

**Final Quality Assurance Plan for the  
Remedial Investigations and Feasibility Studies  
of the Helicopter Hangar Area and the Fire Training Area  
at Fort George G. Meade, Maryland**

**Submitted to:  
U.S. Army Environmental Center  
Aberdeen, Maryland**

**Prepared by:  
Analysas Corporation  
1615 "L" Street, NW Suite 1250  
Washington, D.C. 20036  
(202) 429-5653**

**DAA15-93-D0010  
Delivery Orders 0002 and 0003**

**Distribution Unlimited,  
approved for Public Release**

**May 5, 1995**

**20061219205**

**Final Quality Assurance Plan for the  
Remedial Investigations and Feasibility Studies  
of the Helicopter Hangar Area and the Fire Training Area  
at Fort George G. Meade, Maryland**

**Submitted to:  
U.S. Army Environmental Center  
Aberdeen, Maryland**

**Prepared by:  
Analysas Corporation  
1615 "L" Street, NW Suite 1250  
Washington, D.C. 20036  
(202) 429-5653**

**DAA15-93-D0010  
Delivery Orders 0002 and 0003**

*Distribution Unlimited:  
Approved for Public Release*

**May 5, 1995**

## Table of Contents

	<b>Page</b>
<b>1.0 INTRODUCTION</b>	<b>1</b>
<b>2.0 PROJECT and QA/QC ORGANIZATION and RESPONSIBILITIES</b>	<b>2</b>
2.1 Project Organization	2
2.3.1 Program Manager	2
2.3.2 Task Manager	2
2.2.3 Task Staff	2
2.3 Analysas Corporation QA/QC Organization	4
2.3.1 Program QA Officer	4
2.3.2 Lead Geochemist	5
2.4 PACE Project QA/QC Organization	5
<b>3.0 FIELD and LABORATORY QUALITY ASSURANCE</b>	<b>8</b>
3.1 Sample Collection	8
3.2 Data Review, Sample Tracking and Data Management	9
3.2.1 Data Review	9
3.2.2 Sample Tracking	9
3.2.3 Data Reduction/Evaluation	10
3.3 IRDMIS Data Management	11
3.3.1 IRDMIS Map Data	11
3.3.2 IRDMIS Geotechnical Data	11
3.3.2.1 Distributing Existing Map Databases.	11
3.3.2.2 Updating the Fort Meade Map Databases.	11
3.3.2.3 IRDMIS Geotechnical Data	13
<b>4.0 QA OBJECTIVES for MEASUREMENT DATA in TERMS of PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, and COMPARABILITY</b>	<b>17</b>
4.1 Introduction	17
4.2 QA Objectives for FGGM Data	17
4.2.1 Precision	18
4.2.2 Accuracy	18
4.2.3 Representativeness	20
4.2.4 Completeness	20
4.2.5 Comparability	20
<b>5.0 SAMPLE COLLECTION</b>	<b>22</b>
5.1 Sampling Program for the HHA and FTA.	22
5.2 Sampling Equipment and Procedures	22
5.2.1 Geologic Characterization and Soil Quality Assessment	22
5.2.1.1 Subsurface Clearance Program.	22
5.2.1.2 Exploratory Boring Program.	22

5.2.1.3 Sub-surface Soil Sampling Program.	23
5.2.2 Ground Water Quality Assessment	23
5.2.2.1 Ground Water Monitoring Well Installation and Development Program	24
5.2.2.2 Ground Water Monitoring Well Sampling Program	24
5.2.3 Surface Water Sampling Procedures	24
5.2.4 Sediment Sampling Procedures	25
5.2.5 Location and Elevation Survey	25
5.2.6 Investigation-Derived Waste	25
5.3 Sample Containers, Preservation, and Handling	26
5.3.1 Sample Containers	26
5.3.2 Sample Preservation and Holding Times	28
5.4 Field Quality Control Samples	28
5.5 Sample Handling	29
5.6 Field Personnel	29
<b>6.0 SAMPLE CUSTODY</b>	<b>30</b>
6.1 Field Custody Procedures	30
6.2 Laboratory Custody Procedures	30
<b>7.0 LABORATORY CALIBRATION PROCEDURES</b>	<b>32</b>
7.1 Calibration	32
7.2 QC Samples	32
<b>8.0 DATA REDUCTION, VALIDATION, and REPORTING</b>	<b>34</b>
8.1 Analysis Data Management	34
8.1.1 Flow of Map Data into IRDMIS	34
8.1.2 Flow of Geotechnical Data into IRDMIS	34
8.2 Data Reduction	34
8.3 Data Validation	35
8.4 IRDMIS Record and Group Checks	36
<b>9.0 INTERNAL QC CHECKS and FREQUENCY</b>	<b>38</b>
9.1 Control Samples	38
9.2 Field Control Samples	38
9.2.1 Trip Blanks	38
9.2.2 Field Equipment/Rinsate Blanks	38
9.2.3 Field Duplicates	40
9.3 Laboratory Control Samples	40
9.3.1 Laboratory Blanks	40
9.3.2 Laboratory Duplicates	41
9.3.3 Calibration Standards	41
9.3.4 Spike Sample	41
9.3.5 Internal Standard	41

9.4 Concentration and Frequency of Control Samples	41
9.4.1 Class 1 Performance Demonstrated Method	42
9.4.2 Class 1A Performance Demonstrated Method	42
9.5 Data Reporting for Quality Control	42
9.5.1 Class 1, 1A, and 1B Performance Demonstrated Methods	42
<b>10.0 CONTROL</b>	<b>44</b>
10.1 Control Charts	44
10.2 Out-of-Control Conditions	44

**APPENDIX A: Resumes of Key Field Personnel**

## **List of Figures**

Figure 2-1: Project Organizational Structure

## **List of Tables**

Table 4-1: Data Quality Objectives for Critical Measurements: Precision, Accuracy, and Completeness

Table 4.2: Standard Units for the Reporting of Analytical Data

Table 5-1: Summary of Containers, Preservation Times, and Holding Times for Sampling at The Helicopter Hangar Area and the Fire Training Area

Table 7-1: Data Class, Calibration Type and Frequency

Table 7-2: Analytical Procedures, Methods, and Matrix Spikes

Table 9-1: Frequency of Laboratory QC Samples for USAEC-Performance Demonstrated Methods

## List of Acronyms and Abbreviations

ADD	Average Daily Dose
AEHA	Army Environmental Hygiene Agency
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances Disease Registry
BRAC	Base Realignment and Closure Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDI	Chronic Daily Intake
COC	Chain-of-Custody
COR	Contracting Officer's Representative
CRAVE	Carcinogen Risk Assessment Verification Endeavor
DOI	Department of the Interior
DCE	Dichloroethene
DRMO	Defense Reutilization and Marketing Office
EIS	Environmental Impact Study
ELIN	Exhibit Line Number
EMO	Environmental Management Office
EPA	United States Environmental Protection Agency
FGGM	Fort George G. Meade
FS	Feasibility Study
FTA	Fire Training Area
GC/MS	Gas Chromatography/Mass Spectrometry
GC	Gas Chromatography
GPM	Gallons Per Minute
HASP	Health and Safety Plan
HEAST	Health Effects Assessment Summary Tables
HHA	Helicopter Hanger Area
HI	Hazard Indices
IDW	Investigation Derived Waste
IR	Installation Restoration
IRDMIS	Installation Restoration Data Management Information System
IRIS	Integrated Risk Information Systems
IRM	Interim Reference Materials
MCL	Maximum Containment Level
MCLG	Maximum Containment Level Goal
MDE	Maryland Department of the Environment
MS	Mass Spectrometry
NAD27	North American Datum 1927
NCP	National Contingency Plan
NEPA	National Environmental Policy Administration
NIST	National Institute of Standards and Technology

No.	Number
NPDWR	National Primary Drinking Water Regulations
NPL	National Priorities List
ODC	Other Direct Costs
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PCB	Polychlorinated Biphenyl
PCE	Perchloroethene
PID	Photoionization Detector
PP	Proposed Plan
PRI	Potomac Research, Inc.
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAC	Quality Assurance Coordinator
QAPP	Quality Assurance Project Plan
QCP	Quality Control Plan
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study
RI	Remedial Investigation
RIA	Remedial Investigation Addendum
ROD	Record of Decision
SARM	Standard Analytical Reference Material
SI	Site Inspection
SIA	Site Investigation Addendum
SLI	Site Location Identity
SQL	Sample Quantitation Limit
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCA	Tetrachloroethane
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TEPS	Total Environmental Program Support
TWP	Technical Work Plan
USAEC	United States Army Environmental Center
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USC	Unique Sample Code
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound



## 1.0 INTRODUCTION

The Quality Assurance (QA) reviews under this task order for the U.S. Army Environmental Center (USAEC), formerly the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), are systematic evaluations of four aspects of the Helicopter Hangar Area (HHA) Remedial Investigations and Feasibility Studies (RI/FS) at Fort George G. Meade, Maryland (FGGM). The four aspects are: (1) overall project activities and documents; (2) field/geotechnical activities; (3) laboratory analysis activities; and (4) data files and packages. The overall project and field Quality Assurance reviews will be undertaken by the Analysas project QA officer or his designee. The laboratory Quality Assurance reviews will be accomplished by our subcontracted laboratory, PACE Environmental Laboratories (PACE), with QA oversight provided by the Analysas project QA officer or his designee. The Analysas project QA officer will also review USAEC data packages from PACE.

These reviews will assure that activities and data are implemented in accordance with this plan and Quality Control Plans (QCP) outlined in the *USATHAMA Quality Assurance Program, USATHAMA PAM 11-41, January 1990* and the *USATHAMA Geotechnical Requirements for Drilling, Monitoring Wells, Data Acquisition, and Reports*.

## **2.0 PROJECT AND QA/QC ORGANIZATION AND RESPONSIBILITIES**

This section describes the organizational structure for the FGGM investigations being conducted by Analysas Corporation. This structure indicates the overall assignment of responsibility for all aspects of the project and the functional and communication relationships among the organizational elements participating in this project. The organizational structure for the HHA and FTA RI/FS is presented in Figure 2-1. The roles and responsibilities of key project team personnel are described below.

### **2.1 Project Organization**

#### **2.3.1 Program Manager**

Mr. Richard G. Tringale is the Analysas Corporation Program Manager for the USAEC contract. He will be responsible for: monitoring technical progress; reviewing and approving all work products; reviewing and approving all deliverables before submission to USAEC; monitoring financial and schedule control; and instituting corrective action, if necessary.

#### **2.3.2 Task Manager**

Ms. Alison Doherty is the Analysas Corporation Task Manager for Task Delivery Orders 0002 and 0003 will work directly with the Program Manager. As Task Manager, her responsibilities include: project staffing and direct management of all staff assigned to TDO 0002 and TDO 0003; direct financial and schedule control; review and approval of all deliverables; recommending corrective actions, if necessary, to the Program Manager; and maintaining a liaison with the USAEC Project Officer, and FGGM Environmental Office Manager. In this role, the Task Manager will be responsible for keeping the USAEC Project Officer and FGGM Environmental Office Manager informed of all technical progress as necessary.

#### **2.2.3 Task Staff**

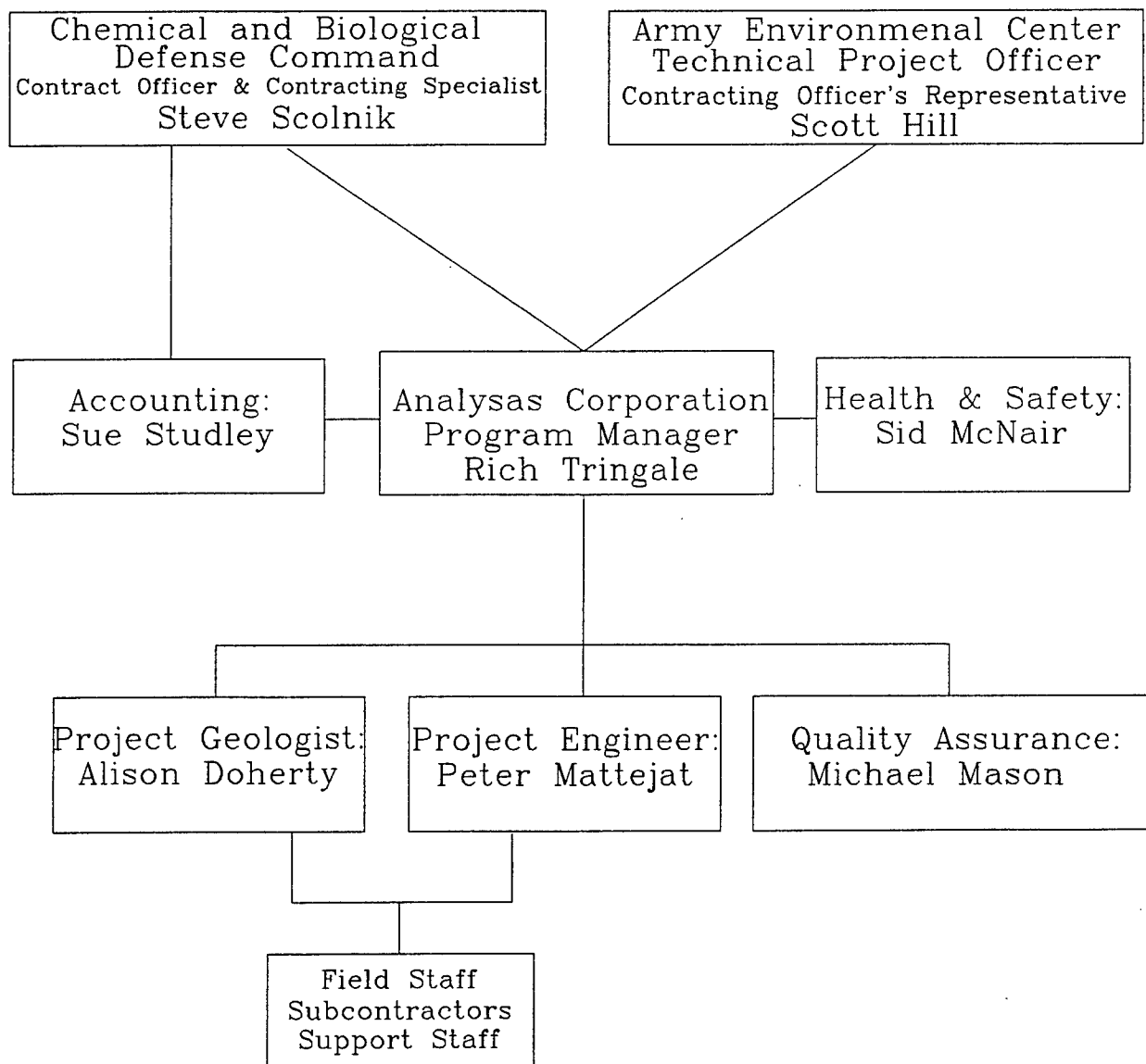
The subtask responsibilities have been assigned as follows:

- Field Activities and Deputy Task Manager - Alison Doherty, C.P.G.
- Laboratory Analysis and QA/Data Review - Alison Doherty, P.G.
- Sample Tracking Database Management - Peter Mattejat, P.E.
- Risk Assessment/Feasibility Study - Peter Mattejat, P.E.

The Subtask Managers are responsible for coordinating all phases of activities required to complete the stated goals of their subtask assignment, including tracking and reporting on technical quality, schedule, budget, deliverables, problems and corrective actions. Subtask Managers are responsible for ensuring that the Task Manager is kept informed of all technical progress and potential problem areas. Consistency in approach for each subtask will be assured through management by the Task and Subtask Managers, brief weekly meetings, and use of a common resource base will be used to perform the specific work assignments. Technical staff members will take direction from the Subtask Managers.

