamics and public treatment works. Terminate (or switch discharge to category 3, below) pumping test if standards are exceeded. Notify appropriate treatment works operators if standards are exceeded.

(3) Discharge groundwater to a portable tank. Upon completion of test, discharge contents to the air stripping unit that is currently used to treat discharge water from the French Drain.

Prior to the start of the pumping test, the static water level in each observation well and the pumping well is measured and recorded. An electronic pressure transducer is then placed in each observation well and the pumping well. The transducers are placed as far below the static water level as their maximum submersion depth rating will allow (check transducer specifications). Each transducer cable is then taped to the outside of the well casing. If available, an absolute pressure transducer will be placed in a bucket of sand and left exposed to the atmosphere to monitor barometric pressure fluctuations. If this option is not invoked, barometric pressure data must be obtained from the nearest weather station. Once installed, all pressure transducers will be connected to one or more electronic data loggers.

The pumping apparatus (either a PVC intake pipe or a submersible pump unit) is then lowered into the well. The intake pipe or pump should be placed at a depth that is greater than the pumping well drawdown determined from previous pumping-test design calculations. The intake point should also be at least three feet above the pressure transducer. The discharge line is then placed at the appropriate location, based on the selected category of discharge point above. The discharge line will be equipped with a check valve (to prevent return flow into the well after pump shutoff; such an occurrence would interfere with water level recovery data that is to be used for subsequent analysis) and a discharge control valve (gate valve or butterfly valve).

To operate the pumping test in a manner that conforms to the conditions simulated in the pumping test design work, a predetermined discharge rate must be met. If the setting for the discharge control valve needed to produce the desired discharge rate is known for the lift at which the pump will be operating, a pre-test is not needed. If this setting for the discharge control valve is not known, a short pre-test will be conducted to determine the appropriate setting of the valve for the desired discharge rate. The water level in the pumping well will then be monitored until it has returned to its original level.

Once the proper setting for the discharge control valve has been determined, the data logger is turned on and observed until all channels show an essentially constant pressure. The recording interval is then set to "continuous" and the pump is turned on to begin the pumping test. The continuous recording interval is maintained for the first 10 minutes. At 10 minutes, the recording interval is set to once per minute; at 100 minutes the recording interval is set to once per 15 minutes; at 1000 minutes, the recording interval is set to once per 30 minutes and remains at this setting for the duration of the test. Once the pumping portion of the test is completed, the pump is shut off and the recovery of the water levels is recorded using the same frequency progression as was used during the pumping phase of the test.

Discharge rates will be monitored throughout the test to allow changes to be made in the valve setting to compensate for changes in the total lift the pump is operating against. Pumping rates will be measured by timing the filling of a large known volume container. The pumping rate will be measured once every 10 minutes during the first two hours of the test. The valve will be adjusted to maintain the original discharge rate. After two hours, the pumping rate will be measured once every hour unless a slow change in drawdown in the pumping well indicates a less frequent check is appropriate.

6.5.9 LNAPL Sampling

When floating product (LNAPL) is to be sampled from monitoring wells, the depth and thickness of the product will be measured as in Section 6.5.7 of this document. Floating product will be sampled using a Teflon® bailer and analyzed using ASTM Method D-3328-78 (reapproved 1982) to identify the type(s) of product present.

7.0 SAMPLING CUSTODY PROCEDURES

7.1 SAMPLE TYPE IDENTIFICATION AND HANDLING

Sample identification and sample container handling are discussed in Section 5.0 of the *Sampling and Analysis Plan.*

7.2 SAMPLE CUSTODY AND SHIPMENT

To maintain the integrity of the samples, it will be necessary to demonstrate that the samples were kept under custody from the time they were collected to the time they were analyzed. Field samples must be stored in environmentally, or when allowable, non-environmentally controlled and locked containers or buildings when they are out of the direct control of the responsible custodian of the sample. Chain of Sample Custody records will be used to list all sample possession transfers. This document will show that the sample was in constant custody between collection and analysis. The Chain of Sample Custody record is included in the *Sampling and Analysis Plan* as Figure 6-1.

