REVISED QUALITY ASSURANCE PROGRAM PLAN
ALCOA - DAVENPORT WORKS
CERCLA Consent Order VII-95-F-0026

VOLUME 1

Prepared by
GERAGHTY & MILLER, INC.
Environment & Infrastructure
4700 Lakehurst Court
Dublin, Ohio 43016-2251
(614) 764-2310

November 27, 1996
REVISED
QUALITY ASSURANCE PROGRAM PLAN
ALCOA-DAVENPORT WORKS

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Prepared for
Aluminum Company of America
Riverdale, Iowa

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Alice J. Waldhauer
Project Scientist/Project Manager

Lawrence S. Graves
Vice President/Project Officer
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REVISED QUALITY ASSURANCE PROGRAM PLAN
ALCOA-DAVENPORT WORKS

1.0 INTRODUCTION

This Quality Assurance Program Plan (QAPP) has been prepared in accordance with the United States Environmental Protection Agency's (EPA) document EPA/540/G-89/004, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA 1988), and will be used as a reference source for all aspects of quality assurance and quality control (QA/QC) during upcoming CERCLA (Comprehensive Environmental Response Compensation and Liability Act [EPA 1990]) activities involving soil and groundwater contamination at the Aluminum Company of America (Alcoa)-Davenport Works in Riverdale, Iowa. Included within this document are general field sampling techniques and specific QA/QC objectives for field and laboratory measurements for all anticipated activities to be conducted as a part of CERCLA activities at the Alcoa-Davenport Works. This QAPP has been revised to be consistent with requirements set forth in the 1995 Consent Order VII-95-F-0026 (effective August 1995 [EPA 1995]) and with consideration given to prior knowledge of site conditions, anticipated project objectives and knowledge of available measurement systems. Details concerning field work and project objectives for each Removal Action assessment groundwater monitoring or RI/FS activity to be conducted as part of CERCLA activities at the Alcoa-Davenport Works will be further explained in specific work plans and field sampling plans submitted prior to commencement of any field work.
2.0 PROJECT DESCRIPTION

This section provides an overview of the scope of this QAPP and a general description of the location and physical setting of the Alcoa-Davenport Works.

2.1 SCOPE OF QAPP AND ASSOCIATED PROJECT PLANS

This QAPP has been written to define QA/QC procedures necessary to ensure proper collection of field and laboratory data for investigations or work conducted for Alcoa-Davenport Works.

This comprehensive QAPP contains not only the QA/QC requirements for sample handling and analysis, but also contains the majority of field data collection procedures that will be utilized during assessment activities. These field and analytical procedures will be used for all activities required under the 1990 and 1995 Consent Orders, including those required by the groundwater RI/FS and removal action process. This will provide the project with consistent and comparable data.

Under the removal action process, a site-specific work plan will be prepared for each necessary unit evaluation. A unit-specific Field Sampling Plan (FSP) will describe the scope and rationale for field activities. The FSP will explain in detail the field and analytical procedures required to meet project objectives, and will serve to connect the FSP with the QAPP by referencing required work elements included in the FSP and approved QA/QC procedures included in the QAPP. The FSP will contain sufficient detail such that the Geraghty & Miller field staff will use it to direct activities in the field.
Similarly for RI/FS activities, a work plan has been prepared to describe the scope and rationale for activities conducted as part of the RI/FS. The RI/FS Work Plan will also be supported by a Sampling and Analysis Plan (SAP) which will detail the number and location of monitoring points to be installed, or other activities that will be completed to accomplish the goals of the RI/FS. The SAP will in turn be supported by this QAPP and a Health and Safety Plan which will provide procedures to ensure collection of quality data in a safe manner. If it becomes apparent that additional quality assurance measures or procedures are necessary for completion of field activities, these measures or procedures will be detailed in the Work Plan, Sampling Plan or FSP submitted prior to commencement of field activities.

2.2 LOCATION AND PHYSICAL SETTING

The Alcoa-Davenport Works is situated in east-central Iowa on a broad river terrace which slopes gently toward the Mississippi River. North of the plant, bedrock hills and bluffs rise about 90 feet above the river valley. In the site area, the Mississippi River trends northeast-southwest. Figure 2-1 illustrates the location and physical setting of the Alcoa-Davenport Works.

Major surface water drainage for the region is provided by the Mississippi River. Local drainage northeast of the plant is provided by Crow Creek, and southwest of the plant by Duck Creek. Both tributaries trend northwest to southeast and flow into the Mississippi River. Surface runoff from the plant enters a series of storm sewers which empty into man-made drainage outfalls and eventually discharge to the Mississippi River. These outfalls are located inside the plant perimeter and are directed toward the Mississippi River. The site layout is illustrated in Figure 2-2.
The Alcoa-Davenport Works lies in the northwest corner of the Illinois Basin physiographic province. The unconsolidated materials underlying the plant site have several sources. Alluvial sediments deposited by meandering streams constitute the majority of unconsolidated deposits present. These sediments are fine-grained and consist of silts, clays and some fine sands. Another source of unconsolidated materials is Quaternary-age glacial deposits consisting of sand and/or sand and gravel. Fill material is also present throughout the site. The thicknesses of these unconsolidated materials range from 0 to an estimated 27 feet across the site.

Bedrock in the region is sedimentary rocks of Cambrian through Pennsylvanian age. In east-central Iowa, the upper 600 feet of strata are predominantly Silurian and Devonian shale and limestone. Locally, the overlying Devonian strata act as a semiconfining unit due to the presence of thin shale horizons. Silurian strata constitute the bedrock aquifer from which Alcoa draws groundwater for plant production. The youngest and uppermost bedrock horizons in the region are Pennsylvanian shales which locally act as confining beds, restricting vertical migration of groundwater.

Additional information on site specific geology and hydrogeology is presented in the "Conceptual Site Model for the Alcoa-Davenport Works" (Geraghty & Miller, Inc. 1995) and the "Facility Site Assessment for the Alcoa-Davenport Works" (Geraghty & Miller, Inc. 1992).
3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section presents the project organization and line of authority, and lists key individuals, including the Quality Assurance Officer (QAO), who are responsible for ensuring that decisions based on laboratory and field data generated during this project are technically sound, statistically valid and properly documented. Figure 3-1 illustrates the project organization. The responsibilities of the positions and individuals listed are summarized below. Qualifications of key project personnel are provided in Appendix A.

EPA Remedial Project Manager

The EPA Remedial Project Manager (RPM) specified in Figure 3-1 oversees implementation of all activities required under the 1990 and 1995 Consent Orders and has the authority vested in RPMs by the NCP, 40 CFR Part 300. The RPM must review and approve all work plans, as well as QAPP, prior to their implementation.

Alcoa Project Coordinator

The Location Remediation Manager for the Alcoa-Davenport Works has been designated the Alcoa Project Coordinator as specified in Figure 3-1. The Alcoa Project Coordinator is responsible for supervising activities required by the terms of the Consent Orders, including all work performed by subcontractors. The Alcoa Project Coordinator will serve as the main contact between Alcoa and the EPA.
Geraghty & Miller Project Officer

The Geraghty & Miller Project Officer is specified on Figure 3-1. The Project Officer, will be responsible for establishing the overall quality objectives for Alcoa projects, ensuring the projects are appropriately managed by qualified technical staff, ensuring that all work is completed on-time and within budget requirements and ensuring that all completed work is in accordance with specified requirements established with the regulatory agency. The Project Officer, will also provide the final review and sign-off authority within Geraghty & Miller for assuring the overall quality of the project and final deliverables. The Project Officer provides managerial direction and assistance to the Geraghty & Miller Project Coordinator and may assume the role of the Project Coordinator in his/her absence. The Project Officer has the authority to commit company resources, to the extent necessary, to complete the project on behalf of Alcoa.

Geraghty & Miller Project Coordinator

The Geraghty & Miller Project Coordinator is specified on Figure 3-1. The Geraghty & Miller Project Coordinator will be responsible for the supervision of all other Geraghty & Miller personnel involved in the project, as well as for scheduling activities and writing and reviewing work plans and reports. The Geraghty & Miller Project Coordinator will serve as the main contact between Geraghty & Miller and Alcoa, and will be available for meetings and conference calls to discuss any aspect of response activities with the EPA RPM or his representatives. The Geraghty & Miller Project Coordinator will ensure that all Geraghty & Miller personnel comply with approved procedures and will assist the Geraghty & Miller QA/QC in implementation of QA/QC responsibilities.
Geraghty & Miller Quality Assurance Officer

The Geraghty & Miller QAO is specified on Figure 3-1 and will oversee the strict implementation of this QAPP. The Geraghty & Miller QAO will oversee collection and reporting of valid measurement data and will perform routine assessments of measurement systems for precision and accuracy. In addition, the QAO will oversee validation of field and laboratory data, ensuring that all data meet quality objectives outlined in this QAPP. The QAO will function as the main contact with the analytical laboratory, and will work closely with the field managers and field staff to ensure data collection and analysis is conducted correctly.

Geraghty & Miller Data Management Coordinator

The Geraghty & Miller Data Management Coordinator is responsible for the storage, management and retrieval of all field and analytical data generated during project investigations. The Geraghty & Miller Data Management Coordinator is specified on Figure 3-1.

Analytical Laboratory Project Manager

Quanterra Environmental Services (formerly Wadsworth/Alert Laboratories) has been selected as the primary analytical laboratory for this project. The Laboratory Project Manager for Quanterra is specified on Figure 3-1. The Laboratory Project Manager has received a copy of, and is familiar with the requirements of the Consent Orders and all aspects of this QAPP. The Laboratory Project Manager's responsibility is to ensure that all analytical work and reporting is consistent with the requirements set forth in this QAPP.
Geraghty & Miller Field Managers and Staff

Geraghty & Miller will appoint a Field Manager who will manage and implement activities required under the Consent Orders. The Field Manager will be familiar with all data collection aspects outlined in this QAPP and will ensure that the assigned field staff collect data and samples correctly. The Field Manager will maintain direct contact with the Laboratory Project Manager and the Geraghty & Miller QAO. He will ensure that all field data collection and sampling procedures are documented correctly, and that a field data package is prepared upon completion of each field sampling event. The field data package will be sent to the Geraghty & Miller QAO for validation.

Geraghty & Miller Senior Technical Advisors and Technical Support

Due to the fact that environmental assessments may require highly technical experience, a set of technical specialists have been assigned to this project to assist project staff in making sound technical judgments. Additional technical experts from Geraghty & Miller's staff will be available and called upon as needed.

Geraghty & Miller Health and Safety Officer

The project Health and Safety Officer is specified on Figure 3-1. The Geraghty & Miller Health and Safety Officer will oversee implementation of the comprehensive Health and Safety Plan for the Alcoa-Davenport Works and preparation of any required task-specific Health and Safety Plans.
4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

The overall QA objective for CERCLA Activities conducted at the Alcoa-Davenport Works is to ensure that all decisions based on laboratory and field data generated during this program are technically sound, statistically valid and properly documented. To ensure this, all procedures utilized for collection of field and laboratory measurements, along with the resulting data, will be assessed for quality based on performance standards presented herein.

Specific procedures to be utilized for laboratory analyses, data reporting and data validation are presented in other sections of this QAPP. They will be, at a minimum, equivalent to those stated in appropriate Statement of Works (SOWs) for the EPA's Contract Laboratory Program (CLP). The primary purpose of this section of the QAPP is to define statistical acceptance criteria for measurement data. The acceptance criteria are referred to in this document as Data Quality Objectives (DQOs), and are expressed in terms of precision, accuracy, completeness, representativeness and comparability.

Due to the complexity of environmental medias, sample-specific DQOs may be attainable only for samples that are homogenous and show no evidence of matrix interference. In the event that sample-specific DQOs cannot be met for specific samples, groups of samples, or samples of a particular matrix, the analytical laboratory will make a reasonable effort to determine why sample-specific DQOs could not be met. If sample-specific DQOs could not be met due to operator error, instrument malfunction, or other identifiable systematic errors with the analytical system, the analytical laboratory will reanalyze affected samples, if possible.
CLP protocols have been developed for a specific set of chemical analyses including metals, cyanide, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and polychlorinated biphenyls (PCBs). Other EPA-approved methodologies may be utilized to attain specified DQOs for analyses not covered under CLP. For many of these EPA-approved methods, interlaboratory method verification studies have been used to establish QC criteria which may be regarded as an inherent part of the method. In such instances, these criteria will take precedence, except in the cases where deviations can be reasonably attributed to sample-related problems.

The following sections provide detailed information on specific DQOs for all related CERCLA activities at the Alcoa-Davenport Works. The QA objectives for measurement data are summarized in Table 4-1.

4.1 PRECISION

Precision is defined as the degree of agreement between repeated measurements of the same parameter under prescribed, similar conditions. Precision, therefore, represents the repeatability of the measurement. Precision of a series of measurements can be expressed in terms of percent relative standard deviation (%RSD) and/or relative percent difference (RPD).