Figure 1

PROJECT TEAM ORGANIZATION  
Delivery Orders 002 & 003  
RI/FS Investigation at HHA & FTA  
Fort George G. Meade, Maryland



Field activities will be managed by the Field Activities and Deputy Task Manager. During the on-site field investigation at FGGM, the field team will include a site coordinator who will be the Field Activities and Deputy Task Manager or her designee and a designated on-site Health and Safety supervisor. In addition to field geologists and technicians, the subcontractors selected for the unexploded ordnance (UXO) survey, drilling, and the elevation/location survey will also report to the site coordinator.

Laboratory activities will be overseen by the Lead Geochemist. She or her designee will be responsible for coordinating field and laboratory activities, and reviewing the operations and data files/packages of our subcontracted laboratory.

The manager of the Environmental Operations Department will serve as Technical Reviewer, serving USAEC in two ways. First, he will provide a high level of corporate attention to the task to ensure that the staffing that is needed to complete the Delivery Order within the proposed schedule is available.

### **2.3 Analysas Corporation QA/QC Organization**

In order to ensure that all aspects of Quality Assurance and Quality Control (QA/QC) are followed according to the USAEC Quality Assurance Program and this Quality Control Plan, the responsibilities to oversee this project have been assigned to the Project QA Officer and the Project Lead Geochemist, in addition to specific responsibilities for QA at PACE.

#### **2.3.1 Program QA Officer**

Mr. Michael Mason, P.G., has been selected as the Project Quality Assurance Officer for the USAEC TEPS Contract. In his role as an independent evaluator of Analysas' performance during this Delivery Order, Michael Mason will discuss our performance, as necessary, with officials at USAEC and other U.S. Army officials in the chain of command. Michael Mason's findings and recommendations will be communicated directly to the Program Manager, and Task Manager during the course of the FGGM project.

The primary focus of the Project Quality Assurance Officer will be to ensure that systems are in place and adequate to maintain the maximum level of quality throughout all aspects of the project.

Specific functions and duties of the Project Quality Assurance Officer include:

- Reviewing and approving of QA policies and procedures
- Reporting the adequacy, status, and effectiveness of the QA program on a regular basis to the project management
- Maintaining responsibility for documentation of corporate QA records, documents, and communications
- Conducting field audits

- Coordinating with the Lead Geochemist, as needed, to ensure QC procedures specific to the laboratory and data management are followed and documented

The purpose of the field audits is to ensure that sampling is conducted in a manner consistent with the QA Program and other USAEC guidelines. This responsibility includes making trips to the site to inspect sampling where applicable. Each major type of sampling (e.g., ground water, surface water, soil, sediment) will be inspected at least once per installation investigation. The visit(s) will occur during the first sampling effort for each matrix. Additional inspections may occur at the discretion of the Project QA Officer, with approval of the USAEC Project Officer and the Analysis Task Manager. The Project QA Officer will document (Appendix U of the USATHAMA QA Program, January 1990) each inspection and ensure that procedures described in the Scope of Work, Project Work Plan, and Project QC Plan are followed. The Program QA Officer has the authority to require re-sampling of any site whose sampling integrity was determined to have been affected by faulty sampling procedures, after obtaining approval from the USAEC Project Officer or the Contracting Officer's Representative.

### **2.3.2 Lead Geochemist**

Analysis Corporation's Lead Geochemist is Alison Doherty. She will assist with oversight of the laboratory activities for this project. Specific functions and duties include:

- Maintaining copies of PACE laboratory documentation, including USAEC-performance demonstrated methods and Quality Assurance Plans
- Providing an external and, thereby, independent QA review of PACE activities and documentation (including all control charts and a 10 percent review of data packages and IRDMIS data files)
- Coordinating with USAEC, Analysis, and PACE to ensure that QA objectives appropriate to the project are established and that PACE personnel are aware of these objectives
- Coordinating with PACE management and personnel to ensure that QC procedures, appropriate to demonstrating data validity and sufficient to meet QA objectives, are developed and in place
- Ensuring data are properly reviewed by an Analysis chemist, including resolving any discrepancies between PACE and the validator
- Requiring and/or reviewing corrective actions taken in the event of QC failures
- Reporting non-conformance with QC criteria or QA objectives, including an assessment of the impact of the data quality or project objectives, to the Program QA Officer and Task Manager

### **2.4 PACE Project QA/QC Organization**

The PACE Analytical Task Manager is Dr. Melvin Rozeboom. Responsibilities of the PACE

Analytical Task Manager include but are not limited to:

- Submit to Analysas Task Manager for approval a detailed Project QC Plan specific to the USAEC project being supported
- Support a Quality Assurance Coordinator (QAC) who will not be subordinate to or be in charge of any person having direct responsibility for sampling or analyses
- Provide sufficient equipment, space, resources, and personnel to conduct analyses and implement the USAEC project and QA Program
- Submit the required documentation and laboratory performance demonstration data to Analysas prior to analyzing field samples
- Ensure that subsampling and other handling procedures in the laboratory are adequate for the sample types received
- Oversee the quality of purchased laboratory materials, reagents, and chemicals to ensure that these supplies do not jeopardize the quality of analytical results
- Ensure implementation of corrective action for any QA/QC deficiencies

The PACE Quality Assurance Coordinator, Minh Nguyen, will:

- Monitor the QA and QC activities of the laboratory to ensure conformance with authorized policies, procedures, and sound practices, and recommend improvements as necessary
- Inform the Analysas Task Manager, Analysas Lead Geochemist, and laboratory management of non conformance to the QA Program
- Request analytical reference materials from USAEC through the USAEC Geology and Chemistry Branch
- Ensure that all records, logs, standard procedures, project plans, and standing operating procedures are distributed to all laboratory personnel involved in the project
- Establish, with the analysts and the Analysas Lead Geochemist, the correct analytical lot size, the correct QC samples to be included in each lot, and the correct procedures for evaluating acceptable, in-control analytical performance
- Ensure that logging of received samples includes establishing appropriate lot size for each analysis and allocating sample numbers for the correct control samples in each lot and that checklist is filled out and maintained

- Review all laboratory data before those data are transmitted to permanent storage, reported to other project participants, or submitted via the USAEC Installation Restoration Data Management Information System (IRDMIS). Before data are released, the QAC must have completed the Contractor QAC Checklist and inspected calibration data, control charts, and other performance indicators to verify that the data were collected under conditions consistent with laboratory performance demonstration and that the analytical systems were in control
- Ensure that a signed Data Package Checklist is included in each completed data package
- Ensure that analysts are preparing QC samples, maintaining control charts, and implementing and documenting corrective action when necessary
- Ensure that all sampling logs, instrument logs, and QC documents are maintained and are completed with the required information
- Collect control charts from analysts, discuss control chart results with the Analytical Task Manager, and submit the charts to Analysas and the USAEC Geology and Chemistry Branch on a weekly basis
- Maintain an awareness of the entire laboratory operation to detect conditions that might directly or indirectly jeopardize controls of the various analytical systems (e.g., improper calibration of equipment, cross contamination through improper storage of samples)
- Audit sampling documentation and procedures to ensure that samples are labeled, preserved, stored, and transported according to prescribed methods following approved chain-of-custody procedures

### 3.0 FIELD AND LABORATORY QUALITY ASSURANCE

Field Quality Assurance reviews will be performed on site for one day during field investigation activities. Through a combination of on-site observations and on-site and off-site review of documentation. Field documentation, field measurements, sampling equipment and techniques, decontamination procedures, and procedures for disposal of investigative derived wastes will be reviewed to ensure conformance with the above-referenced documents:

Laboratory Quality Assurance reviews undertaken by the PACE Quality Assurance Coordinator includes verification that the following meet USAEC requirements:

- Sample log-in and inspection
- QC samples (usually four; one method blank, one low spike, and two high spikes) and sample lot sizes
- Instrument calibration using Standard Analytical Reference Material (SARM's), Interim Reference Materials (IRM's), or "off-the-shelf" materials characterized by two methods (initial and/or daily calibrations)
- Logs, including laboratory notebooks and/or forms (sample log-in, laboratory chain-of-custody forms, instrument usage, calibration, and maintenance notebooks/logs, sample preparation notebooks and logs, sample analysis spreadsheets and files, standard solution preparation and identifications, analysis methods notebooks, and, when required, corrective action documentation
- Laboratory water quality (ASTM Type I and Type II)
- Control charts (single day XBAR, range control charts for high spikes, and three-day moving XBAR and range control charts for low spikes and GC/MS analyses)
- Identification of out-of-control systems and corrective action procedures

Analysas will provide QA oversight through review of laboratory weekly status reports, QC summary reports, control charts, and at least weekly phone calls to the laboratory. The results of the field and laboratory reviews will consist of observations and notations as to whether approved practices are followed. A formal report composed of summary findings shall be distributed to the Program Manager and Task Manager. Deviations from the program, task, or USAEC QA plans will be noted and discussed as appropriate, with the staff members, appropriate management, and USAEC.

#### 3.1 Sample Collection

Sampling to be conducted at the HHA and FTÁ includes soil sampling, surface water sampling, and ground water sampling. These samples will be collected following all applicable guidance



from USAEC and EPA Region III.

Field notebooks will be kept for all, field sampling operations. These notebooks will include date, time, location, and personnel involved in any event being logged. Logbooks will include all pertinent technical information to the sampling task being performed.

### **3.2 Data Review, Sample Tracking and Data Management**

#### **3.2.1 Data Review**

As required by the USAEC QA Plan, all data packages will be reviewed by the PACE Quality Assurance Coordinator. This review serves two purposes; it ensures that all required data and documentation are provided in the package and it checks the content for technical and record keeping errors. The reviewer's name and date of review will be recorded on the QAC checklist; any corrective actions required will also be noted. When the corrective action has been completed, the QAC will initial the date and original comment. The QAC's signature on the checklist will indicate that the data are considered valid and usable. Our subcontracted laboratory will provide Analysas with USAEC data packages for review.

An additional review of approximately 10 percent of the data packages will be performed by the Analysas Lead Geochemist. The packages will be chosen to cover as broad as possible a range of analyses and matrices. In some cases, a particular lot may be selected for additional review by the Analysas or USAEC Project Manager. The Lead Geochemist will assess the completeness of the documentation provided, adherence to the certified or other published method, adherence to USAEC quality control requirements, and acceptability of the quality control data. The Lead Geochemist will also provide a technical review of the data and verify at least one calculation for standard preparation and final reported analyte values from the raw data contained in the data packages to the final reported value in the Installation Restoration Data Management Information System (IRDMIS). Any discrepancies or omissions will be discussed promptly with PACE. A copy of the Analysas Lead Geochemist's review will be added to the data package.

IRDMIS data files will be record-checked by PACE to assess if the method was performed correctly and within the sample holding times specified. After successfully passing the record check, the samples are group-checked to confirm that the proper number of control samples were analyzed and each sample site corresponds to a valid map site. After successful record and group checks, data may be transferred to Potomac Research, Inc. (PRI). Any deviations or problems with data files and/or packages will be reviewed with PACE and appropriate corrective actions will be taken as necessary and will be fully documented.

#### **3.2.2 Sample Tracking**

All samples collected for chemical analysis during the performance of the RI/FS for the HHA and FTA at FGGM are assigned unique sample designation codes so that all chemical and physical data collected in association with each sample can be directly linked to a specific location, depth, time, and sample media prior to interpretation. Each assigned sample designation code is composed of a predetermined Site Location Identity (SLI) and a Unique Sample Code (USC).

from USAEC and EPA Region III. Sampling quality procedures will include but not be limited to the following items.

Field notebooks will be kept for all, field sampling operations. These notebooks will include date, time, location, and personnel involved in any event being logged. Logbooks will include all pertinent technical information to the sampling task being performed.

### **3.2 Data Review, Sample Tracking and Data Management**

#### **3.2.1 Data Review**

As required by the USAEC QA Plan, all data packages will be reviewed by the PACE Quality Assurance Coordinator. This review serves two purposes; it ensures that all required data and documentation are provided in the package and it checks the content for technical and record keeping errors. The reviewer's name and date of review will be recorded on the QAC checklist; any corrective actions required will also be noted. When the corrective action has been completed, the QAC will initial the date and original comment. The QAC's signature on the checklist will indicate that the data are considered valid and usable. Our subcontracted laboratory will provide Analysas with USAEC data packages for review.

An additional review of approximately 10 percent of the data packages will be performed by the Analysas Lead Geochemist. The packages will be chosen to cover as broad as possible a range of analyses and matrices. In some cases, a particular lot may be selected for additional review by the Analysas or USAEC Project Manager. The Lead Geochemist will assess the completeness of the documentation provided, adherence to the certified or other published method, adherence to USAEC quality control requirements, and acceptability of the quality control data. The Lead Geochemist will also provide a technical review of the data and verify at least one calculation for standard preparation and final reported analyte values from the raw data contained in the data packages to the final reported value in the Installation Restoration Data Management Information System (IRDMIS). Any discrepancies or omissions will be discussed promptly with PACE. A copy of the Analysas Lead Geochemist's review will be added to the data package.

IRDMIS data files will be record-checked by PACE to assess if the method was performed correctly and within the sample holding times specified. After successfully passing the record check, the samples are group-checked to confirm that the proper number of control samples were analyzed and each sample site corresponds to a valid map site. After successful record and group checks, data may be transferred to Potomac Research, Inc. (PRI). Any deviations or problems with data files and/or packages will be reviewed with PACE and appropriate corrective actions will be taken as necessary and will be fully documented.

#### **3.2.2 Sample Tracking**

All samples collected for chemical analysis during the performance of the RI/FS for the HHA and FTA at FGGM are assigned unique sample designation codes so that all chemical and physical data collected in association with each sample can be directly linked to a specific location, depth, time, and sample media prior to interpretation. Each assigned sample designation code is composed of a predetermined Site Location Identity (SLI) and a Unique Sample Code (USC).

The SLI is composed of an alphanumeric code that includes the IRDMIS Site ID, Site Type, and Media Code. The USC provides further detail on the area identification, sample interval, and sample media. The SLI will remain consistent for all samples collected from a single location, regardless of depth, and may therefore correspond to several data sets from a particular event. The USC, when concatenated with the SLI, serves to uniquely delineate a data set. All sampling locations that were established previously and that are scheduled for re-sampling during these field activities will use the previously established Site ID to maintain consistency with USAEC's IRDMIS. All newly established sites will be assigned Site ID's consistent with those already in existence.

### **3.2.3 Data Reduction/Evaluation**

Under this task order, data obtained from the previous Site Investigation (SI) and Remedial Investigation (RI), and the addendum, will be evaluated and integrated to provide a basic characterization of the occurrence and distribution of chemical contamination and site characteristics that are likely to influence human exposure or remediation feasibility. The output from this task will be used for completing the RI/FS for the HHA and FTA.

Initially, this will include reducing and organizing the raw field data into IRDMIS format. Data reduction will result in the following:

- Maps will be prepared for each site, utilizing maps prepared from previous investigations, including areas of concern, sampling locations, and ground water elevation data and contours. Ground water contour maps will be constructed for each aquifer investigated.
- For the risk assessment, all IRDMIS level III chemical data will be compiled in site and media-specific tables. The data will also be summarized on additional tables that will include, for each media at each site, range of concentrations, arithmetic mean concentration, and upper 95 percent confidence limit of the mean. These tables will be used in preparation of the RI/FS.
- The chemical concentrations will be plotted onto flow maps so that source areas and directions of contaminant migration can be evaluated.
- The results of the exploratory boring and soil sampling program will be used to develop a series of stratigraphic cross-sections beneath the sites. The various geologic descriptions will be used to correlate the various stratigraphic units identified so that a three-dimensional understanding of the unconsolidated sediments can be attained.
- The chemical results of the ground water sampling will be added to the geologic cross-sections along with water table data that correspond to that particular sampling event. These data will be used in conjunction with the hydraulic data to evaluate the historical and future contaminant migration flow paths.
- The lateral distribution of various contaminants with the ground water will be contoured for each aquifer at each site. This data will be used in conjunction with the hydraulic data to evaluate the historical and future contaminant migration flow paths.