Labels used for samples taken in the field and placards for transportation will be in accordance with UNC and subcontractor approved procedures, and the U.S. Department of Transportation (DOT) Code of Federal Regulations Title 49 CFR Parts 171-179, and U.S. Environmental Protection Agency (EPA) regulations Title 40 CFR Part 263.

Criterion 8 - Identification and Control of Items and Samples, Standard Requirements for Items, of UNC Manual-101 is applicable to this element.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used to obtain data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the acceptable manufacturer's specifications. Calibration of laboratory equipment will be based on approved written procedures.

Calibration of instruments and equipment will be performed at approved intervals as specified by the manufacturer or more frequently as conditions dictate. Calibration standards used as reference standards will be traceable to the National Institute of Standards and Technology.

Requirements to calibrate tools, gauges, instruments, and other devices used that affect or evaluate the quality of activities or items are identified in the technical procedures used to obtain data.

Records of calibration, repair, or replacement will be filed and maintained by the UNC Electronics Laboratory in compliance with the procedures contained in UNC *Calibration and Control Program for Measurement and Test Equipment and Measurement Standards, UNC Manual-113, Rev. 2.*

The calibration procedures for analytical instruments will be performed as specified for the respective UNC or EPA Methods. The concentration of standards and frequency of initial and continuing calibration will be as specified by the method.

Subcontractor Laboratory

Calibration records of assigned laboratories will be filed and maintained at the respective laboratory locations where the work is performed and is subject to QA audit.

Criterion 11 - Test Control, Standard Requirements, and Criterion 12 - Control of Measuring and Test Equipment, Standard Requirements, of the UNC Manual-101 are applicable to this element.

9.0 ANALYTICAL PROCEDURES

The analytical procedures used by the UNC and subcontractor laboratory to perform the analyses required by the Work Plan are EPA or UNC specified as described in Section 5.5 of the *Sampling and Analysis Plan*, Volume II.

All personnel who perform these procedures are trained, qualified, and experienced in the methods used. Their proficiency to perform the procedures is continuously evaluated and training is provided when necessary.

Criterion 5 - Instructions, Procedures, and Drawings, Standard Requirements; Criterion 9 - Control of Processes, "Q" Related Requirements; and Criterion 11 - Test Control, Standard Requirements, of UNC Manual-101 are applicable to define and implement the requirements of this element.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

Documentation will be provided to fully interpret the data, as well as protect it against scientific challenges. Field variance logs, internal review records, field and laboratory records of tests and analyses, field logs, Chain of Sample Custody records, reports, and computer files and codes, programs, and printouts will be designed to eliminate errors during data entry and reduction. Calculation steps are described in the technical and analytical procedures and software listings. Routine data-transfer and entry-validation checks are performed.

10.1 DATA VALIDATION

Each computer program establishes technically sound, documented data-validation criteria that serves to accept or reject data in a uniform and consistent manner. Data validation includes visual checks for proper identification and transmittal errors. In addition, data that do not meet the acceptance criteria of Section 5.1.1.2 or the target reporting limits of Section 10.4 for each site at U.S. Air Force Plant 4 will not be considered as reportable data.

10.2 DATA ACCEPTANCE

The criteria for accepting or rejecting analytical data depend on such factors as type of analysis, concentration found, program requirements, and sample type. Each UNC analysis is evaluated by one or more of the following: calibration to known range of analytes, standard additions to determine matrix interference, instrument response factor, tracers, replicate analysis, control samples, or cation/anion balance.

10.3 COMPUTER MODELS

Computer programs used for modeling hydrological systems will be verified. Criterion 3 - Design Control, Computer Software Requirements for Standard Requirements, and Criterion 11 - Test Control, Standard Requirements, of UNC Manual-101 are applied internally to UNC for this element.