4.1.1 Laboratory Precision

Precision in the laboratory is assessed by evaluating the RPD between investigative samples & laboratory duplicates and between the matrix spike (MS) and matrix spike duplicate (MSD) recoveries. Laboratory duplicate and/or MS/MSD analyses are performed at GERAGHTY & MILLER, INC.
a frequency of 5% (i.e., 1 in 20 investigative samples). In addition, field replicate samples will be collected and analyzed at a frequency of 10% (i.e., 1 in 10 investigative measurements) to qualitatively assess overall precision of field and laboratory procedures. The analytical laboratory for this investigation will, at a minimum, meet all precision criteria in the appropriate CLP SOWs or EPA-approved methodologies with the possible exception of samples exhibiting concentrations less than 5 to 10 times the method detection limit (MDL), or samples exhibiting specific matrix problems that are identifiable by reextraction and/or dilution followed by reanalysis. The precision objective for non-CLP analytical work is 30% RSD unless otherwise stated in EPA-approved methodologies.

### 4.1.2 Field Precision

Field precision for pH, specific conductance (SCON) and temperature will be assessed for groundwater and surface water measurements by evaluating results from quadruplicate water samples collected from a single bailer or grab sample. Precision of water level readings will also be assessed by evaluating results of quadruplicate measurements. Quadruplicate measurements for these field parameters will be collected for each aqueous sample matrix at a frequency of 10% (i.e., 1 in 10 investigative measurements) or 1 per day, whichever is greater, during the implementation of applicable field activities. The %RSD will then be determined. Acceptance criteria for field precision will have a limit of +/- 30% RSD.

For the purposes of this QAPP, %RSD will be calculated as follows:

\[
\% \text{ RSD} = \frac{S}{X} \times 100
\]
where,

\[ \% \text{RSD} = \text{percent relative standard deviation} \]
\[ S = \text{standard deviation of measurements} \]
\[ X = \text{mean of measurements} \]

The RPD will be calculated as follows:

\[
RPD = \frac{D1 - D2}{(D1 + D2)/2} \times 100
\]

where,

\[ RPD = \text{relative percent difference} \]
\[ D1 = \text{first duplicate value} \]
\[ D2 = \text{second duplicate value} \]

4.2 ACCURACY

Accuracy is the measure of the degree of agreement between an analyzed value and the true or accepted value, where it is known.
4.2.1 Laboratory Accuracy

Laboratory accuracy will be assessed through analyses of instrument calibration verification standards, laboratory control samples, matrix spiked samples, surrogate spiked samples and performance evaluation on QC check samples. The degree of accuracy is dependent upon sample matrix, method of analysis, sample preparation method and the analyte being determined. Additionally, concentration of the analyte relative to the detection limit is a major factor in determining accuracy of the measurement. The analytical laboratory will perform all analyses within EPA CLP prescribed limits of accuracy for routine analytical services that are covered under a SOW. The QC objective for accuracy in terms of %D will be +/- 25 %D for soils and water matrices unless otherwise stated in EPA-approved methodologies for services not covered under EPA CLP SOWs. Percent recovery criteria, for reasons stated previously, are variable and the reader is referred to the Quanterra Environmental Services Quality Assurance Management Plan ([QAMP] Appendix B) for further elaboration on this aspect of accuracy.

4.2.2 Field Accuracy

Since true values for pH, SCON and temperature are not known for particular matrices and specific sampling locations, accuracy of data produced by field instruments will be maintained and documented by performing initial calibrations followed by continuing calibration verifications and/or continuing calibrations with known standards in accordance with appropriate standard operating procedures (SOPs) found in Appendix C. The accuracy of all data will be assessed qualitatively by determining if data are consistent with known or anticipated hydrogeologic or chemical conditions and accepted principles.
For the purposes of this document, accuracy will be statistically represented by calculating one or more of the following:

1. Percent recovery (%R) of a known standard added to the sample of interest;

2. Percent difference (%D) between a known standard value and a measured value.

Percent recovery (%R) will be calculated as follows:

\[ \% R = \frac{Q_d}{Q_a} \times 100 \]

where,

- \( Q_d \) = quantity determined by analysis
- \( Q_a \) = true or accepted reference quantity or value

Percent difference (%D) will be calculated as follows:

\[ \% D = \left( \frac{Q_i - Q_c}{Q_i} \right) \times 100 \]

where,

- \( Q_i \) = quantity determined initially
- \( Q_c \) = quantity determined from subsequent analysis
4.3 COMPLETENESS

Completeness, as it pertains to the laboratory and for the purposes of this QAPP, is defined as the ratio of the number of valid sample results to the total number of samples run with a specific analysis and/or on a specific matrix. In terms of sampling protocols, completeness is the ratio of the number of valid samples collected to the total number of samples required to be representative.

4.3.1 Laboratory Data Completeness

Laboratory completeness will be based on the total number of samples that are analyzed under controlled conditions that meet previously defined precision and accuracy objectives. The data quality objective for data produced by the laboratory is to achieve completeness criteria that are greater than or equal to 95% for both soil and water matrices.

4.3.2 Field Data Completeness

Field completeness is defined as the ratio of the number of valid samples collected to the total number of samples required to be representative. Therefore, to ensure completeness of field collected samples, an FSP or work plan will be prepared for each assessment or investigation describing specific field procedures. The prescribed sampling program will be adhered to, and all sampling will be performed using established SOPs (Appendix C) and field procedures (Section 5). The data quality objective for field data is to achieve completeness criteria that are greater than or equal to 95%.
Completeness is expressed as a percent of the overall data that was generated and is calculated as follows:

\[ C = \frac{V}{T} \times 100 \]

where:

- \( C \) = Percent completeness
- \( V \) = Number of measurements judged valid
- \( T \) = Total number of measurements

4.4 REPRESENTATIVENESS

Samples collected during field activities at the Alcoa-Davenport Works will be representative of the population from which they were collected. Representativeness is defined as the degree to which the data collected accurately and precisely characterize a population, a parameter of interest, variations at a sampling point, a process, or an environmental condition.

Attainment of representative samples will be facilitated by utilizing appropriate sample collection and handling procedures presented as SOPs in Appendix C. Procedures presented address methodologies for field activities such as soil sampling, monitor well installation, groundwater sampling, surface water sampling, and pumping tests. Additionally, obtaining representative data will be achieved by adhering to the following protocols:
1. Selection of appropriate sample quantity and locations to adequately characterize the actual and current site conditions.

2. Utilization of appropriate sampling procedures and equipment.

3. Selection of appropriate analytical methodologies that ultimately provide the optimum detection limits for assessment of final DQOs.

4. Selection of appropriate analytical parameters.

5. Collection of a sufficient amount of QA/QC samples to statistically verify proper functioning of analytical equipment.

6. Documentation of field and laboratory procedures using appropriate field forms and laboratory log books that are signed and dated by sampling and analysis personnel.

7. Implementation of proper sample collection and handling procedures.

8. Implementation of proper decontamination procedures.

The above protocols for sample collection, handling, and analysis provide a guideline for obtaining the most representative sample possible in an effort to meet established project DQOs. QA/QC samples, which will be collected to verify that sampling and decontamination procedures are not introducing trace constituents, include the collection of three types of blanks described below.
1. Field blanks will be prepared from source water used in decontamination and steam-cleaning procedures. At a minimum, one field blank will be collected from each source of decontamination water utilized during decontamination procedures. All field blanks will be analyzed for parameters similar to those of samples collected using the associated sampling device.

2. Equipment rinseate blanks will be collected by passing distilled water through the appropriate pre-cleaned sample collection device and subsequently collecting this water after it has touched the walls, screens, and filters (if applicable) of the sample collection device. Equipment rinseate blanks will be analyzed for parameters similar to those of samples collected using the sample collection device. Equipment rinseate blank samples will be collected at a frequency of 1 per 20 (5%) investigative samples per sample matrix.

3. Trip blanks will accompany sample collection containers utilized for the analysis of VOCs in each environmental medium. Trip blanks consist of laboratory reagent water sealed in volatile-organic sample containers and sealed. These blanks will accompany any empty volatile organic container to and around the site during sampling activities, and will be submitted with every shipment to the laboratory that contains samples to be analyzed for VOCs.

4.5 COMPARABILITY

Comparability is the confidence with which one data set can be compared to another. Since previous environmental investigations have been performed at the Alcoa-Davenport
Works, a substantial chemical database exists. To ensure data set comparability, the following steps will be taken:

1. Maps showing locations of previous and existing sampling locations will be reviewed prior to the selection of proposed sampling locations.

2. A review of previous sampling methods will be completed as necessary, and current analyses will be performed using similar or improved methods having detection limits at or below previous analyses.

3. Previous sample collection techniques will be implemented when applicable.

4. Current QA/QC procedures will be, at a minimum, consistent with QA/QC procedures implemented during previous sampling programs.
5.0 SAMPLING TECHNIQUES, PROCEDURES, AND EQUIPMENT

General procedures to be followed during Alcoa-Davenport Works CERCLA activities are described in the following sections. Described activities include soil sampling, monitor-well installation, groundwater sampling, surface-water sampling, and pumping tests. Standard operating procedures associated with these activities are provided in Appendix C. Specific procedures for proposed activities which are not included in the general procedures described in the following sections will be presented in the FSP or work plan prepared for each sampling investigation.

5.1 SOIL SAMPLING AND MONITOR WELL INSTALLATION

The following sections discuss field procedures to be implemented during soil sampling and monitor well installation activities.

5.1.1 Soil Sampling

Soil borings and monitor wells proposed to be installed into unconsolidated material will be advanced to the top of bedrock using the hollow-stem auger drilling technique. Continuous split-spoon sampling will be performed at each boring as outlined in SOP-14.

Upon retrieving the split-spoon sample, the soil core will be removed, inspected, and described by the field hydrogeologist for gross composition, texture, and other observable properties following standardized Geraghty & Miller procedures, which are in general accordance with American Society for Testing and Materials (ASTM) method D2488-84, "Standard Practice for Description and Identification of Soils". Information on drilling
methods, encountered water levels, and standard penetration test values will also be collected as described under ASTM Method D1586-84 (standard practice for Penetration Test and Split-Barrel Sampling of Soils). The standard form to be used in logging soil sample descriptions is provided in Appendix D. Field monitoring of soil cores will be performed by visual means and by using one or two types of organic vapor analyzers (OVAs) for organic vapor screening as described in SOP-15. The two types of OVAs are a Flame Ionizing Detector (FID) and a Photo Ionizing Detector (PID). Selected samples will be collected for chemical analysis by the field hydrogeologist, as called for in the specific FSP or work plan.

Upon retrieval of a split-spoon sample, the proper sample containers will be immediately filled. Sample labels will be affixed to jars containing samples for laboratory analysis. Labels will identify sampling location, sample identification, date of collection, analysis, and the name of the field hydrogeologist. These samples will then be cooled to approximately 4°C and shipped to the laboratory for analysis accompanied by appropriate chain-of-custody documentation.

Soil sample containers used for headspace screening will be labeled to indicate sample number and location, date of collection, depth interval, and the name of the field hydrogeologist. This information will be written on an appropriate label or on the lid of the sample jar with a waterproof marking pen.

Between samples, the split-spoon device will be decontaminated as outlined in SOP-10 to reduce the risk of cross-contamination.
5.1.2 Monitor Well Installation in Unconsolidated Sediments

The boreholes for monitor wells in unconsolidated sediments will be advanced approximately 6 inches into the underlying bedrock. This allows effective monitoring of the zone immediately above the bedrock surface and slightly below bedrock. After completion of the borehole, monitor wells will be constructed with augers in place to prevent collapse of the borehole. The monitor well assembly will consist of 2-inch- or 4-inch- diameter, Schedule 40 polyvinyl chloride (PVC) casing with a 5 foot length of slotted PVC well screen. An artificial sand pack will be installed to at least 2 feet above the top of the screen. Two feet of bentonite pellets will be placed above the sand pack, and a bentonite-grout mixture will be installed to ground surface using a tremie pipe. The well will be equipped with a well cap and a locking protective steel casing. A concrete pad will be installed at the base of the protective casing to divert surface runoff from the well. The majority of wells will be completed approximately two feet above grade, with the exception of those wells installed inside buildings or in high traffic areas, which will be completed flush with the ground surface. A diagram showing the flush-mount well cover is provided in Appendix D. The well-construction log showing typical monitor-well construction in unconsolidated material is provided in Appendix D.

A major objective of the groundwater RI is to identify and evaluate risks associated with any off-site migration of contaminated groundwater. It is therefore important that monitoring wells be installed, developed and sampled in such a manner that the mobile fraction of groundwater contamination is obtained in groundwater samples collected for totals analysis (no filtration). Obtaining representative groundwater samples within the unconsolidated water bearing unit at this site can be problematic due to the fine grain nature of the formation and the highly absorptive nature of many of the COCs. Although natural suspended particle load is anticipated to be minimal in the unconsolidated water-bearing unit due to its fine grain characteristics, special efforts may be needed during unconsolidated well

GERAGHTY & MILLER, INC.
For unconsolidated well construction, industry standard hollow-stem auger drilling and well installation procedures are anticipated; however, the following variations or additional steps may be taken, if necessary, to assure high quality well installation capable of providing representative groundwater samples:

- Cable tool drilling of some unconsolidated wells.

- Use of expendable hollow-stem auger plugs (PVC) to prevent mud rising in the auger flights prior to well installation.

- Use of oversized inside diameter hollow-stem augers with a well centralizer to maximize sand pack annular space.

- Flushing and bailing the borehole with potable water prior to well installation.

- Use of medium to fine grain sand filter pack (a 40-60 sieve sand) wet tremied into place.

- Use of a prepacked (fine sand) well screen.