- The elevation survey data will result in completion of site maps that will be used to correlate all the data acquired at the site. These maps will provide the basis for all sampling data, and provide precise vertical elevations and hydraulic elevation measurements.
- Chemical data for the analysis of background samples, along with data from previous investigations and regionally available metals data, will be summarized for each of the sites under investigation, selected from the analysis of background and filed samples, and will be evaluated using frequency plots to assess if elevated concentrations are present at any cations.

### **3.3 IRDMIS Data Management**

Management of IRDMIS data consists of proper formatting and loading of (1) IRDMIS Map Data, (2) IRDMIS geotechnical data, and (3) IRDMIS chemical data.

#### **3.3.1 IRDMIS Map Data**

IRDMIS map data entry refers to registering sampling locations by a specific naming convention and a coordinate system (x and y locations) using a USAEC software program called PC IRDMIS or PC TOOL.

The naming convention consists of a 4-character Site Type (e.g. WELL, BORE, LAKE - see section 9.17 of the data dictionary) and a 10-character Site Identification (Section 9.16 of the data dictionary) that has few restrictions on the use of the 10 characters, except that the Site ID cannot contain any spaces. One important consideration is that once a site has been named, that same unique name should be used throughout that site's sampling history. The coordinate system will be in Universal Transverse Mercator (UTM) or Maryland State Plane and the locations can be either surveyed, digitized, or read from a map.

In general, map data entry will occur when new samples are taken from new locations in the field. For example, if the sampling location is an immovable site like a well (WELL) or a building (BLDG) then the sampling information for that site will only have to be entered once. However, soil sampling, surface water sampling, and other such sampling will need to be entered each time a sample is taken unless it can be determined that the site is identical to an original sampling location already recorded in the map database.

#### **3.3.2 IRDMIS Geotechnical Data**

##### **3.3.2.1 Distributing Existing Map Databases.**

Analysas Corporation will acquire the latest FGGM map database from PRI and will send this map database to the contracted laboratory so that proper record and group checks will be possible.

##### **3.3.2.2 Updating the Fort Meade Map Databases.**

Analysas Corporation will be responsible for providing both the contracted laboratory and USAEC with updated map files based on sampling efforts at FGGM. When a new site is sampled,

Analysas will enter the map data as follows to ensure proper processing of the associated analytical data:

As a new sampling round is being completed, Analysas will follow the procedures discussed in Chapter 3 of the *PC Data Entry & Validation Subsystems User's Manual* to enter map data into the PC IRDMIS Level I computer system.

- The new site will be named based on a 4-character Site Type and a 10-character Site Identification as explained in Sections 9.17 and 9.16 of the Data Dictionary, respectively. The sample's location will be determined by a surveyor, a map, or a digitized location coordinate so that the X and Y coordinates can be entered. Also, the chart on the following page can be used as a guideline for map data entry.
- Analysas Corporation will then transfer the data into an ASCII-based "transfer" file that will be sent to PRI for processing, validation, and loading to the USAEC legal repository known as Level III.
- Once the map file has been loaded to Level III as indicated by the USAEC weekly status reports, Analysas will request the latest map files to be sent electronically from PRI. Once Analysas receives the map file, it can be copied to the local Analysas IRDMIS data system and sent to the subcontracted laboratory so that proper record and group checks can continue.

Required Elements Map Data Entry:

<u>Field Name</u>	<u>Size/Type</u>	<u>Data Dictionary Section</u>
(1)* Installation	A2	11.04
(2)* Site Type	A4	9.17
(3)* Site Identification	AN10	9.16
(4) Description	AN16	9.07
(5) Pointer Site Type	A4	9.14
(6) Pointer Site ID	A10	9.13
(7) Aquifer Name	A10	9.01
(8)* Coordinate System	A3	9.05
(9)* Coordinate Source	A1	9.03
(10)* Coordinate Accuracy	N1	9.03
(11)* X Coordinate	N7	9.20
(12)* Y Coordinate	N7	9.21
(13) Surface Elevation	N7	9.18
(14) Elevation Source	A1	9.06
(15) Elevation Accuracy	N1	9.06
(16)* Base Closure Indicator	A1	9.02

\* Necessary map data entry element to create a legal map file. All others can be considered optional or have default values, but should eventually be entered for completeness.

### 3.3.2.3 IRDMIS Geotechnical Data

Analysas Corporation will provide USAEC with updated geotechnical files based on sampling efforts at FGGM. When a new well site is drilled and constructed for sampling, Analysas will enter the geotechnical data as follows to insure proper processing of the associated geotechnical data through the IRDMIS data systems.

- As a new sampling round is being completed, Analysas will follow the procedures discussed in Chapter 2 of the *PC Data Entry & Validation Subsystem User's Manual* to enter geotechnical data into the PC IRDMIS Level I computer system.
- There are three types of geotechnical data that Analysas will be responsible for entering and keeping updated as the project at FGGM continues. They are (GWC) Geotechnical Well Construction data, (GFD) Geotechnical Field Drilling data, and (GGS) Geotechnical Ground Water Stabilized data. GWC and GFD geotechnical data files will be created for each new well that is drilled and constructed in association with Analysas' activity at FGGM. In addition, GGS geotechnical information will be gathered and entered for every well that will be sampled including existing well sites.
- The following guidelines will be used to ensure that all pertinent geotechnical information is collected and entered properly into Level I of the PC IRDMIS computer system:

#### Required Elements for Geotechnical Data Entry:

<u>(GWC)</u>	<u>Geotechnical Well Construction</u>	<u>Size/Type</u>	<u>Data Dictionary Section</u>
(1)	Installation	A2	11.04
(2)	File Type	A3	9.09
(3)	Organization	A2	10.09
(4)	Site Type	A4	9.17
(5)	Site Identification	A10	9.16
(6)	Prime Contractor	A2	9.15
(7)	Well Construction Date	D	10.11
(8)*	Action/Measurement	A4	10.01
(9)	Method Number	N2	10.08
(10)	Depth (ft)	N9	10.03
(11)	Interval Thickness	N9	10.06
(12)	Value	N6.2	10.10
(13)	Units	A4	9.19
(14)	Entry	A6	10.04

Bedrock Wells (GWC) require the following Action/Measurement data:

- DPTOT Direct measurement of depth from ground surface to the deepest point encountered during drilling and/or sampling in a bore hole.
- STKUP Filed measurement of length of PVC riser above ground surface (use negative values if below ground surface).
- CSEAL Direct measurement from ground surface of length of permanent external casing used to seal off the overburden of an open-hole (bedrock) well.
- CASES Direct measurement of inside diameter of permanent external casing used to seal off the overburden of an open-hole (bedrock) well.

NOTES:

\* All measurements to the nearest tenth of a foot. Additional Action/Measurements are optional

Screened Wells (GWC) require the following Action/Measurement data:

- DPTOT Direct measurement of depth from ground surface to the deepest point encountered during drilling and/or sampling in a bore hole.
- STKUP Field measurement of length of PVC riser above ground surface (use negative values if below ground surface).
- CASE Direct measurement of length from ground surface to top of the screen of an overburden (screen) well.
- CASED Direct measurement of the inside diameter of the casing of an overburden (screened) well.
- SCREN Length of the screen of an overburden (screened) well.
- GROUT Length of the interval filled with neat cement or cement grout for an overburden (screened) well.
- GFILT Direct measurement of length of gravel filter or sand pack of an overburden (screened) well.

NOTES:

\* All measurements to the nearest tenth of a foot. Additional Action/Measurements are optional

<u>(GFD) Geotechnical Field Drilling</u>		<u>Size/Type</u>	<u>Data Dictionary Section</u>
(1)	Installation	A2	11.04
(2)	File Type	A3	9.09
(3)	Organization	A2	10.09
(4)	Site Type	A4	9.17
(5)	Site Identification	A10	9.16
(6)	Prime Contractor	A2	9.15
(7)	Bore Start Date	D	10.11
(8)*	Action/Measurement	A4	10.01
(9)	Method Number	N2	10.08
(10)	Depth (ft)	N9	10.03
(11)	Interval Thickness	N9	10.06
(12)	Value	N6.2	10.10
(13)	Units	A4	9.19
(14)	Entry	A6	10.04

DPTOT Direct measurement of depth from ground surface to the deepest point encountered during drilling and/or sampling in a bore hole.

GRDWT Direct or estimated measurement of depth from ground surface to first-encountered ground water level at time of drilling.

NOGWT No ground water encountered at time of drilling.

USCS Visual classification in the field of an interval using the Unified Soil Classification System ( including rock classification and special codes).

**NOTES:**

\* All measurements to the tenth of a foot. Additional Action/Measurements are optional

Geotechnical Ground Water

<u>(GGS)</u>	<u>Stabilized</u>	<u>Size/Type</u>	<u>Data Dictionary Section</u>
(1)	Installation	A2	11.04
(2)	File Type	A3	9.09
(3)	Organization	A2	10.09
(4)	Site Type	A4	9.17
(5)	Site Identification	A10	9.16
(6)	Prime Contractor	A2	9.15
(7)	Measurement Date	D	10.07
(8)	Depth (ft)	N9	10.03



- Further information on Action/Measurement requirements can be found in the USAEC Data Dictionary Section 10.01.
- Analysas Will then transfer the geotechnical data into an ASCII-based "transfer" file that will be sent to PRI for processing, validation, and loading to the USAEC legal repository known as Level III.
- Analysas will confirm that the geotechnical file has been loaded to Level III as indicated by the USAEC weekly status reports for each well that data has been generated for.

Analysas will confirm that the chemical data transfer files have been loaded to Level III as indicated by the USAEC weekly status reports for each for which data have been generated.

Analysas' internal tracking system will also ensure that all field samples have had the proper analysis performed and will contact the laboratory and the USAEC Project Officer whenever and wherever discrepancies arise.

Any and all data that will require changes will be handled in the following manner:

IRDMIS Map Data:

- All changes will be made by Analysas Corporation
- All resubmissions will be handled by Analysas Corporation

IRDMIS Geotechnical Data:

- All changes will be made by Analysas Corporation
- All resubmissions will be handled by Analysas Corporation

IRDMIS Chemical Data:

- All analytical data changes will be handled by the contract laboratory with notification provided to Analysas Corporation.
- All map data sites associated with chemical transfer files will be handled by Analysas Corporation unless otherwise noted.
- All resubmission of chemical data will be handled by the contracted laboratory including submission that require a USAEC modification memo, with notification provided to Analysas Corporation.
- Any change that Analysas Corporation makes will be noted and a copy of the transfer file will be sent to the contract laboratory to maintain an updated chemical database tracking system.

## **4.0 QA OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY**

### **4.1 Introduction**

Quality Assurance (QA) objectives are qualitative and quantitative statements that specify the quality of data necessary for regulatory and/or project specific decisions. The process of developing QA objectives for a given study helps to ensure that generated data are of adequate quality for the intended use. QA objectives are expressed in terms of precision, accuracy, representativeness, completeness, and comparability.

### **4.2 QA Objectives for FGGM Data**

Quality Assurance objectives for the data collected under the FGGM investigations covered by this Quality Assurance Project Plan (QAAP) have been defined to ensure that the collected data will be of sufficient quality to support the RI/FS/SI decision-making needs of the USAEC program. In order to provide a common point of reference for all projects and ensure comparability of the data generated within the USAEC program, USAEC prescribes the use of standardized analytical methods that provide sufficient information to evaluate data quality. For specific methods, the USAEC QA program defines QA objectives through a process of method performance demonstration, including pre-performance demonstration calibration and performance demonstration analyses: the USAEC Geology and Chemistry Branch determines whether the results of these analyses demonstrate proficiency of the laboratory and, if proficiency is demonstrated, assigns method numbers to be used when reporting data. This effort also provides the baseline for establishing control limits for daily analyses. Where possible, USAEC-performance demonstrated analytical methods will be used for the analysis of FGGM samples; for non-performance demonstrated methods, analyses will be performed based on standard EPA methods. PACE, a USAEC-performance demonstrated laboratory, will be used to perform all analyses on the field samples collected for this project. All analytical methods used for the FGGM project will generate appropriate QC data to enable data quality to be assessed with respect to the QA objectives of the project.

USATHAMA analytical methods are characterized by rigorous QA/QC protocols and documentation requirements. The USAEC data are of high quality, comparable to EPA Level IV data quality (Data Quality Objectives, 1987). USAEC-performance demonstrated methods will be used for all analyses.

Field screening measurements will also be collected using portable equipment in order to provide real-time data to assist in the optimization of the field sampling activities and for health and safety purposes. Field measurements such as pH, temperature, conductivity, and volatile organics (using a photoionization detector) will be obtained. The quality of these data is generally comparable to EPA Level I data quality (Data Quality Objectives, 1987).

Table 4-1 presents the data quality objectives for critical measurements in terms of precision, accuracy and completeness for all parameters analyzed for this investigation. The table specifies whether the measurement will be made in the field or in the laboratory. Estimated accuracy is expressed as percent recovery and estimated precision is expressed as a relative percent difference (for two values) or a standard deviation (for three or more values). Completeness is expressed in terms of the percentage of valid data generated out of the total number of data points. The information regarding precision and accuracy of the methods presented in this plan has been obtained from a number of sources. For the EPA methods used in this investigation, the precision and accuracy values come from a program for evaluating analytical methods and laboratories that is directed by the EPA. For the USAEC-performance demonstrated methods precision and accuracy are evaluated as part of the control chart program. These indicators of data quality are detailed in the sections that follow.

#### **4.2.1 Precision**

Precision is the degree of mutual agreement among individual measurements of the same parameter, using prescribed conditions and a single test procedure. Overall precision includes variability associated with field and laboratory operations. The results of analyzing field duplicate samples are used to assess variability associated with field activities, which is a function of sample collection/handling as well as matrix homogeneity. Analytical precision can be expressed in several ways, including standard deviation, relative standard deviation, range, and relative percent difference (RPD).

#### **4.2.2 Accuracy**

Accuracy is the difference between individual analytical measurements and the true or expected value of a measured parameter. It is a measure of the bias corresponding to systematic and random errors in the entire data collection process. Sources of error include the sampling process, field and laboratory contamination, sample preservation and handling, sample matrix interferences, sample preparation methods, and calibration and analysis procedures. Sampling accuracy can be assessed, in part, by evaluating the results of analyzing field/trip blanks; analytical accuracy can be evaluated through the use of calibration and methods blanks, calibration verification samples, laboratory control samples, and matrix spikes.

- For the USAEC-performance demonstrated methods, accuracy is assessed as part of the control chart program. A three-day moving average control chart is maintained for each control analyte by plotting the recovery of spiked QC samples; an updated three-day average recovery for each compound is plotted on the control chart as part of the daily laboratory control program. This procedure is intended to monitor variations in the accuracy of routine analyses and detect trends in the observed variations.
- For non-performance demonstrated methods, laboratory accuracy is generally assessed through the use of laboratory spiked samples or as specified in the method.