10.4 TARGET REPORTING LIMITS

Reporting limits for volatile and semi-volatile organics are listed in EPA SW-846 (Third Edition) and in the *Sampling and Analysis Plan*, Table 6-1. Reporting limits for inorganics, priority pollutant metals, TPH, oil and grease, TCLP metals, and radioisotopes are specified in the *Sampling and Analysis Plan*, Table 6-1.

10.5 REPORTS

The UNC Geotech Analytical Laboratory and/or the subcontract laboratory will be required to submit a data report that includes the individual analytical results supported by the following information to allow the data reviewer to evaluate the quality of the data:

- Sample Description (I.D. number, sample type, date sampled, date received by laboratory);
- Analytical Method(s);
- Reporting Limits;
- Quality Assurance/Quality Control (QA/QC) Results, Including an Assessment of Accuracy and Precision;
- Name of Analyst and Reviewer.

Complete CLP/RAS data packages will be required for those activities designated as Level IV in Table 3-1 of the *Sampling and Analysis Plan,* Volume II.

Although a complete CLP/RAS data package is not normally required for those activities designated as Level III in Table 3-1 of the *Sampling and Analysis Plan,* Volume II, UNC will require that the laboratory make available for review at the laboratory all original data worksheets, chain-of-custody records, hard copies of chromatograms or spectra, and other items normally required for CLP/RAS. These will be reviewed for accuracy and completeness during a Performance Audit of the laboratory by the UNC Geotech Quality Assurance Coordinator. Any deficiencies noted will be corrected prior to acceptance of the data.

11.0 INTERNAL QUALITY-CONTROL CHECKS AND FREQUENCY

11.1 LABORATORY QUALITY CONTROL

Internal quality control checks and their frequency are presented in Section 6.5 and Table 4-3, respectively, of the *Sampling and Analysis Plan (Volume II)*.

11.1.1 Quality Control Batching

Quality control batching is specified in Table 4-3 of the *Sampling and Analysis Plan (Volume II)*. Typically, for every analytical batch of 20 or fewer samples of similar matrix to be analyzed, there will be one check standard, one blank sample, one spiked blank sample, and one duplicate (replicate) sample. Specific QA samples required by a method (e.g., matrix spike and matrix spike duplicate) are analyzed at the frequency specified by the method.

11.1.2 Standards and Surrogates

Standard and surrogate compounds are identified in the EPA method for each analyses for which they are used. All standard and surrogate compounds are checked by the method of mass spectrometry for correct identification and gas chromatography for degree of purity. When the compounds pass the identity and purity tests, they are certified for use in standard and surrogate solutions. Concentrations of the solutions are checked for accuracy before release for laboratory use.

11.1.3 Blanks, Spiked Blanks, and Matrix Spikes

Analysis of blank samples verifies that the analytical method does not introduce contaminants. Blank water is analyzed to ensure it is free of contaminants. The spike blank is generated by addition of standard solutions to the blank water. The matrix spike is generated by addition of standard solutions to a randomly selected field sample.

11.2 FIELD QUALITY ASSURANCE

For each sampling event, a minimum of two trip blanks and two field blanks will be analyzed for volatile organic compounds. These blanks will be analyzed to provide a check on sample contamination originating from sample bottle preparation, shipping, and from the site conditions. The blanks will be analyzed for volatile organic compounds by the same procedure used to analyze the samples they accompany. At least one equipment blank and one field duplicate will be collected for every 10 samples to evaluate sampling equipment decontamination procedures and to check on repeatability, respectively.

11.3 DATA SHEETS

Data sheets, which report blank and spiked sample checks performed, will be provided and will indicate when a quality-control check was performed. Criterion 11-Test Control, Standard Requirements, of UNC Manual-101 is applicable to this element.

11.4 UNC SUBCONTRACT LABORATORY

The UNC subcontractor laboratory performing analyses for this project will be required to use EPA SW-846 (Third Edition, November 1986) methodologies.

12.0 PERFORMANCE AND SYSTEM AUDITS

12.1 SCOPE

Performance and System Audits of field and laboratory activities will be performed during the project to ensure the quality of data. The audits will cover all systems and procedures identified for each work task, and will be performed during project task activities.