- Use of a large diameter (4-inch) PVC well.
5.1.3 Monitor Well Installation in Bedrock

5.1.3.1 Shallow Bedrock Monitor Well

For areas with evidence of shallow groundwater contamination, monitor-well installation in shallow bedrock will consist of drilling through the unconsolidated material to the top of bedrock using air-rotary drilling technique. A steel casing will be installed and pressure grouted in the borehole from the surface to the top of competent bedrock to prevent vertical migration of contamination from the unconsolidated material into the bedrock. Grout used to set casing will be 2-5% by weight bentonite amended cement. The general rule of thumb for the proportion of bentonite to cement for a 2% mixture by weight is to use 2 pint jars of bentonite for each 94 pound bag of type 1 cement. Pressure grouting will be completed by installing the grout through the inside of the outer steel casing using a tremie pipe and an inflatable packer or by installing the grout directly around the outside of the outer steel casing. After allowing the grout to set for approximately 24 hours, a borehole will be advanced 20 feet into the bedrock using the air-rotary drilling technique. Potable water may be used during this process to promote advancement of the drill bit. In areas where historical data or field screening (visual inspection and OVA readings) suggests shallow groundwater contamination is not present, temporary steel casing sealed into rock and hydrated bentonite may be used prior to advancing the borehole to depth.

The monitor well assembly will consist of 2-inch- or 4-inch- diameter, Schedule 40 PVC casing with a 10 foot length of slotted PVC well screen. An artificial sand pack will be installed to at least 2 feet above the top of the screen. Two feet of bentonite pellets will be placed above the sand pack, and a bentonite-grout mixture will be installed to ground surface using a tremie pipe. The well will be equipped with a well cap and a locking protective steel casing. A concrete pad will be installed at the base of the protective casing to divert surface
runoff from the well. The majority of wells will be completed approximately two feet above grade, with the exception of those wells installed inside buildings or in high traffic areas, which will be completed flush with the ground surface. A diagram showing the flush-mount well cover is provided in Appendix D. The consolidated well construction log showing typical shallow bedrock monitor well construction details is provided in Appendix D.

5.1.3.2 Intermediate Bedrock Monitor Well

The typical monitor well installation in intermediate bedrock will consist of drilling through the unconsolidated material to the top of bedrock using air-rotary drilling technique. A steel casing will be installed and pressure grouted in the borehole from the surface to the top of competent bedrock to prevent vertical migration of contamination from the unconsolidated and shallow bedrock material into the deeper bedrock. Grout used to set casing will be 2-5% by weight bentonite amended cement. The general rule of thumb for the proportion of bentonite to cement for a 2% mixture by weight is to use 2 pint jars of bentonite for each 94 pound bag of type 1 cement. Pressure grouting will be completed by installing the grout through the inside of the outer steel casing using a tremie pipe and an inflatable packer or by installing the grout directly around the outside of the outer steel casing. After allowing the grout to set for approximately 24 hours, a second steel casing will be installed and pressure grouted in the borehole from the surface to a depth of 75 feet into the bedrock using the air-rotary drilling technique. After allowing the grout to set for approximately 24 hours, a borehole will be advanced 125 feet into the bedrock using the air-rotary drilling technique. Potable water may be used during this process to promote advancement of the drill bit.

In areas where historical data or field screening (visual inspection and OVA readings) suggests shallow groundwater contamination is not present, temporary steel casing sealed into
rock and hydrated bentonite may be used prior to advancing the borehole to depth. The borehole will be left uncased across the depth interval (75 ft to 125 ft) to be monitored for groundwater. The well will be equipped with a well cap and a locking protective steel casing. A concrete pad will be installed at the base of the protective casing to divert surface runoff from the well. The majority of wells will be completed approximately two feet above grade, with the exception of those wells installed inside buildings or in high traffic areas, which will be completed flush with the ground surface. A diagram showing the flush-mount well cover is provided in Appendix D. The consolidated well construction log showing typical intermediate bedrock monitor well construction details is provided in Appendix D.

5.1.3.3 Deep Bedrock Monitor Well

The typical monitor well installation in deep bedrock will consist of drilling through the unconsolidated material to the top of bedrock using air-rotary drilling technique. A steel casing will be installed and pressure grouted in the borehole from the surface to the top of competent bedrock to prevent vertical migration of contamination from the unconsolidated material into the bedrock. Pressure grouting will be completed by installing the grout through the inside of the outer steel casing using a tremie pipe and an inflatable packer or by installing the grout directly around the outside of the outer steel casing. After allowing the grout to set for approximately 24 hours, a second steel casing will be installed and pressure grouted in the borehole from the surface to a depth of 200 feet into the bedrock using the air-rotary drilling technique. After allowing the grout to set for approximately 24 hours, a borehole will be advanced 300 feet into the bedrock using the air-rotary drilling technique. Potable water may be used during this process to promote advancement of the drill bit.

In areas where historical data or field screening (visual inspection and OVA readings) suggests shallow groundwater contamination is not present, temporary steel casing sealed into
rock and hydrated bentonite may be used prior to advancing the borehole to depth. The borehole will be left uncased across the depth interval (200 ft to 300 ft) to be monitored for groundwater. The well will be equipped with a well cap and a locking protective steel casing. A concrete pad will be installed at the base of the protective casing to divert surface runoff from the well. The majority of wells will be completed approximately two feet above grade, with the exception of those wells installed inside buildings or in high traffic areas, which will be completed flush with the ground surface. A diagram showing the flush-mount well cover is provided in Appendix D. The consolidated well construction log showing typical deep bedrock monitor well construction details is provided in Appendix D.

5.1.4 Piezometer Installation

Piezometers will be installed at various locations to determine potentiometric levels at specific points within the unconsolidated water-bearing unit and shallow bedrock. All piezometers are intended to be temporary for the purpose of obtaining static water level measurements only. As such, the method of construction need not consider cross contamination, sample quality or hydraulic efficiency. Final decision on piezometer depth will be made in the field by the field geologist after reviewing borehole soil samples and field screening data.

Piezometers will consist of flush joint 1-inch PVC pipe with a 1 or 2 foot screen at the zone of interest. The screen will be packed with sand extending no more then a foot above the top of the screen. A bentonite seal and/or grout will be placed above the sand pack. Up to two shallow piezometers, monitoring different depths, may be installed in a single borehole provided that sufficient annular space exists (minimum of 4.25-inch) to place the inter-piezometer bentonite seal. Surface completion will be variable depending upon anticipated traffic in the area. At a minimum, the casing will be capped and a 5-foot high flagged stake
marking the location driven adjacent to the riser pipe. More durable or flush-mounted well completions, typical of monitoring wells, will be considered in high traffic areas. No development of piezometers is needed unless sediment has collected within the casing above the top of the screened interval.

Following R1 investigative activities and notification to EPA, all piezometers will be closed by tremie pipe injection of bentonite grout and cutting the casing flush with grade.

5.1.5 **Monitor Well Development**

All bedrock monitor wells will be developed using either a submersible pump or the air lift method. A surge block may also be incorporated with these methods, if necessary. Monitor wells constructed in unconsolidated material will be developed using pumps or a bailer. Development will continue until a minimum of 3 well volumes have been evacuated from the well and indicator parameters (turbidity, pH, SCON and temperature) have stabilized. At least 2 times the amount of water used to install the well must be removed during development, if applicable. Temperature, pH, SCON and turbidity will be monitored in the field during development activities to ensure proper development. Final field screening parameters as well as the total volume of water purged will be recorded on a Monitoring Well Development Log (Appendix D). Details concerning well development are provided in SOP-18.

5.2 **GROUNDWATER-LEVEL MONITORING**

Water levels will be measured at all monitor wells across the site using an electronic water-level indicator as described in SOP-20. These measurements will be used to develop
maps of water-level elevations across the site so that information can be interpreted concerning vertical and horizontal hydraulic gradients and direction of groundwater flow.

5.3 SEPARATE-PHASE THICKNESS MEASUREMENT USING AN OIL/WATER INTERFACE PROBE

Free product thickness will be measured in all product wells using a clean bailer or with an electronic interface probe as described in SOP-21. These measurements will be used to monitor thickness of free product, and to delineate any free-product plume.

5.4 MONITOR WELL SAMPLING PROCEDURES

Prior to initiation of purging and sampling activities, static water levels will be measured in all monitor wells as previously described. This procedure provides the following: 1) accurate data for water-table maps; 2) an opportunity for the sampling team to become oriented to the site; and, 3) immediate information about unusual circumstances, such as wells that might be lost, damaged, dry, or inaccessible.

The following procedures apply to all wells from which groundwater is to be collected and analyzed.

1. **Well Purging.** Prior to sampling each well, the standing water in the well casing and the water immediately surrounding the well screen will be purged so that representative formation water may be sampled. SOP-19 describes the purging procedures in detail.
The volume of water in a well will be calculated by subtracting the depth to water from the total depth of the well and then multiplying this value by a coefficient which relates the diameter of the well to gallons per linear foot. The evacuation will be accomplished using a pump and/or a disposable or site-dedicated bailer. To minimize turbidity, the static water column should not be lowered excessively (greater than 5 feet) during purging of wells in unconsolidated deposits. Two generally-accepted criteria for determining if a sufficient volume of water has been pumped from the well to obtain a sample representative of formation water are: 1) the removal of 3 to 5 standing well volumes, or 2) the removal of enough water so that field parameters, (pH, SCON, turbidity, and temperature) stabilize. A combination of the two criteria will be used at the Alcoa-Davenport Works. A minimum of 3 well volumes will be removed from each well when purging, except when a well is pumped dry during purging. If the field parameters are not stable after 3 well volumes have been removed, an additional 2 well volumes will be removed (a total of 5 well volumes). Groundwater will then be sampled, even if the field parameters still have not stabilized. If a well is evacuated to dryness during purging and the field parameters are stable, or if the well has been evacuated to dryness 3 times, the well will be considered purged, and it will not be necessary to remove the minimum 3 well volumes from the well. Samples will then be collected as soon as enough water enters the well to obtain a sample. The equipment used in well evacuation will be decontaminated between wells as specified in SOP-7 for pumps and SOP-8 for bailers. Disposable high-density polyethylene (HDPE) bailers will be discarded following purging and sampling at each well, and will not require decontamination.

During purging, pH, temperature, SCON, and turbidity will be measured after each well volume of water has been removed from the well. The field parameters will be
considered stable when two successive measurements vary by less than 0.5° Celsius (C) for
temperature, 10 percent for SCON, 10 percent for turbidity, and 0.5 units for pH. The
procedures for calibration and use of portable pH, specific conductance, and turbidity meters
are described in SOP-1, SOP-2, and SOP-26, respectively.

2. **Set-Up for Sample Collection.** Plastic sheeting shall be placed around the well to
provide a clean working surface and protect sampling equipment from potential
contamination. During groundwater sampling activities, a Sampling of Monitoring
Wells Check List, shown in Appendix D, shall be filled out on a daily basis. This
form documents various aspects of the sampling procedures which can affect data
quality and validity. Additionally, a water-sampling log presented in Appendix D
will be prepared for each well. Preliminary information requested in the water-
sampling log (i.e., project, location, time, data, weather, etc.), will be recorded at
each well. Sample identifications will be derived in accordance with the sample
numbering scheme described in the FSP. Sample identifications will be derived in
accordance with the sample numbering scheme described in Section 5.10 of the
QAPP.

3. **Sample Collection.** Procedures describing the collection of groundwater samples
are presented in SOP-22 and SOP-25. Groundwater samples will be collected
from wells using a clean Teflon™ bailer, disposable HDPE bailer or polyethylene
tubing. Water samples will be collected by pouring or decanting the water slowly
from the bailer or tubing into the appropriate sample containers. The bailers will
be rinsed immediately prior to use. For purposes of quality control, field cleaning
of the Teflon™ bailers is preferable to precleaning them in a laboratory. To ensure
that no cross-contamination occurs between wells, a new bailer cord will be used
at each sampling station.
If a well will not yield the volume of water necessary to immediately fill the required number of sample containers, the filled and partially filled containers will be tightly capped, kept out of sunlight, and cooled to approximately 4°C, until the necessary volume of sample can be obtained.

Groundwater samples for analysis of SVOCs, PCBs and total metals may be collected using a low-flow sampling technique if a turbid free sample (<20 NTUs) cannot be obtained by previously mentioned methods. This technique was developed to provide samples that are representative of formation conditions with minimal amounts of suspended material. The procedure for collecting groundwater samples using the low-flow technique are provided in SOP-25. Groundwater samples collected for dissolved metals analysis will be field-filtered as discussed in SOP-24. Groundwater will be filtered through a 0.45-micron filter prior to being preserved with nitric acid. All samples shall be preserved in appropriate containers for the analysis to be performed as outlined in the Quanterra Environmental Services QAMP (Appendix B). Preservatives to be used in fixing groundwater samples for the various chemical analyses to be conducted are included in Appendix B.