**Table 4-1: Data Quality Objectives for Critical Measurements: Precision, Accuracy, and Completeness**

Lab/Field QC	Parameter	Matrix	Estimated Accuracy <sup>a</sup>	Estimated Precision <sup>a</sup>	Completeness
Lab USAEC-PD <sup>1</sup>	TCL VOAs	Soil/Sed	USAEC	USAEC, RPD <50% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	TCL SEMIVOAs	Soil/Sed	USAEC	USAEC, RPD <50% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	TAL Metals	Soil/Sed	USAEC	USAEC, RPD <50% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	PCBs	Soil/Sed	USAEC	USAEC, RPD <50% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	HPLC Explosives	Soil/Sed	USAEC	USAEC, RPD <50% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	Chloride	Soil/Sed	USAEC	USAEC, RPD <50% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	Nitrate/Nitrite	Soil/Sed	USAEC	USAEC, RPD <50% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	Sulfate	Soil/Sed	USAEC	USAEC, RPD <50% <sup>b</sup>	90%
Lab Non-PD <sup>2</sup>	Hydrocarbons	Soil/Sed	50 - 120%	RPD <75%	90%
Lab USAEC-PD <sup>1</sup>	TCL VOAs	Grd/Surf Water	USAEC	USAEC, RPD < 30% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	TCL SEMIVOAs	Grd/Surf Water	USAEC	USAEC, RPD < 30% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	TAL Metals	Grd/Surf Water	USAEC	USAEC, RPD < 30% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	Chloride	Grd/Surf Water	USAEC	USAEC, RPD < 30% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	Nitrate/Nitrite	Grd/Surf Water	USAEC	USAEC, RPD < 30% <sup>b</sup>	90%
Lab USAEC-PD <sup>1</sup>	Sulfate	Grd/Surf Water	USAEC	USAEC, RPD < 30% <sup>b</sup>	90%
Field Non-PD <sup>3</sup>	pH	Grd Water	±0.2 pH Units	±0.2 pH units <sup>b</sup>	90%
Field Non-PD <sup>3</sup>	Temperature	Grd Water	±1°C	±1°C <sup>b</sup>	90%
Field Non-PD <sup>3</sup>	Conductivity	Grd Water	±2% Scale	±2% Scale <sup>b</sup>	90%
Field Non-PD <sup>3</sup>	Turbidity	Grd Water	±2% Scale	±2% Scale <sup>b</sup>	90%
Lab Non-PD <sup>4</sup>	TCLP VOAs	TCLP Extract	Compound Dependent	Compound Dependent	90%
Lab Non-PD <sup>4</sup>	TCLP SEMIVOAs	TCLP Extract	Compound Dependent	Compound Dependent	90%
Lab Non-PD <sup>4</sup>	TCLP Metals	TCLP Extract	±15%	RPD <10%	90%
Lab Non-PD <sup>4</sup>	Total Dissolved Solids	Grd/Surf Water	±20%	RPD <30% RPD <50% <sup>b</sup>	90%

Sources:

1. USAEC, Quality Assurance Program, January 1990
2. Modified method based on SW-846 8015 and ASTM D3328-78
3. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March 1983
4. Test Methods for Evaluating Solid Waste. Physical/Chemical Methods, SW-846, 3rd Ed., January 1990

a. For the USAEC-performance demonstrated (PD) methods, the precision and accuracy will be based on the historical control chart data of PACE Laboratories. For the non-performance demonstration methods, the precision will be based on recovery of spikes and USAEC standard soil and water.

b. RPD-DQO is for the analysis of field duplicates.

#### **4.2.3 Representativeness**

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variation at a sampling point, or an environmental condition. A representative sample should possess the same qualities or properties relevant to the investigation as the material under investigation. Representativeness reflects the design of the sampling program; representativeness is maximized by proper selection of sampling locations and collection of a sufficient number of samples. Sampling locations for the HHA and FTA investigations covered in this project were selected using a targeted sampling design.

#### **4.2.4 Completeness**

Completeness is defined as a measure of the amount (percent) of valid data obtained from a measurement system, either field or laboratory, compared to the amount expected from the system. Completeness will be assessed in terms of the actual number and type of sample results received from the laboratory as compared with the planned number and type of results. A target of 90 percent completeness for all field and laboratory data is expected for this project.

#### **4.2.5 Comparability**

Comparability addresses the confidence with which one data set can be compared to another. Use of appropriate sampling methods, chain-of-custody procedures, and USAEC-performance demonstrated and EPA-approved analytical methods, as well as adherence to strict QA/QC procedures, provide the basis for uniformity in sample collection and analysis activities.

For this project, data will be considered valid with respect to the comparability objectives if the USAEC acceptance criteria for precision, accuracy, and any other method-specified quality criteria are achieved. This project is being conducted under the USAEC requirements for field sampling activities and laboratory analysis. To the extent possible, USAEC-performance demonstrated methods are being used in a USAEC-performance demonstrated laboratory. For non-performance demonstrated analyses, USAEC requirements have been followed for using standardized methods with appropriate QA/QC protocols to generate data of known quality.

Areas of concern were selected to address data gaps from previous investigations; sampling locations will be identified based on existing information and field survey data. Parameter variations at a sampling point can be evaluated on the basis of field duplicate results.

In addition, comparability is assured through the consistent use of units. The data collected as part of this program will be reported in the units given in Table 4.2 on the following page:

**Table 4.2: Standard Units for the Reporting of Analytical Data**

Parameter	Water	Soil/Sediment
TCL Volatiles	µg/L	µg/g
TCL Semivolatiles	µg/L	µg/g
TCL PCB's	µg/L	µg/g
TAL Metals	µg/L	µg/g
HPLC Explosives	µg/L	µg/g
IC Chloride, Sulfate, Nitrate/Nitrite	µg/L	µg/g
Total Dissolved Solids	µg/L	NA
Petroleum Hydrocarbons	µg/L	µg/g
pH	pH Units	pH Units
Temperature	°C	NA
Conductivity	µmhos/cm <sup>2</sup>	NA
Turbidity	NTU	NA

## 5.0 SAMPLE COLLECTION

The quality of the data collected for the HHA and FTA investigations is a function of the overall design and planning of the sample collection program and the specific sample collection and handling procedures employed. In addition to the collection of samples, activities included within the sample collection and handling phase of field investigations include preparation of sample containers, sample preservation, sample identification, sample handling and shipment, and chain-of-custody documentation.

### 5.1 Sampling Program for the HHA and FTA

The sampling program for the HHA and FTA is described in the Work Plan, provided as a separated document. In order to ensure that collected field samples are representative of the matrices under investigation and to ensure that the physical and chemical integrity of the samples is maintained prior to analysis at PACE, detailed procedures comply with USAEC and EPA specifications and guidelines for the collection of environmental samples. The following sections summarize these procedures.

### 5.2 Sampling Equipment and Procedures

The various sampling and data collection procedures that will be followed during the RI/FS field investigation activities are presented below, and include discussions of the various sampling and data acquisition equipment which will be used for each activity.

#### 5.2.1 Geologic Characterization and Soil Quality Assessment

An exploratory boring and surface soil sampling program will be conducted to collect subsurface soil samples from the near surface, and at depth, for geotechnical and chemical characterizations of the various subsurface environments near suspected contaminant source areas. This program will also provide the means for installing ground water monitoring wells at some locations so that the ground water quality and specific hydraulic characteristics of the various subsurface environments can be monitored and evaluated.

##### 5.2.1.1 Subsurface Clearance Program.

The final location of each subsurface soil sample and exploratory borehole will be determined prior to drilling. UXO avoidance will be conducted during each subsurface activity (e.g., drilling).

##### 5.2.1.2 Exploratory Boring Program.

Each exploratory boring will be advanced using a truck-mounted hydraulic hollow stem auger drill rig that has the capability of converting to a drive and wash drilling method, as necessary.

All drilling supplies will be maintained by the drilling subcontractor. These supplies are likely to include extra hollow stem augers, steel casing, well construction materials (e.g., PVC well screens and riser pipe, bags of sand packing material, buckets of bentonite pellets, and bags of grout), and well completion materials (e.g., protective steel surface casings and concrete).

Each drill rig and all drilling equipment such as hollow stem augers, steel casing, drill rods, mud tubs, and split spoon samplers will be steam cleaned immediately prior to initiation of drilling activities. The drilling subcontractor will supply steam cleaners and water trucks (as necessary). Drill water will be obtained from a tested and approved location during the mobilization subtask.

Decontamination of all sampling equipment will be conducted prior to each use in accordance with the Geotechnical Requirements. Each drill rig and all drilling equipment will be decontaminated prior to arrival on site, prior to reaction on site, and prior to leaving the site. Drill rig and drilling equipment will be decontaminated in an area designated for this activity by the FGGM Environmental Management Office (EMO) through the USAEC Project Officer.

Continuous split spoon sampling at each drilling location will be performed at the ground surface and at 5 foot intervals. The final depth of these borings is dependent upon local stratigraphy and contaminant levels detected in each borehole and in surrounding borehole locations. The procedures for installing ground water monitoring wells in designated boreholes is presented in Section 5.2.2.1 of this plan. For exploratory borings that will not have monitoring wells installed, the borehole will be abandoned in accordance with USATHAMA Geotechnical Guidelines.

#### **5.2.1.3 Sub-surface Soil Sampling Program.**

Three soil samples will be collected by Analysas personnel from each boring used for a monitoring well installation. Soil samples will be collected as follows:

- At least one soil sample will be collected from the unsaturated zone.
- A soil sample will be collected near the water table surface.
- Each sample collected will be composited in a stainless steel bowl prior to distribution into the various chemical sample jars. However, if a sample is scheduled for volatile organic compound analysis, the appropriate sample bottle will be filled using a representative portion of soil from the first portion of soil at depth.

#### **5.2.2 Ground Water Quality Assessment**

A series of ground water investigations, including ground water quality and hydraulic flow investigations, will be conducted at the HHA and FTA. The objective of the ground water quality investigation is to collect representative ground water samples from discrete hydraulic zones within the subsurface for chemical analyses. The objective of the hydraulic survey is to identify hydraulic flow gradients within the subsurface. The results of the ground water chemical analyses will be used to determine the concentrations and distributions of detected chemicals within the various hydraulic flow regimes. The hydraulic data, in conjunction with geologic and location/elevation data, form the basis for theoretical chemical transport evaluations.

##### **5.2.2.1 Ground Water Monitoring Well Installation and Development Program**

All ground water monitoring wells will be constructed in accordance with USATHAMA Geotechnical Guidelines, and will generally include a 4-inch diameter, 10-foot length of slotted PVC screen with a 4-inch diameter solid PVC riser extending to approximately 2.5 feet above the



ground surface. Each well will be constructed with a sandpack filling the annular space around the screened interval from no more than 3 feet below the bottom of the well screen to a minimum of 5 feet above the top of the screen. A bentonite seal will be placed above the sandpack, with a maximum slurry thickness or a minimum pellet thickness of 5 feet. Each PVC well will be covered with a PVC slip-cap and protected with a locking steel standpipe and surface finish in conformance with the USATHAMA *Geotechnical Requirements for Drilling, Monitor Wells, Data Acquisition, and Reports* (March 1987).

Each newly installed ground water monitoring well will be developed to restore the aquifer's hydraulic conductivity and to remove well drilling fluids, solids, and other mobile particles from within, and adjacent to, the newly installed well. Well development will be conducted no sooner than 48 consecutive hours after, nor longer than 7 calendar days beyond, initial mortar collar placement.

#### **5.2.2.2 Ground Water Monitoring Well Sampling Program.**

Ground water samples will be collected from all monitoring wells identified in the Work Plan. For newly constructed wells, ground water sampling will be conducted no sooner than 14 days after well development. The depth to water, total well depth, and thickness of any free-phase product that may be present will be measured and recorded prior to ground water sampling. A total of five purge volumes will be removed from the well immediately prior to sampling. The purge volume for each well includes the volume of standing water in the well plus the volume of water in the annular space surrounding the well over the same height. The volume of water within the annular space assumes 30 percent porosity.

Immediately upon initiation and at completion of purging, the following aquifer stabilization parameters will be measured and recorded: pH, temperature, specific conductivity, and turbidity. All purging and sampling procedures will be conducted using a decontaminated, chemically inert, variable flow, submersible pump. All sample bottles and lids will be rinsed with the well water prior to filling, except for the volatile sample vials. Each sample that requires filtering will be collected by attaching an in-line, 0.45 micron, disposable filter to the pump outflow. A new filter will be used at each sampling location. All samples will be preserved in the field as described in Section 5.3.2.

#### **5.2.3 Surface Water Sampling Procedures**

Surface water will be collected as follows:

- Surface water samples will be collected from the Little Patuxent River during periods of moderate flow. Precipitation records for the week prior to sampling will be maintained to confirm the relative flow state.
- The surface water column will be measured and recorded using a weighted tape. The position of the sampling point to the shoreline will also be measured and recorded. Records will include detailed sketches of each sample location for future reference. Each location will also be plotted on the detailed site basemap.

- The pH, temperature, specific conductivity, and turbidity of each surface water sample will be measured immediately prior to collection.
- All sample containers and lids, except for the volatile sample vials, will be rinsed with the sampled surface water prior to filling.

#### **5.2.4 Sediment Sampling Procedures**

Each sediment sample will be collected using a procedure similar to that described for Sub-surface Soil Sampling (Section 5.2.1.3) with the following exceptions:

- The surface water column above each sediment location will be measured and recorded using a weighed tape. The position of the sampling point to the shoreline will also be measured and recorded. Records will include detailed sketches of each sample location for future reference. Each location will also be plotted on the detailed site basemap.
- For sediment collection below relatively shallow surface water bodies (i.e., less than four feet deep) the sampling location will be accessed by the sampler from the downstream direction to minimize disruption of bottom sediment in the sample area. The sampler will be wearing chest waders and will be accompanied by a co-worker who will observe activities from shore in case of emergency and will document all sampling activities.

#### **5.2.5 Location and Elevation Survey**

All sampling points will be plotted on an installation map provided by the USAEC Contract Officer Representative. Where sediment, soil, and surface water samples are involved, sampling point coordinates will be established from a USGS Topographic Map. The location and elevation of all newly installed ground water monitoring wells will be determined by a licensed surveyor within 15 days of completion of the last monitoring well. All locations will be recorded in a dedicated field notebook, entered in the USAEC data management system, and located on an installation map.

#### **5.2.6 Investigation Derived Waste**

Waste generated during the field investigation are managed under this subtask. Potentially hazardous wastes generated include drill cuttings, drill fluids, development water, decontamination fluids, and protective clothing.

In accordance with Section C3.1.9 (Disposal of Wastes Generated Incidental to Investigations) of the basic contract, the contractor shall containerize all soil cuttings, drilling mud, drilling water, decontamination fluids, and other investigation-derived wastes (IDW). Analysis will provide for the characterization of the waste in order to determine the appropriate disposal requirements. Investigation derived waste will be visually inspected and field tested using a Photo Ionization Detector (PID) or Flame Ionization Detector. We will select individual drums for compositing on the basis of visual similarities, and field testing.

We assume that we will be able to composite representative sample aliquots from two to three drums into a single sample for analysis. Composite samples will be collected from the drummed

materials and will be analyzed by RCRA Toxicity Characteristic Leaching Procedure (TCLP) for organics and metals. The analysis will aid in characterizing if the IDW is hazardous and shall account for all federal, state of Maryland, and local requirements. The ultimate disposal of materials will be pursued through use of installation hazardous waste disposal contracts or procedures.