The System Audit will evaluate the adequacy of the systems (procedures, equipment, and personnel) to collect and provide data of known and acceptable quality. The System Audit will be performed early in project activity.

The Performance Audit (surveillance) will be performed later in the project and will verify that the procedures identified for sampling and analyses tasks are being implemented.

12.2 PERSONNEL

Personnel assigned to perform the audits will be experienced Quality Assurance personnel and qualified technical individuals. The Quality Assurance personnel will lead the audits and the technical personnel will assist.

Criterion 10 - Inspections and Surveillances, Standard and "Q" Related Requirements, and Criterion 18 - Audits, Standard Requirements, of UNC Manual-101 are applicable to this element. In addition, UNC QAI 10.1, QA Surveillances, and QAI 18.1, Performance and Reporting of Audits, are followed to implement the criterion of this element.

13.0 PREVENTIVE MAINTENANCE PROCEDURES

Equipment, instruments, tools, gauges, and other items required to perform work tasks both in the field and the laboratory that require preventive maintenance will be serviced in accordance with the manufacturer's recommendations and instructions.

Technical procedures will identify the manufacturer's instructions for purging and cleaning the equipment prior to, during, and after each use.

The laboratory will maintain a maintenance schedule for servicing critical items in order to minimize the downtime of measurement systems and to arrange for service as required.

Preventive maintenance will be performed by the UNC Electronics Laboratory on calibrated measuring and test equipment as a part of routine calibration tasks.

A list of critical spare parts will be ordered from the manufacturer. These spare parts will be stored for availability and use in order to reduce downtime.

14.0 ASSESSMENT OF DATA QUALITY

The Project Manager will assign qualified personnel to perform data quality assessments in accordance with internal procedures.

Field and laboratory analytical data will be routinely reviewed and assessed to ensure that the data quality objectives listed in Table 3-1 of the *Sampling and Analysis Plan,* Volume II, have been met.

Data assessment procedures used to evaluate accuracy, precision, completeness, representativeness, and comparability are described below.

- Accuracy is the nearness of a measurement or the mean (x) of a set of measurements to the true value. Accuracy is assessed by means of reference samples and percent recoveries.

- Precision is the agreement between a set of replicate measurements without assumption or knowledge of the true value. Precision is assessed by means of duplicate/replicate sample analysis.

- Completeness is the measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Sample completeness will be evaluated after results from each sampling round are returned. The target for completeness is 90 percent.

- Representativeness is a term which represents the degree to which a measurement of a subject of a population, e.g., a specific sample from a specific location within a site, is characteristic of the population as a whole.

- Comparability of data is ensured through the use of standard analytical methods or methods with demonstrable equivalency in terms of method performance criteria and equivalent reported units.

15.0 NONCONFORMANCE AND CORRECTIVE ACTION PROCEDURES

15.1 NONCONFORMANCE REPORTING

A nonconformance and corrective action program will be provided to discern, identify, and correct errors and defects at any point in the project implementation process. The data-validation activities and Performance and Systems Audits may identify some of the key errors and deficiencies. Deficient data will be tallied, documentation of the results of corrective actions will be maintained, and causes will be eliminated prior to continuing work.

A nonconformance is defined as a malfunction, failure, deficiency, or deviation that renders the quality of an item as unacceptable or indeterminate. The nonconformance program pertains to all field equipment, measurements, and activities associated with the collection of data needed to fulfill project requirements. Any UNC Geotech employee can originate a Nonconformance Report (Figure 15-1). Use of the report should be restricted to items that make data unacceptable. Minor variations or deviations for any activity will be recorded on the Field Variance Log (see Figure 6-2) by the person noting the problem. The information from the Variance report will be used during data evaluation to assess the results and validity of the data.