Groundwater samples will be collected by conventional means (bailer) unless turbidity is greater than 20 NTU. If turbidity is greater the 20 NTU, a low-flow sampling technique will be used to collect SVOCs, PCBs and inorganic samples. VOC groundwater samples will be collected by conventional means regardless of the turbidity level. If low turbidity samples cannot be obtained using bailer or low-flow sampling technique, sample collection will be attempted using the alternative methods tested below. If the alternative methods prove insufficient to obtain a sample with a turbidity level which appears to be reasonable (based on observations from the other site wells) additional methods maybe proposed to EPA. At a
minimum, an unfiltered sample will be collected and analyzed for all locations specified for sampling. Alternative sampling techniques include:

- Use of peristaltic pump. (Refer to SOP-31.)
- Installation of a dedicated bladder pump. (Refer to SOP-32.)
- Redevelopment of the monitor well. (Refer to SOP-18.)
- Use of a downhole turbidity meter to measure turbidity levels in the well bore. (Follow manufacturer's guidelines.)
- Collection of groundwater samples for analysis of both total and dissolved (filtered) fractions. (Refer to SOP-31.)
- Addition of general analytical parameters to further characterize the geochemistry of a water sample.

Samples collected from monitoring wells containing NAPLs (LNAPL or DNAPL) will be identified as a NAPL sample on the laboratory chain-of-custody. This will prevent the sample from being considered a groundwater sample and representative of groundwater conditions.

Following sample preparation, all groundwater samples shall be placed on ice in cooler chests for storage and shipment to the analytical laboratory. Chain-of-custody procedures and other shipping protocols are further discussed in Section 6.0.

5.5 SURFACE-WATER SAMPLING PROCEDURES

Surface-water samples will be collected according to the procedures in SOP-16. Surface-water samples will be collected by immersing a glass, stainless steel, or Teflon™
dipper from just below the surface of the water to the bottom while standing downstream of the sampling location. Collected surface water will be transferred from the container to prelabeled bottles and immediately stored on ice at approximately 4°C. Collected surface water will be transferred first to VOC sample bottles, each bottle will be filled in a single pour to reduce volatilization. After all VOC sample bottles have been filled, additional surface water samples collected will be evenly split among all remaining bottles to ensure that a representative sample is collected. Both filtered and unfiltered samples will be collected during initial sampling rounds, where necessary. Surface-water samples will be collected by proceeding from the furthest downstream location to upstream locations. The sample collection device will be decontaminated using SOP-10 prior to sampling at each location. Any surface-water samples collected for determining ecological risk is outside the scope of this QAPP.

5.6 SEDIMENT SAMPLING

Sediment samples will be collected at the time of surface-water sampling. Immediately following the collection of each surface-water sample, sediment samples will be collected using a soil-recovery auger, trowel or shovel from a depth of 0 to 12 inches. The details of this procedure are listed in SOP-17. A description of the channel conditions will be recorded in addition to data obtained through field analyses. Sample replicates will be collected where necessary by splitting the sample and placing the portions in respective jars. Any sediment samples collected for determining ecological risk is outside the scope of this QAPP.
5.7 AQUIFER SLUG TEST

A slug test will be conducted on selected monitor wells. The slug test is a relatively quick method of obtaining approximate values of hydraulic conductivity (K) in the immediate vicinity of a monitor well screen. The test consists of displacing a known volume of water in the well with a solid object, or slug. The rate at which water levels return to their initial or static level is a function of the aquifer's hydraulic conductivity. An electronic pressure transducer and data logger will be used to measure water level fluctuations during the slug test. The details of this procedure are listed in SOP-27. Data, as depth-time pairs, are then graphed and used to determine hydraulic conductivity and aquifer transmissivity.

5.8 INSTALLATION AND USE OF STAFF GAGES

Staff gages will be installed in outfalls to assist in determining the effect the outfalls have on groundwater flow. Staff gages are rigid boards or rods, precisely graduated, and accurately located for scalar measurements sections. Staff gages may also be porcelain enameled iron sections, securely bolted or fixed to a secure backing or rod.

The staff gages will be surveyed to establish a datum point relative to mean sea level. This selection of datum makes it possible to work with positive gage heights at extremely low stages. The datum of the gaging station is the elevation of the zero point of the base.

Readings will be recorded periodically during the duration of field activities. The staff gages will be read from a specified location along the bank of the outfall.
5.9 HANDLING OF GENERATED WASTE

Liquid and solid wastes produced during the investigations will be collected, containerized (dated and labeled) and evaluated to determine proper disposal. During sampling activities, information regarding waste generated at each sampling location will be recorded on waste management forms included in Appendix D. Completed waste management forms will be forwarded to the Alcoa Waste Management Department. All containers will be labeled until the proper disposal alternative has been determined. The analytical results from soil and groundwater sampling during each investigation will be considered prior to disposal of generated waste. Liquid wastes from the development, purging, and sampling of monitoring wells can be treated with carbon units as outlined in SOP-28. The proper disposal will be implemented by Alcoa, and will be consistent with all state and federal regulations for the disposal of solid and hazardous waste.

5.10 IDENTIFICATION CODES FOR SAMPLE/MONITOR POINTS AND SAMPLES SUBMITTED FOR ANALYSES

Newly installed sample/monitor points and samples submitted for analyses will be labeled using an identification code which identifies the general area where the monitor point/sample was collected and designates the type, number, and depth, if appropriate. Sample/monitor points and samples submitted for analyses are labeled using an prefix and suffix separated by a dash. The abbreviated unit identifier prefix indicates a nearby FSA unit or specific investigation. A suffix is then added to indicate sampling method, piezometer or well, number of the sample collected in the investigation area, and depth or type of piezometer or well. Some unit prefixes used in previous investigations and several prefixes designated for future areas to be investigated have been abbreviated as follows:
Additional prefix identifiers will be created as needed if additional areas of the facility is investigated. The abbreviated unit represents the prefix to all sample and location identifiers.

The suffix of the sample identification code will be applied to each type of media sampled at Alcoa-Davenport Works during subsequent investigations. Common suffixes employed for sample/media identification are as follows:

- HA - Hand Auger
- P - Piezometer
SB - Soil Boring
SS - Sediment/Sludge Sample
SW - Surface Water Sample

Identification of groundwater samples is based upon the well from which they are collected. Wells at Alcoa-Davenport Works will have a prefix identifying the associated unit and a suffix which defines the well number and the water-bearing zone or aquifer depth which the well is monitoring. These abbreviations are as follows:

U - Unconsolidated Water-Bearing Zone
S - Shallow Portion of the Bedrock Aquifer
I - Intermediate Portion of the Bedrock Aquifer
D - Deep Portion of the Bedrock Aquifer

The following page displays six different media types and an example of the common sample identifier associated with each. Duplicate samples are followed by the letter D.

Surface Water Samples:

FSA UNIT ID
001-SW01D
   |   | DUPLICATE
   |   | NUMERICAL SEQUENCE
   |   | SURFACE WATER SAMPLE

Sediment/Sludge Samples:

FSA UNIT ID
001-SS01
   |   | NUMERICAL SEQUENCE
   |   | SEDIMENT/SLUDGE SAMPLE
Hand Augers:

- FSA UNIT ID
- WDS-HA01
- NUMERICAL SEQUENCE
- HAND AUGER

Soil Borings:

- FSA UNIT OR INVESTIGATION ID
- EXP-SB01-02
- SAMPLE COLLECTION DEPTH
- NUMERICAL SEQUENCE
- SOIL BORING

Groundwater Samples:

- FSA UNIT ID
- BY-01U
- UNCONSOLIDATED WATER-BEARING ZONE
- NUMERICAL SEQUENCE
6.0 SAMPLE CUSTODY

Sample custody is a vital aspect of CERCLA activities, and appropriate sample custody procedures must be rigidly followed to preserve sample integrity and to ensure validity of field and laboratory data. As a result, all sample data must be traceable from the time and location of sample collection, through chemical analyses, and ultimately to the time when the data are used. For the purposes of this project, only Geraghty & Miller personnel associated with sampling activities will function as sample custodians for samples collected during field operations.

6.1 SAMPLE CONTAINER CUSTODY

All sample containers will be shipped from the laboratory by common carrier in sealed coolers to the Geraghty & Miller designated location prior to sampling. Included with the containers will be a shipping form listing all containers and the intended use of each. Upon receipt of the sample containers, the Geraghty & Miller representative will open and inspect the sample containers. The bottle inventory will then be checked and compared to the container list provided by the laboratory. If all bottles are received in good condition, this and any other appropriately completed bottle shipment lists will become an integral part of the chain-of-custody record.

6.2 FIELD CUSTODY PROCEDURES

A key aspect of field custody is based on careful documentation of sampling activities and specific sampling locations. For this reason, Geraghty & Miller will be maintaining several field logs during sampling activities. Field personnel will document times associated
with general field activities on a daily log. When sampling commences at a particular location, appropriate sampling forms will be started by first identifying the sampling point and recording it in the space provided. The appropriate sample containers will then be selected and labeled, using a Geraghty & Miller sample label or equivalent (Appendix D), with the following information: project code number, sampling date and time, sample identification number, parameters of interest, preservative, and initials of sampling personnel. As sampling proceeds, additional details pertaining to sampling technique, visual inspection of the sample, time, date, weather, and a variety of field measurements will be recorded on the appropriate logs. When sampling is complete, the QAO or a designated representative will review, date, and sign each sampling form to ensure its completeness.

6.3 SAMPLE CUSTODY AND SHIPPING AFTER COLLECTION

After collection, environmental samples are considered to be in the custody of Geraghty & Miller if they are:

- In actual possession of a Geraghty & Miller representative or a member of the field sampling team;

- In view, after being in physical possession;

- In a locked container so that prevents tampering, after having been in physical custody; or

- In a secured area restricted to authorized personnel, after being in physical possession.
Prior to transfer of the samples off site at the end of the day, chain-of-custody entries will be made for all samples using a standard Geraghty & Miller chain-of-custody form or equivalent (Appendix D). All information on the chain-of-custody form and the sample container labels will be checked against field sampling log entries and samples will be recounted before sealing the shipping container. If incorrect entries are made on the chain-of-custody form, they should be marked through with a single line, initialed, and dated by the person completing the form. Upon transfer of custody, the chain-of-custody form will be marked with the time and date followed by the sample custodians signature. Since common carriers (Federal Express, Purolator Courier, UPS, etc.) will not sign chain-of-custody forms, the chain-of-custody records will be sealed in plastic bags within each cooler. A signed and dated custody seal (Appendix D) will then be placed over the lid opening of the sample cooler to maintain sample integrity during shipping prior to receipt by the laboratory sample custodian. When received by the laboratory, all chain-of-custody forms, will be signed and dated by the laboratory sample custodian and returned to the Geraghty & Miller QAO with the data report.

6.4 LABORATORY CHAIN-OF-CUSTODY

At the time of sample cooler receipt, the laboratory sample custodian will note the condition of each sample as well as any questions or observations concerning sample integrity. Any questions arising from initial inspection or confusion concerning analyses will be directed to the Geraghty & Miller QAO immediately for clarification. Geraghty & Miller will also maintain a sample tracking database that will follow each sample through all stages of laboratory processing and analyses. These sample tracking records will indicate date of sample receipt, extraction or preparation, if applicable, and sample analysis. These records will be used to determine holding time limits during laboratory audits and data validation.
Laboratory sample handling, analysis, and disposal procedures established for this project are explained in detail in the Quanterra Environmental Services QAMP (Appendix B).

6.5 FINAL EVIDENCE FILE

The project coordinator and the project QAO are responsible for maintaining a central project file for original field records that document sampling activities and laboratory analysis records for future reference. The file will also contain all incoming materials related to the project, such as: historical information (reports, data, and maps); current site maps; daily logs-instrument logs; sampling logs; signed and dated chain-of-custody documentation; bound field notebooks; laboratory correspondence files; laboratory data; field and laboratory data validation notes; and any other pertinent information specific to the Alcoa-Davenport Works.
7.0 CALIBRATION PROCEDURES

In order to meet prescribed DQOs presented earlier in this QAPP, proper calibration procedures for field and laboratory instrumentation must be followed. The following sections provide calibration information for field and laboratory instrumentation, along with required recalibration criteria and frequency.

7.1 FIELD INSTRUMENTATION

All field instrumentation used to collect data during CERCLA activities will be calibrated in accordance with manufacturers instructions. SOPs detailing calibration procedures for each type of instrument are provided in Appendix D. Initial calibration of the FID and/or PID will be performed at the beginning of each working day using a 2-point calibration method. Calibration checks for the FID and/or PID will be performed every hour of instrument use. Initial calibration of the pH meter will be performed using standards that bracket the expected pH values of collected samples. These standards may include pH 4, 7, and 10 buffers. Initial calibration of the SCON meter will be performed at the beginning of each working day using either a 447-umhos/cm or a 1413-umhos/cm (micromhos/centimeter) standard. Continuing calibration checks for pH and SCON meters will be performed at a minimum every 2 hours of steady use. Initial calibration of the turbidity meter will be performed at the beginning of each working day using a 40 NTU standard solution. Turbidity meter calibration checks will be performed every 4 hours of steady use. In addition, continuing calibration checks should be performed for each field instrument every time the instrument is moved to a new sampling location.
7.2 LABORATORY INSTRUMENTATION

Calibration procedures, frequency, and standards for measurement of variables and systems will be employed by the analytical laboratory in accordance with procedures stated in the EPA CLP SOWs for routine analytical services. Calibration procedures for special analytical services will be in accordance with the calibration requirements specified by EPA-approved protocols utilized during this program and listed in the Quanterra Environmental Services QAMP (Appendix B).
8.0 ANALYTICAL PROCEDURES

The analytical program for the Alcoa-Davenport Works has been developed based on results from previous sampling events. Where possible, all methodologies will be consistent with the EPA CLP SOWs for routine analytical services. Other methodologies for special analytical services are in accordance with EPA-approved methodologies and are outlined in the Quanterra Environmental Services QAMP (Appendix B). Field reconnaissance methodologies that may be used during the program have been based, at least in part, on EPA documents including "A Compendium of Superfund Field Operations Methods", December 1987 (EPA 1987). Specific details concerning sampling procedures will be provided in the appropriate FSP or work plan for a given sampling event.