If the material is not classified as a RCRA hazardous waste according to the TCLP analysis, it will be disposed of at FGGM at locations specified by the FGGM EMO. We anticipate disposing of non-hazardous wastes generated during the investigations at HHA and FTA, such as packing materials, in Fort Meade waste handling facilities.

If the material is classified as a RCRA hazardous waste, it will be disposed of in accordance with 40 CFR Part 262, *Standards Applicable to Generators of Hazardous Waste* and the FGGM Environmental Officer. A licensed hazardous material disposal firm will be engaged to provide the transport and disposal of any RCRA hazardous waste generated during the investigations. We expect that Fort Meade will issue any necessary manifests, indicating Fort Meade as the waste generator.

### **5.3 Sample Containers, Preservation, and Handling**

#### **5.3.1 Sample Containers**

To ensure the integrity of the field samples, specific steps must be taken to minimize the potential for contamination from the containers in which the samples are stored. Sample containers must be compatible with the analytes of interest; a complete list of sample containers is provided by USAEC for analytical samples collected in support of the Installation Restoration Program. The following general recommendations will be followed: septum-sealed amber glass vial for volatile compounds; amber glass bottles with Teflon-lined lids for organic compounds other than volatiles; polyethylene bottles for inorganic analytes; and wide-mouth amber glass bottles for the various analytical samples for the HHA and FTA investigation are indicated in Table 5-1.

For the HHA and FTA sampling activities, all sample containers will be supplied by PACE, which is performance demonstrated to perform USAEC analyses. All sample containers will be cleaned prior to shipment to the field. Cleaning procedures will be applied to new containers; reuse of sample containers is expressly prohibited. The cleaning procedures used by PACE are consistent with the specifications of the sample container cleaning procedures outlined in the USAEC QA program.

**Table 5-1: Summary of Containers, Preservation Times, and Holding Times for Sampling at The Helicopter Hangar Area and the Fire Training Area**

ANALYSIS	SAMPLE CONTAINERS	PRESERVATION	HOLDING TIME
TCL Volatiles (Water)	1-L Polyethylene bottle, teflon-lined cap	Cool, 4" C HCl to pH<2	14 days
TCL Volatiles (Soil/Sediment)	250-mL amber wide-mouth glass jar, Teflon-lined cap	Cool, 4" C	14 days
Base-neutral and acid-extractable compounds (Water)	1-L amber glass bottle, Teflon-lined cap	Cool, 4" C	7 days to extraction: 40 days after extraction
Base-neutral and acid-extractable compounds (Soil/Sediment)	250-mL amber wide-mouth glass jar, Teflon-lined cap	Cool, 4" C	7 days to extraction: 40 days after extraction
PCB's (Water)	1-L amber glass bottle, Teflon-lined cap	Cool, 4" C	7 days to extraction: 40 days after extraction
PCB's (Soil/Sediment)	250-mL amber wide-mouth glass jar, Teflon-lined cap	Cool, 4" C	7 days to extraction: 40 days after extraction
TAL Metals (Water)	1-L Polyethylene bottle, teflon-lined cap	HNO <sub>3</sub> to pH<2	6 months
TAL Metals (Soil/Sediment)	250-mL amber wide-mouth glass jar, Teflon-lined cap	Cool, 4" C	6 months
Cyanide (Water)	1-L Polyethylene bottle, teflon-lined cap	Cool, 4" C, NaOH to pH > 12, 0.6g Ascorbic Acid	14 days
Cyanide (Soil/Sediment)	250-mL amber wide-mouth glass jar, Teflon-lined cap	Cool, 4" C, NaOH to pH > 12, 0.6g Ascorbic Acid	14 days
Sulfide (Soil/Sediment)	250-mL amber wide-mouth glass jar, Teflon-lined cap	Cool, 4" C, add Zinc Acetate + NaOH to pH > 9	7 days
Total Organic Carbon (Soil/Sediment)	250-mL amber wide-mouth glass jar, Teflon-lined cap	Cool, 4" C	28 days
TCLP (Soil/Sediment)	Two 250-mL amber wide mouth glass jars, Teflon lined cap	Cool, 4" C	See Table 5-2

Source: USATHAMA Quality Assurance Program (January 1990)

### **5.3.2 Sample Preservation and Holding Times**

The purpose of sample preservation is to prevent or retard the degradation or transformation of target analytes in the field samples during transport and storage. Preservation efforts to ensure sample integrity will be initiated at the time of sampling and will continue until the analyses are performed. Preservatives will be added to the sample container at time of sample collection. The required preservatives for specific analytical samples to be collected for the HHA and FTA RI/FS investigation are indicated in Table 5-1.

Chemical preservatives will be supplied to the field by PACE. Bottles for aqueous samples will be triple-rinsed with the water being sampled, according to USAEC requirements, before the addition of preservatives, except for the volatile sample vials. For volatiles analyses, the preservative will be added before sample container is filled; for all other analyses, the sample container will be filled and then the preservative will be added.

After collection and preservation, all samples will be stored and shipped at 4 degrees Celsius. Samples will be sent to PACE Inc. for analysis as expeditiously as possible to ensure data quality. The recommended maximum holding times for analytical samples will be adhered to by the laboratory subcontracted for analysis of the HHA and FTA samples. Maximum holding times are calculated from the date of sample collection. Freezing of samples to extend the holding time is not permitted.

### **5.4 Field Quality Control Samples**

Field Quality Control (QC) samples are included as part of the HHA and FTA field investigation. The following types of QC samples will be included at a rate of 1 per lot or 1 per 20 field samples, per sampling technique:

The results of analyzing field blanks are used to check the cleanliness and effectiveness of field handling methods. The results of analyzing trip blanks are used to assess potential contamination during sample transport.

- The results of analyzing equipment/rinsate blanks are used to evaluate potential cross-contamination from field sampling equipment, and the effectiveness of the decontamination procedures.
- The results of analyzing field duplicates/collocates are used for assessing the consistency of the field and analytical program.

The field QC samples will be treated by the laboratory as field samples. The purpose of the field QC samples and the frequency of collection are further discussed in Section 9.0 of this Project QC Plan. The QC samples are described in Section 9.1.

## **5.5 Sample Handling**

All Samples, including field duplicates, trip blanks, and equipment blanks will be maintained in a manner that assures the integrity and representativeness of each sample from the time of collection to laboratory analysis. This maintenance includes the accurate completion of all required documents and the secure packaging of samples prior to transport and shipment. Secure packaging of samples prior to transport and shipment. Secure packaging includes the following steps:

- Each sample label is individually wrapped in clear tape to protect the label from water damage, and to assure the sample label is not detached from the sample.
- Each sample bottle will be individually wrapped in bubblewrap to reduce the potential for breakage during transport.
- All samples associated with a shipment will be placed in a rigid pre-cooled container with ample coolant to maintain the samples at 4°C during transport and shipping.
- Individual cooler packing lists and chain-of-custody forms will be placed inside the coolers and will accompany each sample shipment.
- Any open space remaining in the cooler(s) will be filled with bubblewrap to eliminate motion within the cooler.
- Each packed cooler will have a signed and dated custody seal placed across the opening to ensure that the cooler will not be opened until it reaches the laboratory.
- Each cooler custody seal will be protected with clear tape to insure its integrity during transport and shipping.

The individual shipping numbers will be maintained in a field notebook in case tracking of the shipment is required.

## **5.6 Field Personnel**

The resumes of Analysas field personnel for the HHA and FTA field sampling subtask are presented in Appendix A.

## **6.0 SAMPLE CUSTODY**

This section describes procedures for sample chain-of-custody to be followed by Analysis sampling personnel and the subcontracted laboratory, PACE. The primary objective of the chain-of-custody procedures is to provide an accurate written record that can be used to trace the possession and handling of a sample from the moment of its analyses. A sample is considered to be in custody if it is: in someone's physical possession; in someone's view; locked up; or kept in a secured area that can only be accessed by authorized personnel.

The purpose of these procedures is to ensure that the quality of the samples is maintained during sample collection, transportation, storage, and analysis.

Sample identification documents must be carefully prepared so that sample identification and chain-of-custody can be maintained and sample disposition controlled. Sample identification documents include field notebooks, sample labels, custody seals, and chain-of-custody records.

### **6.1 Field Custody Procedures**

The field custody procedures to be followed by the field sampling crew are summarized in this section. The procedures have been prepared in accordance with the programmatic QA requirements specified by USAEC and EPA.

All samples collected for chemical analysis during the performance of the RI/FS for the HHA and FTA are assigned unique sample designation codes so that all chemical and physical data collected in association with each sample can be directly linked to a specific location, depth, time, and sample media prior to interpretation. Each assigned sample designation code is composed of a predetermined Site Location Identity (SLI) and a Unique Sample Code (USC). The SLI is composed of an alphanumeric code which includes the IRDMIS Site ID, Site Type, and Media Code. The USC provides further detail on the area identification, sample interval, and sample media. The SLI will remain consistent for all samples collected from a single location, regardless of depth, and may therefore correspond to several data sets from a particular event. The USC, when compared with the SLI, serves to uniquely delineate a data set. All sampling locations that were established previously and which are scheduled for re-sampling during these field activities will use the previously established Site ID to maintain consistency with USAEC's IRDMIS. All newly established sites will be assigned Site IDs consistent with those already in existence.

### **6.2 Laboratory Custody Procedures**

The laboratory chain-of-custody of the samples begins with sample receipt and continues through final disposition of the field samples and other analytical samples (e.g., extracts) generated during analysis. The areas of concern for laboratory custody of samples include the following: sample receipt and log-in; internal chain-of-custody during analysis; sample lotting and labeling; sample splitting; storage of samples and sample extracts; and disposal.

A copy of applicable field chain-of-custody records will be maintained with each sample. In

**Table 7-2: Analytical Procedures, Methods, and Matrix Spikes**

ANALYTE	USAEC Approved Method
TCL Volatiles (Water)	UM05
TCL Volatiles (Soil/Sediment)	LM33
Base-neutral and acid- extractable compounds (Water)	UM06
Base-neutral and acid- extractable compounds (Soil/Sediment)	LM30
PCB's (Water)	UH21
PCB's (Soil/Sediment)	LH19
TAL Metals (Water)	SS15
TAL Metals (Soil/Sediment)	JS14
Cyanide (Water)	TY03
Cyanide (Soil/Sediment)	KY04
Sulfide (Soil/Sediment)	
Total Organic Carbon (Soil/Sediment)	
TCLP (Soil/Sediment)	



## **8.0 DATA REDUCTION, VALIDATION, AND REPORTING**

### **8.1 Analysis Data Management**

Data management for this project refers to the effective management of all project related information; map, geotechnical and chemical data. Analysis' and PACE's data management systems will be coordinated to achieve an efficient flow of information from the laboratory through Analysis to USAEC.

#### **8.1.1 Flow of Map Data into IRDMIS**

IRDMIS map data entry refers to registering sampling locations by a specific convention and a coordinate system using a USAEC software program called PC IRDMIS or PC TOOL. Analysis will acquire the latest FGGM map database from Potomac Research, Inc. (PRI) and will send this map database to PACE so that proper record and group checks will be possible. Analysis will also be responsible for providing both PACE and USAEC with updated map files based on sampling efforts at the HHA and FTA. When a new site is being sampled, Analysis will enter the map data to ensure proper processing of the associated analytical data.

#### **8.1.2 Flow of Geotechnical Data into IRDMIS**

Analysis will provide USAEC with updated geotechnical files based on sampling efforts at the HHA and the FTA. The geotechnical data from new well sites will be processed and entered into IRDMIS by Analysis. These data will be transferred into an ASCII-based "transfer" file, which will be sent to PRI for processing, validation, and loading to the USAEC legal repository known as Level III.

### **8.2 Data Reduction**

All the processes that change either the form of expression or quantity of data values or numbers of data items are part of the data reduction process.

Raw data from quantitative analysis procedures such as Gas Chromatography (GC), Gas Chromatography/Mass Spectrometry (GC/MS), High Performance Liquid Chromatography (HPLC), Inductively Coupled Argon Plasma (ICAP) and Ion Chromatography (IC) generally consist of peak areas (or peak heights) for the analytes of concern, internal standards, and surrogates. This applies to Class 1, and 1A. These raw data will be converted to concentrations by use of calibration curves or relative response factors that relate peak area to the quantity of analyte introduced in the instrument. For field methods, the calibration procedures are generally less rigorous than those for Class 1 and 1A.

Generally, data will be collected during the analysis of samples either into computer based files or onto hard copy sheets, which, in turn, are either machine generated or hand written. In reporting results, rounding to the correct number of significant figures (this varies with method) will occur only after all calculations and manipulations are completed. For dilutions, the number of significant figures will be reduced by one. Each analytical method referenced in Table 7-1 will describe the data reduction procedures for laboratory analysis results. Additionally, it will describe

the correct procedure for using method blank results.

All uncorrected values less than the certified (performance demonstrated) reporting limit, including no response, will be reported as "less than" the reporting limit. Results of the analyses will be entered into the IRDMIS as outlined in the IR Data Management User's Guide (USATHAMA, September 1992). Non-performance demonstrated analytes will be reported using detection limits documented in the appropriate method and will be flagged for data entry into the IRDMIS Non-THAMA Approved Methods (NTAM) database.

### **8.3 Data Validation**

Data validation is an integral part of this QA program. Data validation will be performed on one hundred percent of all data packages by PACE's QA Coordinator which is a requirement of AEC's Quality Assurance Program. Analyses will periodically review and validate data packages to add redundancy to the process. Data review and validation will be accomplished following USAEC guidelines for data review.

Prior to being reported to Analyses for entry into IRDMIS, final results produced by the PACE analyst are independently reviewed/validated by another analyst or supervisor experienced in the method. They are then approved by the department manager/lab director.

All quality criteria (accuracy, precision, control limits, etc.) are reviewed and approved by the technical staff and independently monitored by the Quality office. Each project is assigned to a project manager. The project manager is responsible for tracking sample progress through the laboratory and ensuring delivery of the product as specified by the client. The report of analysis is approved by the department manager or director.

Complete project files are periodically inventoried and stored off-site in a secure facility. Electronic data are copied onto computer tape, inventoried, and stored off-site in a secure facility.

With the use of the USAEC Data Review Checklist, a thorough package audit is performed. This includes checking the control charts, method blanks, standard matrix, and sample matrix spike recoveries, surrogate recoveries, calibration curves, certified (performance demonstrated) reporting limits, and units. The lab QA Coordinator or assistant makes an initial judgment on the acceptability of the method blank and other data. Also included in the reviews are the analyst's notebook pages, number of samples and sample identifications, dilutions, percent moisture, sample weights, chain-of-custody forms, standard preparation notebooks, instrument logbooks, etc. After ensuring that all these items are present and complete, the QA staff proceeds to review the raw data for precision, accuracy, and completeness. The raw data are checked against the reported values, and the appropriate calculations are spot checked.

Any discrepancies pertaining to any of the previously mentioned QA/QC checks are directed to the analytical task manager for verification, clarification, and/or correction, if necessary. Other queries regarding the data transmission file are addressed directly to Data Management. The questions are usually written under the "Comments" section of the USAEC Data Review

Checklist or on separate attachments. once the questions are satisfactorily answered, the QA staff initials and dates the batch and appropriate sections. The batch folder is then returned to Data Management for entry into IRDMIS.

The control charts are reviewed and transmitted to USAEC and Analysas weekly by the PACE QA Supervisor. The control charts are reviewed by the Analysas Lead Geochemist, and QA Manager before any data are transmitted to USAEC IRDMIS data files.