The Nonconformance Report will be used to document results which are out of control of established quality-control limits due to equipment malfunctions, equipment failure, operator error, or other conditions that adversely affect data quality. The originator of a Nonconformance Report will describe the findings on the form (Figure 15-1) and will then notify the Field Team Leader, Project Manager, or Quality Assurance Coordinator. All Nonconformance Reports will be reviewed by the Quality Assurance Coordinator, who will then coordinate disposition of the nonconformance. The equipment, item, or activity may be temporarily stopped while the nonconformance is being investigated. If the nonconformance does not significantly affect the technical quality or use of the work, the work may continue pending resolution of the nonconformance.

Data generated by analytical laboratories for UNC Geotech will be monitored and reviewed by the laboratory and the Project Manager for conformance with established QA/QC requirements. If data fall outside accepted limits, the out-of-control condition will be recorded and reported by the laboratory using their internal Standard Operating Procedures (SOPs) for nonconformance reporting. The laboratory will notify the UNC Geotech Quality Assurance Coordinator or Project Manager of reportable nonconformances, indicate the source of the nonconformance, and report any proposed or initiated corrective action.

UNC Geotech | **Nonconformance Report** | 13. NCR No.: ____ Page 1 of ____

1. Purchase Order Number:	2. Title or Subject	3. Document No., Title, or Revision
4. Project, Program, or Activity	5. Supplier Name/Address	6. Job No. or ID No.

7. Item | 8. Description of Nonconformance

9. Probable Cause of Condition

10. Recommended Action to Correct

11. Originator's Signature or Name — Date

12. QA Coordinator Signature — Date

14. Disposition/Justification Instructions

15. Design Document Change Required?	16. Reportable As an Event?	17. Corrective Action Required?
☐ Yes (Document No. ____________)	☐ Yes (Report No. ____________)	☐ Yes (specify ____________)
☐ No	☐ No	☐ Yes (CAR No. ____________)
		☐ No

Approvals

18. Technical Representative — Date	Signature — Date	Signature — Date
QA Coordinator — Date	Signature — Date	Signature — Date

Close Out

19. ☐ Disposition Completed As Directed

☐ Other (Specify):

____
Originator or QA Coordinator

Distribution

20. Action — Information Copies

UNC 1586
Rev. 1/87

Figure 15-1. Example of a Nonconformance Report

(continuation sheet)

Instructions for Completion of Nonconformance Report

A Nonconformance Report can be issued by anyone. The individual (originator) identifying the nonconforming condition will enter, or provide to have entered, the following information to complete the portion of the Nonconformance Report within the heavy border (items 1 through 11).

1. The Purchase Order Number or Contract Number of the affected item or service, if applicable.
2. A brief descriptive title or name of the affected item or activity.
3. The requirements document number, title, etc., and revision.
4. The projects, program, or activity affected by or responsible for the item or activity.
5. The supplier or subcontractor name and address (when applicable).
6. A unique identification number for items, or the job number or other reference for activities.
7. Item (line) number of the condition when more than one affects a specific item or activity.
8. Description of the nonconformance condition in a "Required" and "Is" format (for an example see the UNC Geotech Quality Assurance Manual (UNC Manual-101), QAI 15.1, page 15.1-2).
9. When available, enter the most probable cause of the nonconforming condition.
10. When appropriate, enter the originator's recommendation of actions to correct the specific and related conditions.
11. The originator's signature (or printed name when prepared by the QA Coordinator) and the date.

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Figure 15-1 (continued). Example of a Nonconformance Report

15.2 CORRECTIVE ACTION

If corrective action is required to correct problems associated with variance or nonconformance items, the proposed corrective action will be approved by the Field Team Leader or Project Manager in the case of variances. The corrective action(s), once initiated, will be tracked and reviewed by the Quality Assurance Coordinator for evidence that the data or activity are within the established control limits. Failure to demonstrate that the corrective action is effective will result in work stoppage until the problem is corrected. In the case of laboratory data, the laboratory may be requested, when possible, to rerun the analyses in question until acceptable data are received.