8.1 PARAMETERS, SAMPLE MATRIX, AND SAMPLE QUANTITY

Due to the nature of future sampling programs to be conducted in accordance with this QAPP, a summary of investigative samples and associated analytical parameters cannot be discussed in this document. Detailed information specific to each CERCLA activity will be provided in the appropriate investigation FSP or work plan.

Based on potential methodologies presented in Section 8.2 (Laboratory Analytical Methodologies), specific lists of analytes of interest for multi-component analyses (VOCs, SVOCs, PCBs, inorganics and hydrocarbons) are presented in Tables 8-1 through 8-4, 8-6, and 8-7. All other potential analyses are single-component and require no further elaboration. Additionally, the frequency and number of QA/QC samples to be collected in conjunction with this program are detailed in Section 10.0 (Internal Quality Control) of this QAPP.
8.2 LABORATORY ANALYTICAL METHODOLOGIES

Table 8-5 provides analytical methodologies that will be utilized by the laboratory for analysis of environmental samples collected for the Alcoa-Davenport Works. The majority of analyses will be performed in accordance with the EPA CLP. However, some analyses are not covered under the CLP; and therefore, approved EPA methodologies have been listed.

Accompanying each methodology are detection limits for water and soil matrices that are routinely achievable when no interferences are present. It is expected that, due to the complexity of environmental samples, these detection limits will vary from one sample to another.

8.3 FIELD METHODOLOGIES

Field parameters (pH, SCON, temperature, turbidity and headspace volatile organics) will be measured according to specific instrument manufacturer’s instructions. The EPA document, EPA/540/P-87/001 (EPA 1987) will be used as a reference. Additional specific details concerning SOPs (Appendix C) that are to be used will be provided in the appropriate FSP or work plan.
9.0 DATA REDUCTION, VALIDATION, AND REPORTING

Data reduction, validation, and reporting procedures include an evaluation of both the field data package and the laboratory analytical data package. The overall DQOs for CERCLA activities can be met only if data generated in the field and by the analytical laboratory are valid. The following discussions provide the basis for data reduction, review, validation, and reporting.

9.1 DATA REDUCTION

Quanterra Laboratories utilizes a Laboratory Computerized Data Management System (LCDMS) to record, document, and assimilate pertinent laboratory technical and administrative data. This LCDMS provides data management functions for a number of component laboratory activities including: laboratory sample acceptance; sample analytical results; sample status and tracking; analytical QA/QC; final report generation; and client invoicing. The LCDMS enhances efficient coordination among component laboratory activities by providing a highly automated, standardized, communication network for data transfer and correlation. The Quanterra Environmental Services QAMP (Appendix B) and appropriate EPA CLP SOW(s) present details concerning equations, and procedures used to calculate concentrations, types of records maintained, procedures for transfer of data to forms and reports, procedures for proofing and cross-calculation checks, and procedures for handling blank results.

Once data reports are received by Geraghty & Miller and validation is complete, chemical data will be entered into an environmental database designed for the Alcoa-Davenport Works. Summary data tables will be prepared and checked by the Geraghty
& Miller QAO or his designee for completeness and transcription errors prior to release for scrutiny.

9.2 FIELD DATA REVIEW AND VALIDATION

The field data package will be reviewed by the Geraghty & Miller QAO or a designee and assessed for the following items:

- Completeness of field data logs;

- Verification that equipment blanks, field blanks, and trip blanks were properly prepared, identified and analyzed;

- Review of field analyses and equipment calibrations for general condition and completeness; and

- Review of chain-of-custody forms for proper completion, and signatures of field personnel and the laboratory sample custodian.

A failure in any of the above areas may result in data being classified as estimated or unusable.

9.3 LABORATORY DATA REVIEW AND VALIDATION

After validation of the field data package, a percentage of the analytical data will be validated by the QAO or designee from Geraghty & Miller. Past experience with complete
Validation of CLP lab data packages indicates that problems with the data occur infrequently. Since laboratory QC procedures effectively discover problems prior to finalizing the data package, Geraghty & Miller will validate a minimum of 10% of the data. The validation steps will be performed in accordance with the EPA National Functional Guidelines for Organic Data Review (EPA 1994a), and EPA National Functional Guidelines for Inorganic Data Review (EPA 1994b), and compared to the project measurement DQOs specified in Table 4-1. A minimum of 10% of the analytical data packages will undergo validation by Geraghty & Miller. Laboratory data to be validated will be selected to represent a cross section of data collected. Where practical, data will be validated for each parameter group and environmental medium to represent the entire field investigation, with consideration given to potential problems such as laboratory loading or difficulty of the analytical procedure.

Validation of the analytical data package may include, but not be limited to, the following items:

- A comparison of the data package to the reporting requirements specified in the Data Reporting section of this QAPP to ensure completeness in the analytical data package and compliance with EPA-approved procedures for a minimum of 10% of the samples.

- A comparison of sampling dates, sample extraction dates, and analysis dates to check that samples were extracted and/or analyzed within proper holding times will be conducted for a minimum of 10% of the samples.

- A review of analytical methods and suggested method detection limits will be conducted for a minimum of 10% of the samples.
• A review of field and laboratory blanks to evaluate possible contamination sources. The preparation techniques and frequencies, and the analytical results (if appropriate) will be considered. A minimum of 10% of the blanks will be evaluated in accordance with the National Functional Guidelines for Organic Data Review (EPA 1994a), and National Functional Guidelines for Inorganic Data Review (EPA 1994b).

• A review of field replicates to check precision of chemical analyses and field sample collection techniques will be conducted for a minimum of 10% of the samples. If available, a minimum of 10% of the field replicates and laboratory duplicates for water matrices will be reviewed.

• A review of surrogate spike results to ensure results are within allowable control limits specified for the method will be conducted for a minimum of 10% of the samples.

• A review of matrix spike recoveries will be conducted for a minimum of 10% of the matrix spikes analyzed. Matrix spike recoveries for organic analyses are considered advisory by the EPA and will be used to evaluate the presence of matrix interferences that may be affecting recovery of a particular analyte. Control limits must be reported when matrix spike data are reported. When matrix spike duplicates are performed and/or reported, the RPD must be calculated and control limits reported. Matrix recoveries for inorganic analyses are definitive. If matrix spike recoveries are outside control limits, data may be considered quantitatively suspect and qualified as estimated.
If a problem with the analytical package is discovered in the course of data validation, review of additional data may be conducted to determine the extent of the problem.

9.4 DATA REPORTING

A general data flow and reporting scheme, from collection of raw data through storage, is included as Figure 9-1. Details concerning laboratory reporting requirements are specified in the appropriate EPA CLP SOWs. Special analytical services will be reported in accordance with requirements provided in Appendix E. These requirements will provide information concerning overall analytical quality assurance, and will allow for validation checks on laboratory-generated data. The laboratory is to follow the specified reporting requirements as closely as possible for both routine and special analytical services.

All data units will be reported in either milligrams or micrograms of analyte per liter (mg/L and μg/L respectively) for aqueous samples, and in milligrams of analyte per kilogram of solid (mg/Kg) on a dry weight basis for soils.
10.0 INTERNAL QUALITY CONTROL

Quality control checks on field and laboratory procedures will be performed to ensure collection of representative samples and the generation of valid analytical results. These checks will be performed routinely by project participants under the guidance of the project QAO or a designee.

10.1 INTERNAL FIELD QUALITY CONTROL CHECKS

The Geraghty & Miller QAO or a designee will conduct internal quality control checks of sampling procedures and laboratory analyses. These checks will consist of the preparation and submittal of equipment rinseate blanks, filter blanks, and field blanks at a frequency of 1 per 20 (5%) investigative samples collected of a similar matrix. Additionally, sample replicates will be collected at a frequency of 1 per 10 (10%) samples collected of a similar matrix. Trip blanks will accompany all coolers used for the storage or shipment of samples to be analyzed for VOCs in each environmental medium. The trip blanks will be analyzed at the laboratory for VOCs only, and will serve as a check for sample contamination during transport either to or from the site.

10.2 INTERNAL LABORATORY QUALITY CONTROL CHECKS

Internal quality control checks to be used by the laboratory are described in detail in the Quanterra Environmental Services QAMP (Appendix B). The laboratory will demonstrate the ability to produce acceptable results using any of the suggested methods presented in Table 8-5 and in their Quanterra Environmental Services QAMP (Appendix B). Internally
produced data will be evaluated by the laboratory based on the following criteria (as appropriate for inorganic or organic chemical analyses):

- Method performance using the following QA checks:
  - Gas chromatography (GC)/matrix spike tuning with bromofluorobenzene (BFB) or decafluorotriphenylphosphine (DFTPP),
  - GC calibration performance,
  - Laboratory control samples,
  - Spike recoveries (matrix and surrogate),
  - RPDs between MS and MSD, and between samples and laboratory duplicates,
  - Linearity of response of calibration check compounds ([CCC], %D and %RSD),
  - Precision of calibration checks (system performance check compounds [SPCC] and CCC), and
  - Recoveries of laboratory control samples and independent QC check samples.
- Percent recovery of internal standards:
- Adequacy of detection limits obtained:
- Precision of replicate analyses; and
- Comparison of the percentage of missing or undetected substances among replicate samples (not known by lab).
11.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits for sampling and analyses operations consist of review of field and laboratory quality assurance systems, and on-site review of sampling, calibration, and measurement procedures. The audits are designed to evaluate the effectiveness of QA/QC procedures including the capability and performance of project personnel, status and condition of work areas and activities, and review and storage of project documentation. Results from the audits will be submitted to EPA RPM for review and comment.

11.1 FIELD PERFORMANCE/SYSTEM AUDIT(S)

The project QAO, or an appointed representative, will make one or more non-scheduled visits per year to the Alcoa-Davenport Works to observe the performance of the field operations team during any phase of field activities (boring program, monitor well installation, groundwater and surface water sampling, etc.). During this same period of time, a systems audit of field operations personnel by the project QAO or his designee may also be performed. The audits will be performed and assessed in accordance with guidelines set forth in the "Compendium of Superfund Field Operations Methods" (EPA 1987), Sections 19.0 and 20.0.

11.2 LABORATORY SYSTEM AUDIT

Quanterra Laboratories has undergone a detailed laboratory systems audit by Geraghty & Miller as a requisite for participating in its Analytical Quality Assurance/Laboratory Contract Program (AQA/LCP). As such, Quanterra Laboratories is under contract with Geraghty & Miller to provide analytical services under specified conditions based on the EPA
CLP. Because of the AQA/LCP program, the QA/QC review of data generated by these laboratories is constantly under the scrutiny of Geraghty & Miller project managers. If circumstances dictate that an additional systems audit be performed, the Geraghty & Miller QAO or designee will perform it in accordance with guidelines set forth in the "Compendium of Superfund Field Operations Methods" (EPA 1987), Sections 19.0 and 20.0.

11.3 PERFORMANCE EVALUATION AUDIT

A Performance Evaluation (PE) Audit is used to evaluate a laboratory's ability to perform an accurate and precise analysis of a blind check sample for a specific analytical method. Following analytical data validation described in the previous section, a PE audit of the laboratory may be conducted. This audit may be conducted if it is determined that the quality assurance data provided in the analytical data package for any parameter are outside acceptance criteria control limits. These PE audits may include a review of all raw data developed by the laboratory as well as submission of a blind spiked check sample for analyses of the parameters in question. In such an instance, the project QAO or a designee will be responsible for obtaining a prepared PE sample from an analytical standard supplier that provides documentation of standard accuracy and traceability to the National Institute of Standards and Testing (formerly National Bureau of Standards) or equivalent agency. These check samples may be submitted and disguised as field samples, in which case the laboratory will not know the purpose of the samples.

PE audits may also be conducted by reviewing the laboratory's results from certification testing and/or EPA CLP evaluation samples. An additional component of PE audits is review and evaluation of raw data generated from the analysis of PE samples and actual field samples.
12.0 PREVENTATIVE MAINTENANCE

Preventative maintenance procedures are established to ensure that laboratory and field instrumentation perform their intended functions. Instrument maintenance records for both laboratory and field instrumentation will be maintained for each individual instrument.

12.1 LABORATORY AND INSTRUMENTATION

Maintenance schedules for laboratory equipment have been established and are described in the Quanterra Environmental Services QAMP (Appendix B).

12.2 FIELD INSTRUMENTATION

All Geraghty & Miller field equipment requiring preventative maintenance will be serviced as described in the operators manual for each instrument. Preventative maintenance on measuring and test equipment is the responsibility of field personnel who will be reporting to the Project Coordinator.

All field equipment undergoes regularly scheduled preventative maintenance and operational checks performed by trained technicians or professionals, generally prior to calibration test schedules. When in use, all field instruments undergo preventative maintenance checks at least monthly or more frequently, depending upon use of the instruments and the manufacturer's recommendations.