Three data levels are used to indicate increasing QA and validation performed on the data. Data reviewed by the Analysas QA Manager and subsequently transmitted to IRDMIS files are considered to be Level I data. At USAEC, Potomac Research, Inc. (PRI), the USAEC on-site data management contractor, loads the data into a computer for group and record checks. Errors, if present, are reported to the USAEC COR and chemist. Based on the nature of the error, the data are corrected or rejected. When the data have successfully passed group and record checks, they are elevated to Level II. Level II data become Level III when they are uploaded into the USAEC computer system. Level III data are available to users to create reports and graphs, but they cannot be changed by contractors. Generally, only Level III data are available to the USAEC COR. Under unique circumstances, the COR may request and receive Level I data. Level I data are used for informational purposes only. Major decisions and risk assessments are based on Level III data only.

#### **8.4 IRDMIS Record and Group Checks**

After each data packet has been reviewed by key individuals and validated by QA, the data file from the packet is loaded into the USAEC IRDMIS system at Analysas and run through the first record check followed by the group check. Every data point is checked using these two routines. IRDMIS record check determines the following:

- Validity of file name and site type combinations.
- Validity of sampling program and technique, and existence or absence of depth measurement.
- Sample date, preparation/extraction date, and analysis date are compared to determine any holding-time violations.
- All test names are verified as valid, and either performance demonstrated or flagged as non-performance demonstrated, at the time of analysis or at present.
- Value compliance with Certified (performance demonstrated) Reporting Limit and Upper Certified (performance demonstrated) Limit.
- Correct Boolean values such as ND, LT
- Correct QC test, mantissa and exponent values, and uncorrected mantissa and exponent values.

- If required, dilution mantissa, exponent, and moisture content inclusion.
- Inclusion of all required flagging codes.

IRDMIS group check determines the following:

- That all test names/analytes found in QC are present in all of the samples.
- That all required QC spikes exist, all spiking levels are valid as determined by the methods table, and no aberrations exist in QC or sample data.

Specific criteria for record checks are based on the specific analytical method and on the current performance demonstration status of the laboratory performing the analysis. these criteria are stored in IRDMIS as certifications (performance demonstration) tables.

## **9.0 INTERNAL QC CHECKS AND FREQUENCY**

### **9.1 Control Samples**

Control samples are those that are introduced into the train of environmental samples to function as monitors of the analytical method. All required QC samples will be prepared from standard matrices or actual field samples and processed through the complete performance demonstrated analytical method. Stock solutions used to spike QC samples will be prepared independently of stocks used for calibration or performance demonstrations samples.

### **9.2 Field Control Samples**

Various types of field QC samples are used to check the cleanliness and effectiveness of field handling methods. Field QC samples help indicate whether project data quality objectives have been met by providing quantitative and qualitative measures of precision, accuracy, representativeness, completeness, and comparability parameters. They are analyzed in the laboratory as samples, and their purpose is to assess the sampling and transport procedures as possible sources of sample contamination and document overall sampling and analytical precision. Field staff may add blanks or duplicates if field circumstances are such that they consider normal procedures insufficient to prevent or control sample contamination, or at the direction of the Task Manager. Rigorous documentation of all field QC samples in the site logbooks is mandatory.

Field QC samples and the programmatic recommendations for frequency of collection are briefly described below. The specification and number of field QC samples to be collected at the HHA and FTA site are provided in Table 9-1.

#### **9.2.1 Trip Blanks**

Trip blanks are not exposed to field conditions; results from the analysis of trip blanks are used to assess potential contamination from everything except ambient field conditions. Trip blanks are prepared at the laboratory prior to the sampling event by adding reagent ground water to a 40-ml VOA vial containing two to three drops of concentrated hydrochloric acid; they are shipped with the sample bottles. One trip blank will be used with every shipment of water samples for volatile organic analysis. Each trip blank will be transported to the sampling location, handled in the same manner as a field sample (except the bottle cap is not removed), and returned to the laboratory for analysis without having been opened in the field.

#### **9.2.2 Field Equipment/Rinsate Blanks**

The results of analyzing field equipment/rinsate blanks are used to document that sampling equipment have been properly prepared and cleaned before field use and that cleaning procedures between samples are sufficient to minimize cross-contamination. Rinsate blanks are prepared onsite by passing analyte-free water over sampling equipment; they are analyzed for all applicable parameters. If a sampling team is familiar with a particular site, it may be possible to predict the areas or samples that are likely to have the highest concentration of contaminants. The equipment blank sample should be collected after a sample is expected to exhibit high concentrations of target analytes.

**Table 9-1: Frequency of Laboratory QC Samples for USAEC-Performance Demonstrated Methods**

USAEC CLASS	ANALYSIS	Method Blank	Spikes
1	Metals	1	3
	Explosives	1	3
	Nitrate	1	3
	PCB's	1	3
	Sulfate	1	3
	Chloride	1	3
1A	VOA's	1*	1
	BNA's	1*	1
2	PCB	1	1

\* = Surrogates only

Rinsate blanks will generally be collected at a frequency of one per day per equipment type used that day. Rinsate blanks will not be collected for sampling activities using dedicated equipment to collect each sample.

### **9.2.3 Field Duplicates**

Field duplicates are two samples collected independently at a sampling location during a single sampling event. The results of analyzing field duplicates are used to assess the consistency of the overall sampling and analytical system. Field duplicate samples are generally collected at a rate of 1 per 20 or fewer samples per matrix.

## **9.3 Laboratory Control Samples**

Quality Control data are necessary to determine precision and accuracy and to provide quantitative evidence that the method is performing comparably or better than when documented during method development and performance demonstrations. Laboratory-based control samples will consist of standards, surrogates, spikes, and blanks. Data generated from control samples included in each lot will be plotted on control charts to monitor day-to-day variations in routine analyses. For this program PACE will follow the approach described by the USAEC QA Program for performance demonstrated methods with respect to laboratory control samples. For non-performance demonstrated methods will follow the specific method directives. Generally, a blank, a spike, and a duplicate will be included in each lot of 20 or fewer samples.

The types of laboratory control samples and the minimum acceptable performance for non-performance demonstrated methods for USAEC projects are briefly described below.

### **9.3.1 Laboratory Blanks**

In addition to field blank samples, three types of blanks that may be analyzed in the laboratory are calibration blanks, and reagent blanks. Method blanks and reagent blanks are used to assess laboratory procedures as possible sources of sample contamination. Calibration blanks establish the analytical baseline against which all other blanks are measured.

- Method blanks are laboratory blanks that correspond to the first step in sample preparation and as such, provide a check on contamination resulting from sample preparation and measurement activities. For USAEC-performance demonstrated procedures, method blanks for water and soil samples consist of a standard matrix that is subjected to the entire sample procedure as appropriate for the analytical method being utilized. For non-performance demonstrated methods, the method blank is typically an appropriate volume of laboratory water carried through the entire preparation and analysis procedure.
- Reagent/Solvent blanks are closely related to method blanks, but they do not incorporate all sample preparation materials and analytical reagents in one sample. When a method blank reveals significant contamination, one or more reagent blanks may be prepared and analyzed to identify the source of contamination.

- Calibration blanks consist of pure reagent matrix and are used to zero an instrument's response to the level of analytes in the pure reagent matrix. They do not provide a direct indication of the types, sources, or levels of contamination, but they establish the analytical baseline.

### **9.3.2 Laboratory Duplicates**

Laboratory duplicate samples are defined as two sample aliquots taken from the same sample container and analyzed independently. The results of these analyses serve as an indicator of the precision of the method and the sample results. The frequency of these duplicates is specified in the performance demonstrated methods. For non-performance demonstrated methods, duplicates will be prepared with the frequency specified in the referenced method.

### **9.3.3 Calibration Standards**

A calibration standard is prepared in the laboratory by dissolving a known amount of a pure compound in an appropriate matrix. The final concentration calculated from these standards are used to generate a standard curve and thereby quantify the compound in the environmental sample. See Section 7.0 for calibration procedures.

### **9.3.4 Spike Sample**

A sample spike is prepared by adding to an environmental sample or standard matrix (for USAEC-performance demonstrated methods; before extraction or digestion), a known amount of pure compound of the same type that is to be analyzed for in the analysis. The spike may also be a surrogate compound for the analyte of interest. These spikes simulate the background and interferences found in the actual samples and provide a mechanism to verify overall method performance. The calculated percent recovery of the spike is taken as a measure of the accuracy of the total analytical method. For USAEC-performance demonstrated methods, between one and three spiked samples, as specified in each method, will be included in each lot. For non-performance demonstrated procedures, spiked samples will be analyzed with the frequency specified in the method.

### **9.3.5 Internal Standard**

An internal standard is prepared by adding a known amount of pure compound to the environmental sample. The compound selected is not one expected to be found in the sample, but is similar in nature to the compound of interest. Internal standards are added to the environmental sample just prior to analysis.

## **9.4 Concentration and Frequency of Control Samples**

One method blank shall be included in each analytical lot, regardless of performance demonstration class. A single method blank/spike for GC/MS procedures (Class 1A) serves as a standard matrix QC blank and spike. The frequency of QA samples is described below and will be included in each analytical lot:



#### **9.4.1 Class 1 Performance Demonstrated Method**

- Two independently-prepared spiked standard matrix QC samples shall contain all the control analytes at a concentration near the upper end of the certified (performance demonstrated) range or approximately 10 times certified (performance demonstrated) reporting limit (CRL).
- One spiked standard matrix QC sample prepared at the regulatory action level or approximately two times certified (performance demonstrated) reporting limit.

Control analytes will be specified in USAEC standardized methods. For multi-analyte methods, USAEC will designate the required control analytes. Control Limits will be initialized for all analytes.

Control charts will be maintained for each control analyte. Out-of-control situations are discussed in section 10.0.

#### **9.4.2 Class 1A Performance Demonstrated Method (GC/MS only)**

- One independently-prepared standard matrix QC sample (method blank/spike), containing all the performance demonstrated surrogate analytes at approximately 10 times certified (performance demonstrated) reporting limit (not to exceed the upper limit of the certified (performance demonstrated) range). For the method blank/spike, surrogate results represent the QC spike, while unspiked, non-surrogate results represent the method blank.
- Every field sample will be spiked with performance demonstrated surrogate analytes at approximately 10 times the certified (performance demonstrated) reporting limit. The spike concentration will be the same for all samples.

Control analytes will be specified in the USAEC standardized method. Additional non-surrogate target analytes may be specified by the USAEC project officer.

Control charts will be maintained in accordance with the USAEC Quality Program (January, 1990). Out-of control situations are discussed in section 10.0.

### **9.5 Data Reporting for Quality Control**

#### **9.5.1 Class 1, 1A, and 1B Performance Demonstrated Methods**

Results for each analyte in the spiked QC sample will be determined using the same acceptable calibration curve that is used for analytical samples in the lot. Raw values below the CRL will be reported as "less than" the reporting limit. All certified (performance demonstrated) data will be entered into IRDMIS by personnel trained in the use of IRDMIS.

The results of the method blank and spiked QC samples will be quantified each day of analysis. A new lot of samples will not be introduced into the analytical instrument until the results for QC samples in the previous lot have been calculated, plotted on control charts, and the entire

analytical method has been shown to be in control.

Data from the method blank will be reported, usually as "less than" the CRL for each analyte. Any values above the terms of concentration, will be entered into IRDMIS. Data collected from analyses with contaminated blanks will not be used or will be reported flagged.

## 10.0 CONTROL

### 10.1 Control Charts

For Class 1, 1A, and 1B performance demonstrated methods, control charts are used to monitor the variations in the precision and accuracy of routine analyses and to detect trends in these variations. The construction of a control chart requires initial data to establish the mean and range of measurements. The QC control charts are constructed from data representing performance of the complete analytical method. Data used in control charts are not adjusted for accuracy. Control charts are not used with Class 2 performance demonstrated methods.

Control charts include the analyte, method number, PACE laboratory code of UB, spike concentration, and chart title. All data presented on a control chart are also presented in tabular form. The following charts may be selected from the USAEC-supplied computer control chart program:

- Single-Day X-Bar Control Chart (High Spike Concentration)
- Single-Day Range Control Chart (High Spike Concentration)
- Three-Day X-Bar Control Chart (Low Spike Concentration)
- Three-Day Range Control Chart (Low Spike Concentration)

In addition, the following information is also included on each control chart:

- Three-letter designation for each point, shown on the X-axis
- Percent recovery (for X-Bar control charts), or range (for R control charts) along the Y-axis
- Upper control limit (CUL)
- Upper warning limit (UWL)
- Mean
- Lower warning limit (LWL), on X-Bar charts
- Lower control limit (LCL), on X-Bar charts

For some analytes specified by USAEC, warning limits on X-Bar charts are deleted and replaced by modified control limits based upon data quality specifications.

### 10.2 Out-of-Control Conditions

Results of the analysis of quality control samples are reported to QA within 48 hours of completion through the analyst's submission of a Preliminary QC report.

The analyst quantifies each analyte in the method blank and spiked QC sample each day of analysis. Processing of additional lots will not occur until the results of the previous lots have been calculated, plotted on control charts as required, and the entire analytical method is shown to be in control.

An indication of an out-of-control situation may include a value outside the control limits or classified as an outlier by statistical test, a series of seven successive points on the same side of the mean, a series of five successive points going in the same direction, a cyclical pattern of control values, or two consecutive points between the UWL and CUL or the LWL and LCL.

If the points for at least two-thirds of the control analytes for a multi-analyte method are classified as in control, the method is in control and environmental sample data may be reported. A method may be deemed out-of-control even if greater than or equal to two-thirds of the control analytes meet control criteria. Of the remaining control analytes, (less than one-third possible out-of-control), if one analyte has two consecutive out-of-control points, as defined above, the method is deemed out-of-control. If data points for fewer than two-thirds of the control analytes are classified as in control, the method is considered out-of-control and all work on that method must cease immediately. No data for environmental samples in that lot may be reported.

In all cases, investigation by the analyst and the Quality Assurance Coordinator is required to determine the cause of the condition and to decide on appropriate corrective action. The pertinent details of the situation and the corrective action taken are fully documented in a Corrective Action Report (CAR). Field sample data are evaluated and re-analyzed as necessary.

When a method is determined to be out-of-control, the analysis of field samples by that method is suspended. Corrective action must be documented and the method must be demonstrated to be in control before analysis of field samples is reinstated. Analytical control is demonstrated through the acceptable analysis of an appropriate set of QA samples.

**APPENDIX A**

**Resumes of Key Field Personnel**

## **ALISON M. DOHERTY, CPG**

**Experience Summary:** Ms. Doherty has more than 14 years of experience in site characterization, the remedial investigation/feasibility study process (RI/FS), risk assessments, and design and implementation of remedial actions. Ms. Doherty has conducted geologic and hydrogeologic assessments and investigations at numerous DOD, CERCLA, and RCRA sites, as well as municipal and private sector sites. Ms. Doherty has performed environmental site assessments from discovery and initial site surveys through remedial design and implementation. She has performed compliance audits, regulatory analysis, cost-effectiveness studies, and geochemical studies, working in more than 40 states, Canada, and the Caribbean. She is experienced in hazardous waste site entry operations using all levels of personal protective equipment and has provided emergency response support to USEPA. Additionally, she is experienced in contract management, cost control, and innovative contracting strategies.