16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Formal reports will be issued to the project sponsor by the UNC Project Manager through the U.S. Department of Energy (DOE) to identify progress in the execution of the planned activities. The reports include an assessment of the status of the project activities in relation to the quality and acceptance of the data. The reports will also address results of ongoing performance and system audits, data-quality assessments, and significant Quality Assurance problems with proposed corrective action implementation.

APPENDIX A

GLOSSARY OF TERMS

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AUDIT--A systematic check to determine the quality of operation of some function or activity. Audits may be of two basic types: (1) Performance Audits in which quantitative data are independently obtained for comparison with routinely obtained data in a measurement system, or (2) System Audits of a qualitative nature that consist of an on-site review of a laboratory's quality-assurance system and physical facilities for sampling, calibration, and measurement.

DATA QUALITY--The totality of features and characteristics of data that bears on its ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability. These characteristics are defined as follows:

- Accuracy--The degree of agreement of a measurement (or an average of measurements of the same thing), X, with an accepted reference or true value, T, or the difference as a percentage of the reference or true value, 100 (X - T)/T, and sometimes expressed as a ratio, X/T. Accuracy is a measure of the bias in a system.

- Precision--A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist, depending upon the "prescribed similar conditions."

- Completeness--A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.

- Representativeness--Expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

- Comparability--Expresses the confidence with which one data set can be compared to another.

DATA VALIDATION--A systematic process for reviewing a body of data against a set of criteria to provide assurance that the data are adequate for their intended use. Data validation consists of data editing, screening, checking, auditing, verification, certification, and review.

ENVIRONMENTALLY RELATED MEASUREMENTS--A term used to describe essentially all field and laboratory investigations that generate data involving (1) the measurement of chemical, physical, or biological parameters in the environment; (2) the determination of the presence or absence of criteria or priority pollutants in waste streams; (3) assessment of health and ecological effect studies; (4) conduct of clinical and epidemiological investigations; (5) performance of engineering and process evaluation; (6) study of laboratory simulation of environmental events; and (7) study or measurement on pollutant transport and fate, including diffusion models.

PERFORMANCE AUDITS--Procedures used to determine quantitatively the accuracy of the total measurement system or component parts thereof.

QUALITY ASSURANCE (QA)--The total integrated program for assuring the reliability of monitoring and measurement data. A system for integrating the quality planning, quality assessment, and quality improvement efforts to meet user requirements.

QUALITY ASSURANCE PROGRAM PLAN (QAPP)--A document identifying the requirements that have been selected from the UNC Geotech Quality Assurance Program, along with customer's QA requirements that are to be imposed on a particular program. This document includes the management policies, objectives, principles, and general procedures by which an agency or laboratory outlines how it is to produce data of known and acceptable quality.

QUALITY CONTROL--Those quality actions necessary to control and verify the features and characteristics prescribed in standards of performance in the monitoring and measurement process.

STANDARD OPERATING PROCEDURE--A written document that details an operation, analysis, or action whose mechanisms are thoroughly prescribed and commonly accepted as the method for performing certain routine or repetitive tasks.

APPENDIX B

QUALITY ASSURANCE MANUAL
(UNC Manual-101)

(TO BE PROVIDED UPON REQUEST)

APPENDIX C

PROGRAM DIRECTIVES PROCEDURE

SCOPE

This procedure provides details for the use, generation, approval, and issuance of Program Directives.

APPLICATION

The Program Directive is a mechanism for Program Management to formally notify Support Organizations of the need for, and to authorize additions or changes to their procedures (Desk Instructions) for work in support of the program. The Program Directive system provides a mechanism for tailoring Support Organization procedures to the needs of the program without imposing permanent changes to the procedures. The use of Program Directives by the Support Organizations is not intended to allow rapid changes to their internal procedures.

Program Directives will be directed to the individual Support Organizations and will identify changes or additions to a specific procedure within a specific UNC Manual or Project Planning Document needed to fit the project of program needs.