Field equipment maintenance is generally performed on a daily or weekly basis whenever the equipment is in use. Maintenance schedules for each piece of field equipment
are checked prior to each field effort to ensure that required maintenance and calibration checks have been performed. After each field effort, routine maintenance will consist of:

- Decontamination,

- Power source (e.g. battery) checks and replacement, if necessary,

- Calibration checks and recalibration, if necessary (some instruments such as ground-penetrating radar must be returned to the manufacturer for proper calibration), and

- Tagging instruments and entering the maintenance check in the calibration log book.

Reserved back-up instrumentation will be available in case of equipment failure during field operations. However, except for the routine maintenance performed at the project site, most electronic field equipment requires checking and repair by a factory representative.
12.3 CRITICAL SPARE PARTS LIST

Critical spare parts will be maintained by Geraghty & Miller and the analytical laboratory for field and analytical equipment, respectively. These spare parts will be stored for availability and use in order to reduce instrument downtime in the event of equipment failure. A critical spare parts list for Geraghty & Miller field equipment is provided below. The reader is referred to the Quanterra Environmental Services QAMP (Appendix B) for a detailed list of spare parts for each analytical instrument. The drilling subcontractor will be responsible for critical spare parts for their equipment.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Spare Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flame Ionization Detector</td>
<td>Hydrogen, batteries, filter</td>
</tr>
<tr>
<td>M-Scope</td>
<td>Battery</td>
</tr>
<tr>
<td>Oil/Water Interface Probe</td>
<td>Battery</td>
</tr>
<tr>
<td>pH Meter</td>
<td>Battery, spare probe</td>
</tr>
<tr>
<td>Conductivity</td>
<td>Battery, spare probe</td>
</tr>
<tr>
<td>Masterflex Filter Pumps</td>
<td>Fuses (two)</td>
</tr>
<tr>
<td>Turbidity Meter</td>
<td>Tube splicing kit</td>
</tr>
<tr>
<td>Photo Ionization Detector</td>
<td>Battery</td>
</tr>
<tr>
<td></td>
<td>Battery, spare bulb</td>
</tr>
</tbody>
</table>
13.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA (PRECISION, ACCURACY, AND COMPLETENESS)

Details concerning evaluation of data precision, accuracy, and completeness are described in the following sections. The information presented is to be used as a guideline in the overall evaluation of field and laboratory data.

13.1 PRECISION

Precision is defined as an estimate of the reproducibility of a method and/or collection procedure, and is estimated by several statistical tests: standard deviation of the error distribution, coefficient of variation (CV) and RPD between replicate (duplicate) samples. Information regarding precision of chosen sample collection methodologies and analytical methods will be ascertained by reviewing the results of field replicates and laboratory duplicates. Additional information concerning laboratory precision will be obtained from MS/MSD results and continuing calibration verification results. If sufficient replicate and/or duplicate data are collected, the arithmetic mean and standard deviation can be determined.

Precision may also be evaluated by calculating the CV, which expresses the standard deviation as a percentage of the mean. Specific statistical comparison of replicate (duplicate) data from field and laboratory measurements, as a means of evaluating precision of both sample collection procedures and laboratory performance, may be accomplished by first comparing the obtained replicate (duplicate) results with the published EPA CLP criteria for method precision. If not available for a given method, the RPD may be calculated and compared to laboratory precision criteria found in the Quanterra Environmental Services...
QAMP (Appendix B). This calculated precision value may then be compared with the stated precision DQO for the analyte in question to determine whether the DQO has been satisfied.

13.2 ACCURACY

Accuracy of a method is an estimate of the difference between the true value and the determined mean value. Certain QA parameters, such as laboratory control samples, reagent water spike samples, QC check samples, matrix spike samples and surrogate spike samples, all have known concentrations prior to analysis. By comparing the percent recovery results (%R) to the known true value, it is possible to measure the accuracy of the analysis. In routine practice, the laboratory will collect data for each parameter for at least 30 measurements. The 30 measurements will then be used to calculate a mean value. Based on the desired level of confidence, 2 or 3 standard deviation ranges will be established as practical control limits. To be valid, these control limits must meet the accuracy limits specified in the appropriate EPA method for each analyte measured. If the determined control limits are within the range established for the analyte and method by the EPA, then the determined range becomes the practical control limit used by the laboratory until another set of data is developed and new control limits are calculated.

Specific statistical comparison of %R values reported by the laboratory as a measure of method accuracy will be compared with published EPA criteria for the accuracy of an individual method to determine whether the result is within control limits. Data not meeting control criteria for accuracy may be considered invalid or unusable unless the laboratory can provide additional information to substantiate matrix problems.
13.3 COMPLETENESS

Data completeness is defined as the percentage of total tests conducted that are deemed valid, and also as the percentage of the total tests required in the scope of work that are deemed valid. Data completeness will be evaluated during data validation, and resulting information will be used to determine completeness of analyses. Criteria for data completeness will be determined and compared to project DQOs presented in Section 4.0 of this QAPP.
14.0 CORRECTIVE ACTIONS

Acceptance limits for sampling and chemical analyses under this program will be consistent with those stated in the method or as defined by other means presented in this QAPP. Corrective actions are often immediate in nature and require implementation by the analyst, sampling personnel, and/or project management personnel. The corrective action implemented usually involves recalculation, reanalysis, or repeat sample collection. Long-term corrective action may be identified through analysis of PE samples, standards, control charts or other data. In either case, action taken must be properly documented.

14.1 IMMEDIATE CORRECTIVE ACTION

If an immediate corrective action can be taken as part of normal operating procedures, the collection of poor quality data can be avoided. Instrument and equipment malfunctions are amenable to this type of action. Actions taken will be noted in field or laboratory notebooks, but no other formal documentation is required unless further corrective action is necessary. Immediate corrective actions are a routine element of the QA/QC system.

Corrective action during the field sampling program is most often due to equipment failure or operator error, and may require that the sample be reanalyzed. Operator oversights will be avoided by having field personnel audit each other’s work prior to and after a sample reading. Every effort will be made by the field crew and their manager to ensure that all QC procedures are followed. If problems are not solved by immediate corrective action, Geraghty & Miller will default to a formalized long-term correction action if necessary.
Corrective action for analytical work will be based on procedures outlined in the Quanterra Environmental Services QAMP (Appendix B).

14.2 LONG-TERM CORRECTIVE ACTION

As previously mentioned, long-term corrective action may be identified by standard operating procedures, control charts, performance or system audits. Any problem which cannot be solved by immediate corrective action falls into the long-term corrective action category. The established QA system ensures that the data quality problem is reported to the person responsible for performing the corrective action. The essential steps in the corrective action system are as follows:

- Identify and define the problem,
- Assign responsibility for investigation of the problem,
- Investigate and determine the cause of the problem,
- Determine a corrective action to eliminate the problem,
- Review the likely effectiveness of the proposed corrective action,
- Assign responsibility for implementing the corrective action,
- Implement the correction action, and...
• Verify that the corrective action has eliminated the problem.

Documentation of the problem and solution are important to the system. When a data quality problem is discovered, the person responsible for investigating the problem will document the problem, list possible causes, identify the person responsible for the problem and describe corrective action that will be taken. The QAO or a designee will make checks to ensure that initial action was taken and that it appears effective, and at an appropriate later date, verify that the problem has been fully resolved. All submitted corrective action reports then become an integral part of the project files.
15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The project QAO or a designee will prepare QA reports that document all QC activities completed in the laboratory and in the field. These reports will be submitted to the Project Coordinator upon the completion of each phase of field work associated with the site. Additionally, QA summary reports and data summary sheets will be prepared periodically in conjunction with submitted investigation reports. At a minimum, reports will include the following:

- Quality assurance activities and quality of collected data (results of data validation),
- Equipment calibration and preventive maintenance activities,
- Results of data precision and accuracy calculations,
- Evaluation of data completeness and contract compliance,
- Field and/or laboratory QA problems and recommended and/or implemented corrective actions,
- Results of QA audit findings,
- Project status and anticipated completion dates for important tasks, and
- Any changes to procedures documented in the QAPP.
Following completion of field and laboratory work, a summary quality assurance report will be prepared along with a data validation package summarizing laboratory and field analytical problems encountered and corrective actions taken. The final QA report along with copies of the laboratory data summary sheets will be submitted to the Geraghty & Miller Project Coordinator. The full CLP package will be kept on file, and will be maintained as part of the project record.
16.0 REFERENCES


Table 4-1. Quality Assurance Objectives for Measurement of Data Precision, Accuracy and Completeness, Alcoa Davenport Works, Riverdale, Iowa.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Precision</th>
<th>Accuracy</th>
<th>Completeness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Field Parameters:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>+/-0.05 pH</td>
<td>+/-0.02 pH</td>
<td>95%</td>
</tr>
<tr>
<td>Specific Conductance</td>
<td>+/-7.6 umhos/cm</td>
<td>+/-2 umhos/cm</td>
<td>95%</td>
</tr>
<tr>
<td>Temperature</td>
<td>+/-0.1 C</td>
<td>+/-0.2 C</td>
<td>95%</td>
</tr>
<tr>
<td>Turbidity</td>
<td>+/-10%</td>
<td>+/-1NTU</td>
<td>95%</td>
</tr>
<tr>
<td><strong>Organics:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLP Target Compound List for Volatile Organics, Base/Neutral-Acid Extractables, PCBs</td>
<td>As defined in the CLP SOW for Organics</td>
<td>As defined in the CLP SOW for Organics</td>
<td>95%</td>
</tr>
<tr>
<td><strong>Metals:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLP Target Analyte List for Inorganics and Cyanide</td>
<td>As defined in the CLP SOW for Inorganics</td>
<td>As defined in the CLP SOW for Inorganics</td>
<td>95%</td>
</tr>
<tr>
<td><strong>Indicator Parameters:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various Non CLP Parameters</td>
<td>+/-30%</td>
<td>+/-30%</td>
<td>95%</td>
</tr>
</tbody>
</table>
Table 8-1. CLP Target Compound List for Volatile Organics, CAS Number, Soil and Water Detection Limits, Alcoa-Davenport Works, Riverdale, Iowa.

<table>
<thead>
<tr>
<th>Volatiles</th>
<th>CAS Number</th>
<th>CRDL Water (ug/L)</th>
<th>CRDL Low Soil/Sediment (ug/kg)</th>
<th>Drinking Water (ug/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>67-64-1</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Benzene</td>
<td>71-43-2</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td>75-27-4</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Bromoform</td>
<td>75-25-2</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Bromomethane</td>
<td>74-83-9</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2-Butanone</td>
<td>78-93-3</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>75-15-0</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>56-23-5</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>108-90-7</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Chloroethane</td>
<td>75-00-3</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Chloroform</td>
<td>67-66-3</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>74-87-3</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>cis-1,3-Dichloropropene</td>
<td>10061-01-5</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Dibromochloromethane</td>
<td>124-48-1</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Dichlorobenzenes</td>
<td></td>
<td>-</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>75-34-3</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>1,1-Dichloroethene</td>
<td>75-35-4</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>107-06-2</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>1,2-Dichloroethene (total)</td>
<td>540-59-0</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
<td>78-87-5</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>100-41-4</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>2-Hexanone</td>
<td>591-78-6</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>75-09-2</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>4-Methyl-2-pentanone</td>
<td>108-10-1</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Styrene</td>
<td>100-42-5</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Tetrachloroethene</td>
<td>127-18-4</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>trans-1,3-Dichloropropene</td>
<td>10061-02-6</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Trichlorethene</td>
<td>79-01-6</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>1,1,1-Trichloroethane</td>
<td>71-55-6</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 8-1. CLP Target Compound List for Volatile Organics, CAS Number, Soil and Water Detection Limits, Alcoa-Davenport Works, Riverdale, Iowa. (continued)

<table>
<thead>
<tr>
<th>Volatiles</th>
<th>CAS Number</th>
<th>CRDL Water (ug/L)</th>
<th>CRDL Low Soil/(^1) Sediment (ug/kg)</th>
<th>Drinking Water (ug/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>79-34-5</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>1,1,2-Trichloethane</td>
<td>79-00-5</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Vinyl Acetate</td>
<td>108-05-4</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Vinyl Chloride</td>
<td>75-01-4</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Xylenes (total)</td>
<td>1330-20-7</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

CRDL Contract required detection limit.

\(^1\) Medium/sediment CRDLs for volatile compounds are 125 times the individual low soil/sediment CRDL.

Specific detection limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment on a dry weight basis as required by the contract will be higher.
Table 8-2. CLP Target Compound List for Semivolatile (Base Neutral/Acid Extractable) Organics, CAS Number, Soil and Water Detection Limits, Alcoa-Davenport Works, Riverdale, Iowa.