### ***Related Experience:***

#### **Analysas Corporation, Hydrogeologist, (1994 - present)**

- \* Project Manager for two RI/FS sites at Fort George G. Meade, Maryland.
- \* Program Manager for \$3M contract to provide technical support to the U.S. Army Environmental Center, in areas ranging from hydrogeology, toxicology and risk assessment to remedial design and action, and unexploded ordnance.
- \* Acts as contractor interface with government representatives in order to maintain cost and scheduling requirements for contracts estimated at \$400,000.
- \* Responsible for business development, proposal management and preparation and contract negotiations

#### **BDM International, Inc. Manager, Regulatory Compliance, (1991 - 1994)**

Served as manager on the Transition Team for the Department of Energy's National Institute for Petroleum and Energy Research. Developed the Groundwater Protection Management Plan; the Environmental Compliance Monitoring Plan; the Preparedness and Prevention Contingency Plan and the Emergency Preparedness Plan. Responsible for compliance in all areas of emergency preparedness and contingency planning for the 200-person facility.

Served as Program Manager for two USAF-funded State Priority (Superfund) sites undergoing soils and groundwater remediation, in the Commonwealth of Massachusetts. Coordinated activities among the USAF, BDM, the Potentially Responsible Parties, subcontractors and various State regulatory agencies. Provided technical oversight and approval of field activities. Studies were conducted on a highly compressed schedule, requiring innovative approaches to scheduling, contracting, the actual field investigation phase, and acquisition of regulatory approval for site

closure.

Developed the environmental criteria for a comprehensive multi-attribute use theory model designed for the U.S. Army Materiel Command, which evaluates both tangible and intangible costs and benefits. The model was developed for use in prioritizing and apportioning funding allocations for installations being closed or realigned under the Base Realignment and Closure Act (BRAC).

Served on the working group that conducted the Fernald Environmental Management Project (FEMP) Technology Needs Study. The study links technology development and technical support activities with FEMP milestones.

**Professional Service Industries, Senior Hydrogeologist, (1991)**

Served as senior technical professional for an Environmental Management Group, supporting 25 regional project offices. Provided analytical quality assurance, risk assessment, remedial technology selection and implementation, regulatory interface, health and safety, and training.

Conducted an environmental site assessment at an explosives manufacturing facility. Her knowledge of military chemistry, explosive manufacturing, and chemical process design allowed delineation of locations and functions of the abandoned nitroglycerine/dynamite complex. The audit team identified leaking PCB transformers and unique, threatened and endangered species onsite.

Served as senior geologist for a municipal project in Ohio during design of two domestic wastewater lagoons. Complex hydrogeology, coupled with cost control, was balanced against stringent requirements for liner performance.

Conducted a risk assessment to complete closure of a RCRA surface water impoundment for a metal products manufacturer in Florida. During the site investigation, evidence of offsite contamination was found to be migrating onto the subject facility. Completion of the risk assessment allowed for final closure of the impoundment in compliance with RCRA requirements.

**HAZMAT TISI, Hazardous Materials Training Specialist; (1989 - present)**

Develops and presents RCRA- and OSHA-compliant training to satisfy the requirements of 40 CFR 265 and 29 CFR 1910.120, .134, and .1200. Conducts classroom and practical training exercises, tabletop scenarios, and emergency simulations on hazardous waste management and remediation, health and safety, and emergency response, throughout the US and in the Caribbean. Serves as a consultant for facility audits and designs customized training and compliance programs.

**Hatcher-Sayre, Inc., Senior Hydrogeologist, (1988 - 1990)**

Served as corporate Health and Safety Director, responsible for ensuring compliance with OSHA regulations and ensuring safe conduct of remedial investigations and site remediations. Conducted mandatory hazardous materials training. Prepared and certified health and safety plans.

Managed the investigation of a state priority hazardous waste site contaminated with lead, including site characterization and risk assessment. Her proposed remedial strategy, capping, was estimated to cost one-tenth of the expense of exhumation and offsite disposal of the contaminated soils, while providing acceptable risk reduction.

Initiated a research effort to identify alternative cold-temperature geochemical methods to immobilize lead in contaminated soils in a cost-effective and technically-feasible manner.

Conducted a risk assessment for a CERCLA NPL site in Kentucky, to evaluate both short-and long-term exposures for resident and transient populations and biota.

Conducted a groundwater contamination investigation for a major optical products manufacturer, to evaluate the impact of halogenated hydrocarbons and their biodegradation products. Passive remediation and continued monitoring of the plume was the technology selected, based on risk factors and the groundwater flow regime.

**Reynolds Metals Company, Staff Hydrogeologist, (1987 - 1988)**

Developed a database to track all hazardous, non-hazardous and solid wastes generated at more than fifty facilities in the US and Canada, from point of generation through disposal.

Initiated the first major groundwater conducted by the company, in response to contamination migrating onto the plant site from a neighboring manufacturing facility.

**Radian Corporation, Staff Hydrogeologist, (1985 - 1987)**

Managed a site investigation for USAF at a former pesticide storage facility, including multimedia sampling of soils, wood, and structural materials. Identified fuel oil contamination under the subject facility.

Participated in multi-base studies conducted under the USAF Installation Restoration Program. Responsibilities included design and installation of monitoring well networks, analysis and interpretation of chemical and hydrogeologic data, health and safety, and quality assurance.

Managed a facility-wide site investigation for USMC under the Navy Assessment and Control of Installation Pollutants program. Prepared and implemented the work plan, health and safety program and quality assurance plan, while evaluating multiple Operable Units. Subsequently, one of the Operable Units has been added to the National Priorities List.



**Army Environmental Hygiene Agency, Physical Scientist, (1983 - 1985)**

Conducted engineering and chemical analyses of soils in support of the Waste Disposal Engineering Division.

Conducted wet chemical analysis of installation drinking water, industrial and domestic wastewaters, oils, sludges and commercial chemical products. Responsible for quality assurance and quality control database.

**Roy F. Weston, Inc. Associate Project Geologist, (1980 - 1983)**

Participated in site investigations at uncontrolled hazardous waste sites, from initial investigation through remediation. Installed monitoring wells, collected multi-media environmental samples, prepared boring logs and completed reports.

Served on the Region III Technical Assistance Team, providing emergency response support to EPA during hazardous materials emergencies; identifying potential sites and conducting initial site entries at uncontrolled hazardous waste sites; and conducting emergency and planned removal actions.

**Education:**

James Madison University, Harrisonburg, Virginia  
B.S., Geology, (1980)

***Certifications:***

- \* Certified Professional Geologist, Commonwealth of Virginia, 1988; No. 684
- \* Hazardous Waste Operations and Emergency Response; OSHA 29 CFR 1910.120;
- \* Site Worker, Supervisor and Trainer Certifications, 1982 - Present

***Memberships:***

- \* National Water Well Association
- \* Association of Groundwater Scientists and Engineers
- \* National Speleological Society

## **MICHAEL R. MASON, CES, PG**

**Experience Summary:** Mr. Mason possesses an M.S. in Geophysics from Virginia Polytechnic Institute and State University and a B.S. in Geology from Old Dominion University. He has been involved in design, engineering, and operations research in nuclear activities including environmental impact, radiation health and safety, nuclear fuel cycle, transportation, waste management, spent fuel storage, and economic analysis. In addition to his nuclear experience, as an engineer officer in the U.S. Army Corps of Engineers, he had substantial construction design, planning, management, and supervision experience. Holds a Q clearance with Department of Energy (DOE).

### **Related Experience:**

#### **Analysas Corporation (Oak Ridge Tennessee), Project Manager IV, (January 1994 - present)**

- \* Directs Analysas technical support of Hazardous Waste Remedial Action Program (HAZWRAP)
- \* Responsible for project controls for geotechnical and environmental engineering projects
- \* Provides geotechnical and engineering support to planning and execution of environmental projects, including integration of remotely sensed imagery and geographical information systems technologies
- \* Quality Assurance Manager, Southeastern Regional Operations (Oak Ridge)
- \* Project manager for planning, development, and operations directed towards satellite tracking and communications applied to shipments of hazardous and/or sensitive materials (TRANSCOM)

#### **E. R. Johnson Associates, Incorporated (Fairfax, Virginia), Senior Consultant, Geotechnical and Environmental Engineering (April 1992 - December 1993)**

- \* Involved in areas related to environmental engineering, radiological safety, waste management, geotechnology, human factors, and economic analysis. He was responsible for plans, designs, organization, and management associated with environmental assessment and inventory projects
- \* Transportation systems planning for the DOE, Civilian Radioactive Waste Management System
- \* Project manager for the testing of the prototype legal weight truck cask transport system
- \* Provided port-of-entry and shipper inspections of international shipments of radioactive

materials

- \* Wrote custom programs for and applied standard software to engineering, scientific, and statistical calculations

**U. S. Army Corps of Engineers, Defense Mapping Agency, (Fort Belvoir, Virginia), Topographic Engineer/Division Chief, (August 1989 - April 1992)**

- \* Major Mason provided technical assistance to all services and agencies within the Department of Defense on systems for exploitation of remotely sensed imagery, multi-spectral imagery, and other digital data sources in the geographical information system environment
- \* Provided technical mapping, charting, and geodesy support to major commands, federal agencies, and qualified allied military organizations
- \* Directed instruction in remotely sensed imagery, multispectral imagery, geographic information systems, geodesy, error theory, grids and projections, and other mapping, charting, and geodesy subjects

**U. S. Army Corps of Engineers, Commander and Engineer Officer (July 1980 - August 1989)**

- \* Supervised design and construction of environmentally compatible airfield and auxiliary facilities, directed construction of antiballistic shielding for nuclear weapons facilities
- \* Conducted the environmental assessment for construction of a combat airfield
- \* Designed and coordinated a program for environmental protection, monitoring, and remedial action for a major exercise; this included determining and demarking sensitive areas, inventory and assessment of environmental damage, design of proposed remedial action, assignment of constrained engineer resources, and conduct of quality assurance inspection
- \* Conducted an assessment of an environmentally compromised recreational lake, proposed remediation alternatives, and completed project design for the chosen option

**E. R. Johnson Associates Incorporated /Nuclear Audit and Testing Company, (Reston, Virginia), Research Associate (June 1978 - July 1980)**

- \* Involved in design, engineering, and operations research in nuclear activities including environmental impact, radiation health and safety, nuclear fuel cycle, transportation, waste management, spent fuel storage, and economic analysis
- \* Conducted quality assurance audits of nuclear fuel production, hardware fabrication, and modification of nuclear reactor safety systems

- \* Provided port-of-entry and shipper inspections of international shipments of radioactive materials
- \* Researched geotechnical constraints associated with heat loading of geological structures, migration of toxic materials, properties of clays, and environmental effects on containment of spent fuel and high level waste

**Relevant Experience:**

**U. S. Army, Meteorological Observer (August 1970 - May 1973)**

- \* Provided meteorological support to research and development and aviation operations
- \* Designed, procured, emplaced, and operated a monitoring station and evaluated data for projects to monitor near surface meteorology and water quality
- \* Supervised radiosonde operations including instrumentation, data evaluation, and quality assurance

**Education:**

- \* Virginia Polytechnic Institute and State University, M.S. (Geophysics), Blacksburg, Virginia, 1989  
Thesis: *Gravity Profile Evaluation of Geological Cross Sections of the Appalachian Mountains in Frederick County, Virginia*
- \* Old Dominion University, B.S. (Geology), Norfolk, Virginia, 1977

**Specialized Training:**

- \* *Supervision and Management*

Program Managers Course, Department of Defense, Washington, DC, 1991

Combined Arms Staff Support School, United States Army,  
Fort Leavenworth, KS, 1987

- \* *Engineering/Scientific*

Joint Space Intelligence Operations Course, United States  
Air Force, Colorado Springs, CO, 1991

Geographic Information Systems Course, Defense Mapping Agency,  
Fort Belvoir, VA, 1990

Multi-Spectral Imagery Course, Defense Mapping Agency, Fort Belvoir, VA, 1990

Mapping, Charting, and Geodesy Staff Officer Course, Defense Mapping Agency,  
Fort Belvoir, VA, 1984

Engineer Officer Advanced Course, 1983, and Engineer Officer Basic Course,  
1980, U. S. Army Corps of Engineers, Fort Belvoir, VA

Nuclear Quality Assurance/Quality Control Procedures, Nuclear Audit and  
Testing Company, Vienna, VA, 1978

#### **Certifications:**

- \* Registered Professional Geologist, Tennessee (TN3509), 1994
- \* Certified Environmental Specialist, Environmental Assessment Association, 1992
- \* Master Instructor, Faculty Development Program, Defense Mapping School, Fort Belvoir, VA, 1991

#### **Memberships:**

- \* The Society of American Military Engineers
- \* Association of the United States Army
- \* Armed Forces Communications and Electronics Association

#### **Papers:**

- \* M. Mason, "Exploitation of the Global Positioning System for the Establishment of Geographical Control of Environmental Sampling Locations and Well Sites (Points)", for Bechtel National Inc, Oak Ridge, TN, 1994.
- \* *Human Factors Engineering Applications in the Testing of the Legal Weight Truck Cask Transportation System*, 1993, International High-Level Radioactive Waste Conference, American Nuclear Society, 22-26 May, 1994, Las Vegas Nevada
- \* M. Mason, S. Kersey, R. Alcaparras, et al, A classified evaluation of spectral parameters and instrumentation requirements for a dedicated space platform, for the United States Air Force Space Command, Colorado Springs, 1991.
- \* M. Mason, "Contribution of Military Installations to the Particulate Contamination of the Chesapeake Bay", research for the United States Army Corps of Engineers, Fort Belvoir, VA, 1984.
- \* M. Mason, et al, "Environmental Assessment for the Construction of a Standard Theater Airfield on Fort Leonard Wood, Missouri", for Directorate of Engineering and Housing, Fort Leonard Wood, MO, 1982.