RESPONSIBILITIES

Program or Project Managers will be responsible for the implementation of this procedure for their respective projects. They are responsible for assuring that Program Directives are properly prepared, approved, and issued. Additionally, they are responsible for maintaining logs of Program Directives applicable to their programs or projects and for assuring the copies of the Program Directives are included in Program or individual Project records.

INSTRUCTIONS

Initiation of Program Directives

Individuals recognizing a need for a Program Directive are to notify the Program or Project Manager of the need. With the approval of the appropriate manager, they will generate a draft Program Directive following the format identified in this instruction.

Program Directives will be directed to the individual UNC Geotech support organization and will specifically identify the changes or additions to a specific procedure within a manual or planning document. Changes to more than one procedure will require separate Program Directives for each procedure.

The directives are to be written as if they are revisions to the procedure which could be inserted by "cut and pasting". The changes are to include the specific wording and affected pages and paragraphs (i.e. Page 6, Paragraph 4.3.3. Delete value as a permanent change for all work, the organization may incorporate the Program Directive into its internal procedures. If it is project-specific and not applicable to the entire program, it may be deleted after a specified time.

APPROVAL OF PROGRAM DIRECTIVE

Drafts of Program Directives will be provided for review and comment by all impacted organizations within a Program. Program Directives will require, as a minimum, approval by the manager of the implementing organization and the Program or Project Manager. The appropriate manager will approve the Program Directive for issue and implementation when all comments have been resolved. Program Directives must be approved prior to use.

Program Directives will be issued with a specific life (i.e. 90 calender days) or for the life of a specific Program or Project.

The approved directive will be identified to the Program, will be numbered sequentially (i.e. AFP 4 Program Directive 1, 2, etc.) and entered in a log listing the Program Directive Number and date of expiration (if not permanent).

A record copy of the Program Directive will be maintained for inclusion into the Program or Project records.

ISSUANCE OF PROGRAM DIRECTIVES

Approved Program Directives will be issued to the affect UNC support organization for implementation and to all other supporting organizations for their information. The implementing organization will issue copies of the Program Directive to all holders of the affected procedure for inclusion with the procedure.

When appropriate, training on the contents of the directive should be considered.

PROGRAM DIRECTIVE FORMAT

As a minimum, Program Directives will include the following information:

- Program Directive Number and Program or Project Identification;

- Approval signatures of the Program or Project Manager and the implementing organization manager. In addition, major changes in procedure may require the approval of the Program sponsor or lead regulatory agency (i.e. EPA Region VI);
- Date of approval;
- Date of implementation;
- Expiration date;
- Manual or specific procedure affected, including revision number;
- The specific changes, deletions, or additions made.

APPENDIX D

SAMPLING MATRIX ACCURACY LIMITS

1.0 INORGANICS

Percent recoveries of spiked analytes

Sample Matrix	% Recovery
Dissolved Metals (Water)	90-110
Metals (Total metals--water)	90-110
Anions and Common Ions (Water)	90-110

2.0 VOLATILE ORGANIC COMPOUNDS

2.1 Percent recoveries of spiked analytes using EPA Method 8240.

Analytical Parameter	% Recovery Range
Benzene	37-151
Bromodichloromethane	35-155
Bromoform	45-169
Bromomethane	D-242
Carbon tetrachloride	70-140
Chlorobenzene	37-160
2-Chloroethylvinyl ether	D-305
Chloroform	51-138
Chloromethane	D-273
Dibromochloromethane	53-149
1,2-Dichlorobenzene	18-190
1,3-Dichlorobenzene	59-156
1,4-Dichlorobenzene	18-190
1,1-Dichloroethane	59-155
1,2-Dichloroethane	49-155
1,1-Dichloroethene	D-234
trans-1,2-Dichloroethene	54-156
1,2-Dichloropropane	D-210
cis-1,3-Dichloropropene	D-227
trans-1,3-Dichloropropene	17-183
Ethyl benzene	37-162
Methylene chloride	D-221
1,1,2,2-Tetrachloroethane	46-157
Tetrachloroethene	64-148
Toluene	47-150

2.1 (Continuation)

1,1,1-Trichloroethane	52-162
1,1,2-Trichloroethane	52-150
Trichloroethene	71-157
Trichlorofluoromethane	17-181
Vinyl chloride	D-251

D = Detected; result must be greater than zero.