<table>
<thead>
<tr>
<th>Semivolatiles</th>
<th>CAS Number</th>
<th>CRDL Water (ug/L)</th>
<th>CRDL Low Soil/Sediment (ug/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acenaphthene</td>
<td>83-32-9</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>208-96-8</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Anthracene</td>
<td>120-12-7</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Benzo(a)anthracene</td>
<td>56-55-3</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>50-32-8</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td>205-99-2</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Benzo(g,h,i)perylene</td>
<td>191-24-2</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>207-08-9</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Benzoic acid</td>
<td>65-85-0</td>
<td>50</td>
<td>1600</td>
</tr>
<tr>
<td>Benzyl alcohol</td>
<td>100-51-6</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>bis(2-chloroethoxy)methane</td>
<td>111-91-1</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>bis(2-chloroethyl)ether</td>
<td>111-44-4</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>bis(2-chloroisopropyl)ether</td>
<td>108-60-1</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>bis(2-ethylhexyl)phthalate</td>
<td>117-81-7</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Butylbenzylphthalate</td>
<td>85-68-7</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>4-Bromophenyl-phenyl ether</td>
<td>101-55-3</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Chrysene</td>
<td>218-01-9</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>2-Chloronaphthalene</td>
<td>91-58-7</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>2-Chlorophenol</td>
<td>95-57-8</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>4-Chloro-3-methylphenol (para-chloro-meta-cresol)</td>
<td>59-50-7</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>4-Chloroaniline</td>
<td>106-47-8</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>4-Chlorophenyl-phenyl ether</td>
<td>7005-72-3</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Dibenz(a,h)anthracene</td>
<td>53-70-3</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Dibenzofuran</td>
<td>132-64-9</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Diethylphthalate</td>
<td>84-66-2</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Dimethylphthalate</td>
<td>131-11-3</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Di-n-butylphthalate</td>
<td>84-74-2</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Di-n-octylphthalate</td>
<td>117-84-0</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>1,2-Dichlorobenzene</td>
<td>95-50-1</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>1,3-Dichlorobenzene</td>
<td>541-73-1</td>
<td>10</td>
<td>330</td>
</tr>
</tbody>
</table>
Table 8-2. CLP Target Compound List for Semivolatile (Base Neutral/Acid Extractable) Organics, CAS Number, Soil and Water Detection Limits, Alcoa-Davenport Works, Riverdale, Iowa. (continued)

<table>
<thead>
<tr>
<th>Semi-Volatiles</th>
<th>CAS Number</th>
<th>CRDL Water (ug/L)</th>
<th>CRDL Low Soil Sediment (ug/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,4-Dichlorobenzene</td>
<td>106-46-7</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>2,4-Dichlorophenol</td>
<td>120-83-2</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>2,4-Dimethylphenol</td>
<td>105-67-9</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>2,4-Dinitrophenol</td>
<td>51-28-5</td>
<td>50</td>
<td>1600</td>
</tr>
<tr>
<td>2,4-Dinitrotoluene</td>
<td>121-14-2</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>2,6-Dinitrotoluene</td>
<td>606-20-2</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>3,3-Dichlorobenzidine</td>
<td>91-94-1</td>
<td>20</td>
<td>660</td>
</tr>
<tr>
<td>4,6-Dinitro-2-methylphenol</td>
<td>534-52-1</td>
<td>50</td>
<td>1600</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>206-44-0</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Fluorene</td>
<td>86-73-7</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Hexachlorobenzene</td>
<td>118-74-1</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Hexachlorobutadine</td>
<td>87-68-3</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Hexachlorocyclopentadiene</td>
<td>77-47-4</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Hexachloroethane</td>
<td>67-72-1</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Indeno(1,2,3-cd)pyrene</td>
<td>193-39-5</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Isophorone</td>
<td>78-59-1</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>2-Methylnaphthalene</td>
<td>91-57-6</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>2-Methylphenol</td>
<td>95-48-7</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>4-Methylphenol</td>
<td>106-44-5</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>N-nitroso-di-n-dipropylamine</td>
<td>621-64-7</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>N-nitrosodiphenylamine</td>
<td>6-30-6</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>91-20-3</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Nitrobenzene</td>
<td>98-95-3</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>2-Nitroaniline</td>
<td>88-74-4</td>
<td>50</td>
<td>1600</td>
</tr>
<tr>
<td>2-Nitrophenol</td>
<td>88-75-5</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>3-Nitroaniline</td>
<td>99-09-2</td>
<td>50</td>
<td>1600</td>
</tr>
<tr>
<td>4-Nitroaniline</td>
<td>100-01-6</td>
<td>50</td>
<td>1600</td>
</tr>
<tr>
<td>4-Nitrophenol</td>
<td>100-02-7</td>
<td>50</td>
<td>1600</td>
</tr>
<tr>
<td>Pentachlorophenol</td>
<td>87-86-5</td>
<td>50</td>
<td>1600</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>85-01-8</td>
<td>10</td>
<td>330</td>
</tr>
</tbody>
</table>
Table 8-2. CLP Target Compound List for Semivolatile (Base Neutral/Acid Extractable) Organics, CAS Number, Soil and Water Detection Limits, Alcoa-Davenport Works, Riverdale, Iowa. (continued)

<table>
<thead>
<tr>
<th>Semi-Volatiles</th>
<th>CAS Number</th>
<th>CRDL Water (ug/L)</th>
<th>CRDL Low Soil/1 Sediment (ug/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenol</td>
<td>108-95-2</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>Pyrene</td>
<td>129-00-0</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>1,2,4-Trichlorobenzene</td>
<td>120-82-1</td>
<td>10</td>
<td>330</td>
</tr>
<tr>
<td>2,4,5-Trichlorophenol</td>
<td>95-95-4</td>
<td>50</td>
<td>1600</td>
</tr>
<tr>
<td>2,4,6-Trichlorophenol</td>
<td>88-06-2</td>
<td>10</td>
<td>330</td>
</tr>
</tbody>
</table>

CRDL  Contract required detection limit.

1 Medium/sediment CRDLs for semivolatile TCL compounds are 60 times the individual low soil/sediment CRDL.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

Quantitation limits listed for soil/sediment are based on wet weight. Quantitation limits calculated by the laboratory for soil/sediment on a dry weight basis as required by the contract will be higher.
Table 8-3. CLP Target Compound List for Polychlorinated Biphenyls (PCBs), CAS Number, Soil and Water Detection Limits, Alcoa-Davenport Works, Riverdale, Iowa.

<table>
<thead>
<tr>
<th>PCBs</th>
<th>CAS Number</th>
<th>CRDL Water (ug/L)</th>
<th>CRDL Low Soil/1 Sediment (ug/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aroclor-1016</td>
<td>12674-11-2</td>
<td>0.5</td>
<td>80.0</td>
</tr>
<tr>
<td>Aroclor-1221</td>
<td>11104-28-2</td>
<td>0.5</td>
<td>80.0</td>
</tr>
<tr>
<td>Aroclor-1232</td>
<td>11141-16-5</td>
<td>0.5</td>
<td>80.0</td>
</tr>
<tr>
<td>Aroclor-1242</td>
<td>53469-21-9</td>
<td>0.5</td>
<td>80.0</td>
</tr>
<tr>
<td>Aroclor-1248</td>
<td>12672-29-6</td>
<td>0.5</td>
<td>80.0</td>
</tr>
<tr>
<td>Aroclor-1254</td>
<td>11097-69-1</td>
<td>1.0</td>
<td>160.0</td>
</tr>
<tr>
<td>Aroclor-1260</td>
<td>11096-82-5</td>
<td>1.0</td>
<td>160.0</td>
</tr>
</tbody>
</table>

CRDL  Contract required detection limit.

1 Medium/sediment CRDLs for PCBs are 15 times the individual low soil/sediment CRDL.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

Quantitation limits listed for soil/sediment are based on wet weight. Quantitation limits calculated by the laboratory for soil/sediment on a dry weight basis as required by the contract will be higher.
Table 8-4. CLP Target Analyte List for Inorganics, Soil and Water Detection Limits, Alcoa-Davenport Works, Riverdale, Iowa.

<table>
<thead>
<tr>
<th>Analytes</th>
<th>Detection Limits&lt;sup&gt;(1)&lt;/sup&gt;</th>
<th>Water Matrices (µg/L)</th>
<th>Low Soil/Sediment (µg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td></td>
<td>200</td>
<td>5</td>
</tr>
<tr>
<td>Antimony</td>
<td></td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>Arsenic</td>
<td></td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Barium</td>
<td></td>
<td>200</td>
<td>0.5</td>
</tr>
<tr>
<td>Beryllium</td>
<td></td>
<td>5</td>
<td>0.25</td>
</tr>
<tr>
<td>Cadmium</td>
<td></td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Calcium</td>
<td></td>
<td>5000</td>
<td>0.5</td>
</tr>
<tr>
<td>Chromium</td>
<td></td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Cobalt</td>
<td></td>
<td>50</td>
<td>2.5</td>
</tr>
<tr>
<td>Copper</td>
<td></td>
<td>25</td>
<td>0.5</td>
</tr>
<tr>
<td>Cyanide</td>
<td></td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>Iron</td>
<td></td>
<td>100</td>
<td>2.5</td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>Magnesium</td>
<td></td>
<td>5000</td>
<td>0.5</td>
</tr>
<tr>
<td>Manganese</td>
<td></td>
<td>15</td>
<td>0.5</td>
</tr>
<tr>
<td>Mercury</td>
<td></td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Nickel</td>
<td></td>
<td>40</td>
<td>2</td>
</tr>
<tr>
<td>Potassium</td>
<td></td>
<td>5000</td>
<td>50</td>
</tr>
<tr>
<td>Selenium</td>
<td></td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Silver</td>
<td></td>
<td>10</td>
<td>0.5</td>
</tr>
<tr>
<td>Sodium</td>
<td></td>
<td>5000</td>
<td>5</td>
</tr>
<tr>
<td>Thallium</td>
<td></td>
<td>10</td>
<td>0.5</td>
</tr>
<tr>
<td>Vanadium</td>
<td></td>
<td>50</td>
<td>2.5</td>
</tr>
<tr>
<td>Zinc</td>
<td></td>
<td>20</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<sup>(1)</sup> Specific quantitation limits for soils are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.
Table 8-5. Summary of Methods and Detection Limits for Chemical Analyses, Alcoa-Davenport Works, Riverdale, Iowa.

<table>
<thead>
<tr>
<th>Chemical Analyses</th>
<th>Method(s)</th>
<th>Detection Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Field Parameters:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH (soil/water)</td>
<td>SOP-1</td>
<td>0.1 units</td>
</tr>
<tr>
<td>Specific Conductance</td>
<td>SOP-2</td>
<td>0.1 umhos/cm</td>
</tr>
<tr>
<td>Temperature</td>
<td>SOP-29</td>
<td>0.1 degrees</td>
</tr>
<tr>
<td>Turbidity</td>
<td>SOP-26</td>
<td>0.1 NTUs</td>
</tr>
<tr>
<td><strong>Organics:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volatile Organics (soil/water)</td>
<td>Target Compound List EPA/CLP</td>
<td>See Table 8-1</td>
</tr>
<tr>
<td>Base/Neutral-Acid Extractables (soil/water)</td>
<td>Target Compound List for Semi-Volatile Organics EPA/CLP</td>
<td>See Table 8-2</td>
</tr>
<tr>
<td>PCBs (soil/water)</td>
<td>Target Compound List for Pesticides/PCBs EPA/CLP</td>
<td>See Table 8-3</td>
</tr>
<tr>
<td>Extractable Hydrocarbons and BTEX</td>
<td>Iowa-OA1 and Iowa-OA2</td>
<td>See Table 8-6</td>
</tr>
<tr>
<td><strong>Inorganics:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAL-Metals and Cyanide</td>
<td>Target Analyte List EPA/CLP</td>
<td>See Table 8-4</td>
</tr>
<tr>
<td><strong>Indicators:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkalinity, bicarbonate</td>
<td>Calculate</td>
<td>20 mg/L</td>
</tr>
<tr>
<td>Alkalinity, carbonate</td>
<td>EPA 310.1-CLP-M</td>
<td>20 mg/L</td>
</tr>
<tr>
<td>Chloride</td>
<td>SW-846 9250-CLP-M</td>
<td>2 mg/L</td>
</tr>
<tr>
<td>Density (NAPL only)</td>
<td>ASTM-D1298-85</td>
<td>NA</td>
</tr>
<tr>
<td>Fluoride</td>
<td>EPA 340.2-CLP-M</td>
<td>0.1 mg/L</td>
</tr>
<tr>
<td>Nitrogen, Ammonia</td>
<td>EPA 350.2-CLP-M</td>
<td>0.2 mg/L</td>
</tr>
<tr>
<td>Nitrogen, Nitrate</td>
<td>EPA 353.3-CLP-M</td>
<td>0.1 mg/L</td>
</tr>
<tr>
<td>Nitrogen, Nitrite</td>
<td>EPA 353.3-CLP-M</td>
<td>0.04 mg/L</td>
</tr>
<tr>
<td>Nitrogen, Total Kjeldahl</td>
<td>SW-846 9200-CLP-M</td>
<td>0.3 mg/L</td>
</tr>
<tr>
<td>Phosphorus, Total</td>
<td>EPA 365.2-CLP-M</td>
<td>0.1 mg/L</td>
</tr>
<tr>
<td>Silica</td>
<td>SW-846 6010-CLP-M</td>
<td>1 mg/L</td>
</tr>
<tr>
<td>Sulfate</td>
<td>EPA 375.4-CLP-M</td>
<td>5 mg/L</td>
</tr>
<tr>
<td>Total Dissolved Solids (TDS)</td>
<td>EPA 160.1</td>
<td>5 mg/L</td>
</tr>
<tr>
<td>Viscosity (NAPL only)</td>
<td>ASTM-D1296-86</td>
<td>0.5 mPa*s</td>
</tr>
</tbody>
</table>
Table 8-6. Iowa Method Compound List for Extractable Hydrocarbons and BTEX, Soil and Water Detection Limits, Alcoa-Davenport Works, Riverdale, Iowa.