## Quality Assurance Auditing Experience

<u>AUDITED COMPANY</u>	<u>ACTIVITY AUDITED</u>	<u>PURPOSE</u>
AlliedSignal Automotive Proving Grounds New Carlisle, IN	DOE facility qualification	QA program
Allmetal Steel Garden City, NY	nuclear hardware fabrication	QC/acceptance
Atlas Bridge & Iron Gainsville, VA	nuclear pressure vessel fabrication	QA/QC non-compliance
Cotter Corporation Canon City, CO	mining/milling environmental monitoring program	non-compliance (Colorado)
for Edlow International (U.S. Ports of Entry)	import; uranium yellow cake export; uranium hexafluoride	compliance compliance
G.E. Wilmington, NC	nuclear fuel fabrication	QA/acceptance
Oberg Sarverville, PA	nuclear hardware fabrication (for export)	QC/acceptance
Niagra Mohawk Power Oswego, NY	reactor piping restraint modifications	QA/remedial action
Superior Tube Westchester, PA	nuclear hardware fabrication	QC/acceptance

## Computer Experience Checklist

### Operating Systems

DOS  
UNIX  
CPM

### Math & Science

Fortran

### Word Processing

WordPerfect (Windows & DOS)  
Microsoft Works  
Ashton Tate Multimate  
Wordstar

### Graphics

Basic

SAS and SAS Graph  
Datum (affine transformation)  
Madtran (affine transformation)

Harvard Graphics  
Paintbrush  
Print Shop

**Engineer Management**

Primavera  
Open Plan

**Data Base**

Lotus 1-2-3  
Microsoft Works  
Dbase III & IV

**Geographic Information Systems**

ARC/Info  
ERDAS  
Intergraph

## **Examples of Engineering Experience**

### **Construction**

*(note: ALL Corps of Engineers construction projects require construction estimates, bills of materials, critical path engineer schedule, and resource constraining.)*

Mid-winter design and construction of heavy concrete access ramps, roads, and parking and maneuver areas for heavy construction equipment training areas. (Fort Leonard Wood, MO, engineer platoon leader)

Design, Environmental Impact Statement, construction estimate, and engineer schedule for standard combat airfield constructed on Fort Leonard Wood. (battalion engineer officer)

Site survey, soil analysis, design & engineer estimate for recreation lake restoration accomplished in Rolla, MO. (battalion engineer officer)

Reconnaissance, design, engineer estimate, and management of road construction/repair at Eglin AFB, FL. Includes replacement of two collapsed two-lane bridges and restoration of environmental and infrastructure damage. (battalion engineer officer)

Directed construction of a warehouse in Kaiserslautern, Germany. (company commander)

Directed runway repair at Sembach Air Base, Germany (company commander)

Directed construction of Blackhawk helicopter airfield and facilities at Schwabish Hall, Germany. (company commander)

Directed construction of reinforced concrete anti-ballistic protective structures for Pershing missile site near Illertissen, Germany. (company commander)

### **Demolitions**

Estimated, scheduled, and supervised demolition and removal of eight two-story barracks structures and restoration of the site to unlimited access. (engineer platoon leader)

Cleared decommissioned munitions/ demolitions training areas of unexploded ordinance and returned the sites to unrestricted access (Fort Leonard Wood, engineer platoon leader)

### **Design, Scheduling, and Cost Estimating**

Provides cost/schedule controls for geotechnical and environmental engineering projects. (Analysas Corporation)

Developed conceptual design and estimated construction, operating, and decommissioning costs



for a Pacific island high level nuclear waste storage facility. (for DOE/Boeing Corporation)

Developed conceptual design and estimated construction, operating, and decommissioning costs for a spent nuclear fuel reprocessing facility. (for DOE)

Developed engineer schedule (using CPM software) for construction/acquisition of infrastructure, equipment, and services for the transportation of spent nuclear fuel. (DOE, Office of Civilian Radioactive Waste Management)

### **Maintenance**

Responsible for preventative maintenance, recovery, and repair of heavy construction equipment during the largest peace-time construction project by a Corps of Engineers unit (Grafenwoehr Range, 18th Engineer Brigade, battalion maintenance officer)

**R. STEVE McKAMEY, P.E.**

**Experience Summary:** Mr. McKamey has over nine years of technical and managerial experience in the engineering, modeling, testing, and analysis of dynamic fluid systems. He has participated in projects to model and characterize the hydrogeology of both RCRA and CERCLA facilities. He has extensive experience with mathematical modeling techniques applied to surface water, groundwater, radiation dosimetry, and turbine engine performance. He also has experience with the statistical validation of mathematical models, the statistical design of experimental tests, measurement uncertainty analysis and the 3-D visualization of environmental data.

**Professional Experience:**

**Analysas Corporation, Geo-Environmental Group, Principal Environmental Engineer/Hydrogeologic Modeler (June 1993 - Present)**

- \* Acting Department Manager - Environmental Operations Department
- \* Program Manger - FUSRAP Technical Support - Program Manager of a seven million dollar subcontract to Bechtel Environmental for technical support to the FUSRAP Program.
- \* Principal Environmental Engineer/Lead Hydrogeologic Modeler, duties include Decontamination and Decommissioning, Hydrogeologic Characterization and Modeling, Marketing and Business Development

**EcoTek, INC., Uranium Decommissioning Group, Environmental Scientist III/Hydrologic Engineer (June 1992 - June 1993)**

- \* Management of site groundwater activities including development of a mathematical, hydrogeological site model of the Nuclear Fuel Services plant in Erwin, Tennessee. Compilation of a database from existing hydrogeological data. Planning and execution of pumping and slug tests to support modeling efforts.

**Oak Ridge National Laboratory, Health and Safety Research Division, Contract Hydrogeological and Dosimetry Modeling Services (February 1992 - May 1992)**

- \* Performed groundwater and dosimetry modeling and sensitivity analyses.

**Independent Consultant, Fluid and Hydrological modeling (November 1990 - February 1992)**

- \* Waste load model of a large eastern seaboard river using EPA's QUAL-II surface water quality model. Analytical model of an advanced marine propeller design.

**Sverdrup Technology, INC., Analysis and Evaluation Branch, AeroPropulsion Systems Test Facility (September 1985 - November 1990)**

- \* Modeling of turbine engine components, cycles, and test facilities. Validation of vendor models. Computational model development for the Advanced Tactical Fighter Engine compressor. Performed analysis of turbine engine and rocket tests from USAF altitude test facilities at Arnold Engineering Development Center.

***Categorized Work Experience:***

**Groundwater Modeling:**

**Three-Dimensional Groundwater Flow Model of a Mixed Waste Burial Ground, Nuclear Fuel Services (NFS), Erwin TN.** Simulated numerous iterations of a multiple well pumping scheme to dewater a mixed waste burial ground in a complex hydrogeologic environment. Effort included a seven-day pumping test to validate the model.

**Two Dimensional Model of Two Hydrocarbon Plumes; HAZWRAP, Oak Ridge, Tennessee.** Used the USGS Method of Characteristics Model (MOC).

**Two-Dimensional Groundwater Flow Model of Three Closed Surface Water Waste Impoundments, NFS, Erwin, TN.** Used MODFLOW to study the effects of streams, springs, and surface impoundments on the water table at the NFS plant.

**Three-Dimensional Analytical Model of a Dewatering System for a Mixed Waste Burial Pit; Nuclear Fuel Services, Erwin, Tennessee.** Developed a code to simulate Three-dimensional water table surface based on the Dupuit-Theim equation and the principle of indirect superposition. Many simulations were completed and the model was compared to MODFLOW predictions and actual pumping test results.

**Review of Two-Dimensional Groundwater Model of an Air National Guard Base for HAZWRAP.** Performed a thorough review of the results of a MODFLOW simulation of the Phelps-Collins ANG Base in Alpena, Michigan. The review included the validity of assumptions and conclusions, the appropriateness of boundary conditions, and the usage of input data.

**Sensitivity Study of The Hanford Environmental Radiation Dosimetry Model, GENII; Oak Ridge National Laboratory, Oak Ridge, Tennessee.** Performed a sensitivity study on GENII code to assess its application to the Barnwell Low-Level Radioactive Waste Disposal Facility.

**Two-Dimensional Model for Generic Multi-Phase Flow Research Project; Oak Ridge National Laboratory, Oak Ridge, Tennessee.** Modeled simple multi-phase DNAPL transport problems using the SWANFLOW code.

### **Groundwater Hydrogeology:**

**Execution and Analysis of a 7-day, 7 GPM, 24 Observation Well, Pumping Test; Nuclear Fuel Services, Erwin, Tennessee.** Planning, field coordination, and execution of a pumping test to hydraulically characterize a Solid Waste Management Unit at this RCRA facility.

**Analysis of Pumping and Slug Tests conducted at a CERCLA Medical Waste Landfill for a Confidential Client.** Performed analysis and QA for pumping tests conducted at a landfill located in a complex fractured geologic setting.

**Execution and Analysis of Slug Tests; Nuclear Fuel Services Plant, Erwin, Tennessee.** Performed both falling head and rising head slug tests for over 30 wells using injection, bailing, solid cylinder insertion, and solid cylinder extraction methods. Performed analysis of these tests using Bouwer-Rice, Cooper-Papadopolous, Nguyen-Pinder, and Hvorslev methods.

**Conceptual Model of the Hydrogeology of Loring Air Force Base, Maine (LAFB) for HAZWRAP.** Performed research and helped prepare a database and conceptual hydrogeological model of LAFB. This effort included mapping a groundwater divide, identifying paths of contaminant migration, and possible reservoirs of contamination.

**Q/A of Historical Aquifer Test Data for the NFS Plant, Erwin TN.** Checked all previous calculations of hydrogeologic parameters for accuracy and pertinence of assumptions that were made. Re-calculated a substantial number of results using more appropriate methods.

### **Environmental Engineering:**

**Design and Logistics of a 7-day, 7 GPM, 24 Observation Well, Pumping Test; Nuclear Fuel Services, Erwin, Tennessee.** Performed planning and design services for a pumping test to characterize hydraulic parameters for a Solid Waste Management Unit at this RCRA facility.

**Design and Logistics of Slug Tests; Nuclear Fuel Services Plant, Erwin, Tennessee.** Designed specialized hardware and test procedures for slug tests in over 30 wells using injection, bailing, solid cylinder insertion, and solid cylinder extraction methods.

**RI/FS for a Mixed Waste Medical Landfill, Confidential Client, North Carolina.** Supported the design of a groundwater monitoring system, execution and analysis of aquifer tests.

**RI Workplan for an Industrial Site, Elizabethton, TN.** Supported the design of a groundwater monitoring system.

**RFI for the 55-acre NFS Plant, Erwin, TN.** Technical lead for the design and implementation of a rehabilitation plan for groundwater monitoring equipment for 19 Solid Waste Management Units (SWMU's) and two Areas of Concern (AOC's).

**RCRA Closure Support for the Pilot Waste Treatment Facility at the Paducah Gaseous Diffusion Plant (PGDP).** Provided site support for a RCRA Closure Plan for the C-409 Pilot Plant at PGDP. Task included equipment inspection, site walkthroughs, and recommendations for the disposition of equipment contaminated with hazardous and mixed wastes.

**CERCLA:**

**FUSRAP - Program Management and Technical Support to DOE's FUSRAP program through Analysas' subcontract to Bechtel Environmental.** Prepared data analyses, data gap analyses, characterization studies, and statistical and modeling analyses for several sites in Missouri and Ohio.

**RI/FS for a Mixed Waste Medical Landfill, Confidential Client, North Carolina.** Supported the design of a groundwater monitoring system, the execution and analysis of aquifer tests, and technical documentation of results.

**RI Workplan for an Industrial Site, Elizabethton, TN.** Supported the preparation of a groundwater monitoring plan.

**Calculation of Hazard Ranking System (HRS) Scores, Data Analysis, and Preparation of RI Sampling Plans for the FUSRAP Program; Bechtel National, Inc., Oak Ridge, Tennessee.**

**RCRA:**

**RFI for the 55-acre NFS Plant, Erwin, TN.** Technical lead and support for various groundwater programs for 19 Solid Waste Management Units (SWMU's) and two Areas of Concern (AOC's).

**RCRA Closure Support for the Pilot Waste Treatment Facility at the Paducah Gaseous Diffusion Plant (PGDP).** Provided on site support for a RCRA Closure Plan for the C-409 Pilot Plant at PGDP. Activities included equipment inspection, building walkthroughs, and recommendations for the disposition of contaminated equipment.

**Clean Water Act:**

**Waste Load Model of a Large Eastern Seaboard River for a Confidential Client.** Used EPA's QUAL-II model to support a NPDES permit application for a large industrial client.

***Professional Registrations/Affiliations/Certifications:***

- \* Professional Engineer (TN #022016)
- \* Association of Ground Water Scientists and Engineers
- \* OSHA 29 CFR 1910.120 40-hour HAZWOPER Training and 8-hour Supervisor Training
- \* Dynamic Graphics 4-Day EARTHVISION training class.

***Education:***

University of Tennessee at Knoxville  
Currently Pursuing M.S. in Environmental Engineering

University of Tennessee Space Institute, Tullahoma, TN  
M.S. in Aerospace Engineering

University of Tennessee at Knoxville  
B.S. in Aerospace Engineering

***Publications:***

- \* Fields, D.E., Eckerman, K.F., and McKamey, R.S., "Dose Modeling for Performance Assessment", Final Letter Report to USNRC, March 31, 1992.
- \* McKamey, R.S., Masters Thesis: "A Method of Adjusting Turbine Engine Transient Test Data for the Effects of Variations in Environmental Conditions", The University of Tennessee, Knoxville, May 1991.
- \* Chappel, M.A. and McKamey, R.S., "Adjusting Turbine Engine Transient Performance for the Effects of Environmental Variances", AIAA 90-2501, American Institute of Aeronautics and Astronautics, June 1990.
- \* Malloy, D.J., McKamey, R.S., and Dodd, J.E., "Test Analysis Program for a Variable Cycle Engine with a Two-Dimensional, Vectoring Exhaust Nozzle", AEDC ER-90-1, Arnold Engineering Development Center, May 1990.
- \* McKamey, R.S., "Validation of Aircraft Gas Turbine Engine Steady-State Mathematical Models", Presented to the AIAA/SAE/ASME 21st Joint Propulsion Conference at Huntsville, Alabama on June 18, 1986.

**ANTHONY R. TINGLE, P.E.**

Experience Summary: Mr. Tingle has several years of experience in hydrogeologic activities, including the collection of geotechnical data from soil and groundwater samples, and the preparation of reports from sample data. He has spent the past 4 years working at the Martin Marietta facility, Hazardous Waste Remedial Actions Program (HAZWRAP), performing hydrogeologic duties.

***Related Experience:***

**Analysas Corporation, Hydrogeologic Technician II (1994-Present)**

- \* Support work on environmental investigations at both Department of Energy and Department of Defense facilities.
- \* Assist in the preparation and review of reports and data handling.
- \* Conduct field observations and soil sampling efforts.

**Oak Ridge Associated Universities, Hydrogeologic Intern (1991-1994)**

- \* Assist HAZWRAP hydrogeologists with field sampling and report activities.
- \* Served as intern field team leader for groundwater sampling activity.

**University of Tennessee, Graduate Research Assistant (1989-1990)**

- \* Supported field activities related to thesis project, including water sample collection and analysis, rock sample collection and analysis, and geologic mapping.

***Education:***

University of Tennessee, Knoxville  
M.S. in Geology (Projected graduation 1994)

Appalachian State University  
B.S. in Geology (1987)

***Specialized Training:***

- \* 40-Hour OSHA Training and Fit Testing
- \* Martin Marietta General Employee Training (GET)
- \* Martin Marietta General Employee Radiation Training (GET/RAD)
- \* Radiation Worker Frisker Training

## **KELLI ANNE GILLILAND**

***Experience Summary:*** Ms. Gilliland has two years experience with Hazardous Waste Remedial Actions Program (HAZWRAP) in hydrogeology. She has experience working in the field supervising and performing sampling activities, as well as documenting health and safety plans, data summaries, and monthly site status reports.

### ***Related Experience:***

#### **Analysas Corporation, Hydrogeological Technician II (1993-Present)**

- \* Prepares Site Investigation Data Summaries and Scoresheets.
- \* Supervises/performs environmental sampling of groundwater, surface water, soil, and sediment.
- \* Directs field operations at hazardous waste sites.
- \* Provides health and safety oversight.
- \* Writes, reviews, and revises health and safety plans.
- \* Reviews and revises technical documents.
- \* Performs Quality Assurance/Quality Control tasks.
- \* Prepares Decision Documents.
- \* Reformats Monthly Progress Reports for Air Combat Command and Air Training Command.

#### **Oak Ridge Institute for Science and Education, Hydrogeological Intern (1992-1993)**

- \* Performed environmental sampling of groundwater, surface water, and sediment.
- \* Assisted with health and safety oversight.
- \* Performed field operations at hazardous waste sites.
- \* Reviewed and revised technical documents.

### ***Education:***

University of Tennessee, Knoxville, Tennessee  
Pursuing M.S. in Safety Education and Service

Roane State Community College, Harriman, Tennessee  
Pursuing A.S. in Environmental Health Technology

Tennessee Technological University, Cookeville, Tennessee  
B.S. in Business Administration (1989)

Roane State Community College, Harriman, Tennessee  
A.S. in Business Administration (1987)



***Specialized Training:***

- \* 8-Hour Occupational Safety and Health Refresher Course (1994)
- \* Environmental Protection Agency Environmental Sampling Seminar (1993)
- \* Groundwater Sampling Training Course, Portsmouth, Ohio (1992)
- \* 8-Hour Radiation Worker Training (1992)
- \* 40-Hour Occupational Safety and Health Course (1992)
- \* General Employee Training/Radiation Area Certified (1992)