2.2 Percent recoveries of spiked analytes using EPA Method 8260. Percent recovery is listed in two columns. Column 1 indicates percent recovery determined with a wide bore capillary column. Column 2 indicates percent recovery determined with a narrow bore capillary column. Results are comparable if the calculated percent relative standard deviation (RSD) does not exceed 2.6 times the single laboratory RSD or 20%, whichever is greater and the mean recovery lies within the interval R ± 3S or R ± 30%, whichever is greater.

Analytical Parameter	Column 1 % Recovery	Column 2 % Recovery
Benzene	97	99
Bromobenzene	100	97
Bromochloromethane	90	97
Bromodichloromethane	95	100
Bromoform	101	101
Bromomethane	95	99
n-Butylbenzene	100	94
sec-Butylbenzene	100	110
tert-Butylbenzene	102	110
Carbon tetrachloride	84	108
Chlorobenzene	98	91
Chloroethane	89	100
Chloroform	90	105
Chloromethane	93	101
2-Chlorotoluene	90	99
4-Chlorotoluene	99	96
1,2-Dibromo-3-Chloropropane	83	92
Dibromochloromethane	92	99
1,2-Dibromoethane	102	97
Dibromomethane	100	93
1,2-Dichlorobenzene	93	97
1,3-Dichlorobenzene	99	101
1,4-Dichlorobenzene	103	106

2.2 (Continuation)

Analytical Parameter	Column 1 % Recovery	Column 2 % Recovery
Dichlorodifluoromethane	90	99
1,1-Dichlorobenzene	96	98
1,2-Dichlorobenzene	95	100
1,1-Dichloroethene	94	95
cis-1,2-Dichloroethene	101	100
trans-1,2-Dichloroethene	93	98
1,2-Dichloropropane	97	96
1,3-Dichloropropane	96	99
2,2-Dichloropropane	86	99
1,1-Dichloropropene	98	102
Ethylbenzene	99	99
Hexachlorobutadiene	100	100
Isopropylbenzene	101	102
p-Isopropyltoluene	99	113
Methylene chloride	95	97
Naphthalene	104	98
n-Propylbenzene	100	99
Styrene	102	96
1,1,1,2-Tetrachloroethane	90	100
1,1,2,2-Tetrachloroethane	91	100
Tetrachloroethene	89	96
Toluene	102	100
1,2,3-Trichlorobenzene	109	102
1,2,4-Trichlorobenzene	108	91
1,1,1-Trichloroethane	98	100
1,1,2-Trichloroethane	104	102
Trichloroethene	90	104
Trichlorofluoromethane	89	97
1,2,3-Trichloropropane	108	96
1,2,4-Trimethylbenzene	99	96
1,3,5-Trimethylbenzene	92	101
Vinyl chloride	98	104
o-Xylene	103	106
m-Xylene	97	106
p-Xylene	104	97

2.3 The percent recoveries of matrix spikes in Level IV analysis (Table 3-1 of the *Sampling and Analysis Plan*) of volatile organics are as follows:

Analytical Parameter	% Recovery Range
Benzene	76-127
Chlorobenzene	75-130
1,1-Dichloroethene	61-145
Toluene	76-125
Trichloroethene	71-120

3.0 SEMI-VOLATILE COMPOUNDS

Semi-volatile analyses will be performed by subcontracted laboratories which will meet the requirements of EPA SW-846 (Third Edition). A matrix spike sample will be prepared and analyzed at a rate of 1 per group of 20 samples of a similar matrix. For analysis by gas chromatography/mass spectrometry (GC/MS), surrogate spike analyses will be run on all samples.

Percent recoveries of spiked analytes are in EPA Method 8270, Table 6 of SW-846 (Third Edition).

FINAL PAGE

ADMINISTRATIVE RECORD

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