<table>
<thead>
<tr>
<th>Extractable Hydrocarbons</th>
<th>Method II</th>
<th>Detection Limit Soil (mg/kg)</th>
<th>Detection Limit Water (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Extractable Hydrocarbons</td>
<td>Iowa-OA2</td>
<td>10.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Diesel</td>
<td>Iowa-OA2</td>
<td>10.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Motor Oil</td>
<td>Iowa-OA2</td>
<td>10.0</td>
<td>2.0</td>
</tr>
<tr>
<td>BTEX</td>
<td>Iowa-OA1</td>
<td>0.5</td>
<td>0.002</td>
</tr>
<tr>
<td>Benzene</td>
<td>Iowa-OA1</td>
<td>0.5</td>
<td>0.002</td>
</tr>
<tr>
<td>Toluene</td>
<td>Iowa-OA1</td>
<td>0.5</td>
<td>0.002</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>Iowa-OA1</td>
<td>0.5</td>
<td>0.002</td>
</tr>
<tr>
<td>Xylenes, Total</td>
<td>Iowa-OA1</td>
<td>0.5</td>
<td>0.002</td>
</tr>
<tr>
<td>Total Hydrocarbons</td>
<td>Iowa-OA1</td>
<td>10.0</td>
<td>0.10</td>
</tr>
<tr>
<td>Analyte</td>
<td>CAS Number</td>
<td>CRDL Water (µg/L)</td>
<td>CRDL Soil/Sediment (µg/kg)</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------</td>
<td>-------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Acetone</td>
<td>67-64-1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Acrolein</td>
<td>107-02-8</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>107-13-1</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>n-Butylbenezene</td>
<td>104-51-8</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2-Butanone</td>
<td>78-93-3</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Benzene</td>
<td>71-43-2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Bromobenzene</td>
<td>108-86-1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Bromochloromethane</td>
<td>74-97-5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td>75-27-4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Bromoform</td>
<td>75-25-2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Bromomethane</td>
<td>74-83-9</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>2-Chloroethyl vinyl ether</td>
<td>110-75-8</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2-Chlorotoluene</td>
<td>95-49-8</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4-Chlorotoluene</td>
<td>106-43-4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>75-15-0</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>56-23-5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>108-90-7</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Chloroethane</td>
<td>75-00-3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Chloroform</td>
<td>67-66-3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>74-87-3</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>cis-1,2-Dichloroethene</td>
<td>156-59-2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>cis-1,3-Dichloropropene</td>
<td>10061-01-5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1,1-Dichloroethene</td>
<td>75-34-3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,1-Dichloroethene</td>
<td>75-34-4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,1-Dichloropropene</td>
<td>563-58-6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1,2-Dibromo-3-chloropropane</td>
<td>96-12-8</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>1,2-Dibromomethane</td>
<td>106-94-3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,2-Dichlorobenzene</td>
<td>95-50-1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1,2-Dichloromethane</td>
<td>106-93-4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
<td>78-87-5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,3-Dichlorobenzene</td>
<td>541-73-1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1,3-Dichloropropane</td>
<td>142-28-9</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1,4-Dichlorobenzene</td>
<td>106-46-7</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2,2-Dichloropropane</td>
<td>594-20-7</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
Table 8-7. Method 8260 Volatile Organics - 25 mL Purge Detection Limits, Alcoa-Davenport Works, Riverdale, Iowa.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>CAS Number</th>
<th>CRDL Water (ug/L)</th>
<th>CRDL Soil/Sediment (ug/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dibromochloromethane</td>
<td>124-48-1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Dibromomethane</td>
<td>74-95-3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>75-71-8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>100-41-4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2-Hexanone</td>
<td>591-78-6</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Hexachlorobutadiene</td>
<td>87-68-3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>p-Isopropyltoluene</td>
<td>99-87-6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Iodomethane (Methyl Iodide)</td>
<td>74-88-4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Isopropylbenzene</td>
<td>98-82-8</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4-Methyl-2-Pentanone</td>
<td>108-10-1</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>75-09-2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>91-20-3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>n-Propylbenzene</td>
<td>103-65-1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>sec-Butylbenzene</td>
<td>135-98-8</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Styrene</td>
<td>100-42-5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,1,1-Trichloroethane</td>
<td>71-55-6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,1,1,2-Tetrachloroethane</td>
<td>630-20-6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,1,2-Trichloroethane</td>
<td>79-00-5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>79-34-5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,2,3-Trichlorobenzene</td>
<td>87-61-6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1,2,3-Trichloropropene</td>
<td>96-18-4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1,2,4-Tetrachlorobenzene</td>
<td>120-82-1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1,2,4-Trimethylbenzene</td>
<td>95-63-6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1,3,5-Trimethylbenzene</td>
<td>108-67-8</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>tert-Butylbenzene</td>
<td>98-06-6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Tetrachloroethene</td>
<td>127-18-4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>trans-1,2-Dichloroethene</td>
<td>156-60-5</td>
<td>0.5</td>
<td>5</td>
</tr>
<tr>
<td>trans-1,3-Dichloropropene</td>
<td>10061-02-6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Trichloroethene</td>
<td>79-01-6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Trichlorofluoromethane</td>
<td>75-69-4</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Vinyl Acetate</td>
<td>108-05-4</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Vinyl Chloride</td>
<td>75-01-4</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

GERAGHTY & MILLER, INC.
Table 8-7. Method 8260 Volatile Organics - 25 mL Purge Detection Limits, Alcoa-Davenport Works, Riverdale, Iowa.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>CAS Number</th>
<th>CRDL Water ug/L</th>
<th>CRDL Soil/Sediment ug/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>m,p-Xylene</td>
<td>108-38-3</td>
<td>0.5</td>
<td>2.5</td>
</tr>
<tr>
<td>o-Xylene</td>
<td>95-47-6</td>
<td>0.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Xylene (total)</td>
<td>1330-20-7</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

CRDL - Contract required detection limits.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

Quantitation limits listed for soil/sediment are based on wet weight. Quantitation limits calculated by the laboratory for soil/sediment on a dry weight basis as required by the contract will be higher.
LOCATION AND PHYSICAL SETTING OF ALCOA–DAVENPORT WORKS RIVERDALE, IOWA (USGS BASE)
Figure 3-1. Project Organization, Alcoa-Davenport Works, Riverdale, Iowa.
Sample Preparation and Analysis

QC Results Acceptable?

YES

Precision and Accuracy Achieved?

YES

Proceed with Data Reduction, Report All Values in Appropriate Units

NO

Review Data Reanalyze if Necessary

Data Review by Task Manager or Section Head. Data Acceptable?

YES

1. Validated Data Entered into Project File
2. Data Reported

Figure 9-1. Analytical Data Validation and Reporting Scheme, Alcoa-Davenport Works, Riverdale, Iowa.
APPENDIX A

QUALIFICATIONS OF PROJECT PERSONNEL
LAWRENCE S. GRAVES  
Vice President/Principal Hydrogeologist

CREDENTIALS/REGISTRATION

M.S. Geology, Bowling Green State University, 1977
B.A. Philosophy/Geology, Bowling Green State University, 1975
Certified Professional Geologist: American Institute of Professional Geologist

PROFESSIONAL AFFILIATIONS

Association of Ground-Water Scientists and Engineers
American Institute of Professional Geologists

FIELDS OF SPECIALIZATION

- RCRA Program: RCRA Facility Investigation (RFI); Part B Permit Preparation; Closure/Post-Closure Plans; Post-Remedial/Post-Closure Monitoring
- CERCLA Program: Remedial Investigation (RI)/Feasibility Study (FS)
- Expert Testimony/Litigation Support
- Groundwater Contamination Investigation and Analysis
- Groundwater Remediation
- Hydrocarbon Assessment: USTs; Refineries
- Monitoring System Design
- Site Assessment/Property Transfer
- Regulatory Agency Negotiation

EXPERIENCE SUMMARY

Mr. Graves has 18 years of experience in the environmental field serving in a variety of technical and management roles. Having worked with private industry for 15 years and having been employed by both Ohio Environmental Protection Agency (EPA) and U.S. EPA for 3 years, Mr. Graves is in a position to facilitate successful, aggressive negotiations in many state and federal arenas. His background in the practical/applied aspects of hydrogeology have been applied in directing and advising on a variety of different projects including: RCRA Facility Investigations, State Superfund Remedial Investigations, Monitoring System Design, Groundwater Remediation, Environmental Site Assessment for Property Transfers, Hydrocarbon Assessments, and Litigation Support. In implementing these activities, Mr. Graves has consistently demonstrated excellent project management skills through successful budget controls and schedule compliance.
SELECTED PROJECTS

- Project Advisor for a groundwater RI/FS and removal action for 81 units at a CERCLA site in Iowa. Contaminants of concern include BTEX, Solvents, both DNAPLEs and LNAPLEs.

- Project Advisor for an RFI of a Department of Energy facility in Piketon, Ohio. Contaminants of concern include solvents and low-level radioactive constituents.

- Project Advisor for an RFI of a beryllium products manufacturing plant in northwest Ohio. Contaminants of concern included solvents and a variety of metals.

- Project Advisor for an RFI of a major automotive parts manufacturing plant in Dayton, Ohio. Contaminants included solvents, hydrocarbons, and metals.

- Principal Investigator of a study in Tennessee to evaluate the impacts of an abandoned limestone quarry used for waste disposal on surface-water and groundwater quality. Study included installation of monitor wells, evaluation of soil borings, and analysis of water quality.

- Principal Investigator of a study to evaluate seepage from a waste-oil impoundment and landfill. Both surface-water and groundwater quality impacts were studied and remedial measures were recommended.

- Project Manager of a study in Iowa to evaluate the potential for, and extent of, migration of contaminants from a waste-oil lagoon located along the Mississippi River. Study included the evaluation of soil borings, installation of monitor wells, and sampling and analysis of surface water and groundwater.

- Project Manager of a study to assess the hydrogeology of a proposed fly ash disposal site in Virginia. Also, the disposal facility design was assessed for its adequacy in protecting groundwater.

- Project Manager of two projects in Maryland to install monitor wells and develop sampling and analysis plans in compliance with the groundwater monitoring requirements of RCRA.

- Project Manager of a project in Maryland to recover waste fluids from a disposal facility by use of a recovery well. Project included developing the well design and conducting a pumping test to evaluate performance.
SELECTED PROJECTS (continued)

- Participant in the preliminary geologic investigation and the design of a water-supply well for the town of Chesapeake Beach, Maryland.

- Project Manager of two studies to assess the extent of groundwater contamination resulting from two inactive industrial waste disposal sites in southwestern Ohio.

- Project Manager of a study to determine groundwater conditions at a proposed coal pile site in eastern Virginia.

- Project Manager for the conceptual design and installation of a 2,000-foot long oil recovery drain for the interception and recovery of PCB-contaminated oil from an inactive industrial waste lagoon.

- Project Advisor for two RI/FS-type studies in southwestern Ohio to determine the extent of solvent contamination in ground water from two medium-sized manufacturing plants.

- Project Advisor for a study in southwestern Ohio involving a large steel manufacturing plant. Study evaluated the impacts of plant activities, including heavy groundwater pumpage on local groundwater flow and quality. Study included piezometer installations and measurements, pumping tests, and water-quality sampling and analysis.

- Project Manager for environmental site assessments related to commercial real estate transactions in Ohio and Indiana. Projects have ranged from simple plant walk-throughs and letter reports to full-scale soil and groundwater investigations and reports.

- Provided expert testimony and technical support in litigation cases involving groundwater contamination and alleged regulatory violations by industrial clients in Ohio and Maryland.
SELECTED PUBLICATIONS/PRESENTATIONS


ALICE J. WALDHAUER
Project Manager

CREDENTIALS/REGISTRATION

B.S./Geology, The Ohio State University, 1986

PROFESSIONAL AFFILIATIONS

American Water Well Association
Association of Groundwater Scientists and Engineers
American Chemical Society
National Association of Environmental Professionals

FIELDS OF SPECIALIZATION

- CERCLA Program: Removal Actions
- RCRA Program: Closure/Post Closure Plans/RCRA Facility Investigation
- Groundwater Contamination Investigation and Analysis
- Soil Contamination Investigation and Analysis
- Project Management

EXPERIENCE SUMMARY

Ms. Waldhauer has nine years of experience in the environmental field with five years managing multi-tasked projects. Her experience has focused on the design and implementation of hydrogeologic investigations assessing soil and groundwater contamination and migration. She has implemented or managed several successful field investigations under the regulation of both state and federal agencies. Ms. Waldhauer offers demonstrated expertise in program management, cost and schedule management of large and small projects and the design and installation of groundwater monitoring systems. Ms. Waldhauer is currently the project manager of a large-scale CERCLA project in Iowa which involves the investigation and remediation of over 70 environmental assessment units.

CERCLA Removal Actions

Ms. Waldhauer has prepared and implemented Quality Assurance documents and Field Sampling Plans for investigating several sites regulated under CERCLA removal actions. She has managed and conducted field operations investigating soil and groundwater contamination in various types of industrial settings to collect the necessary data for risk assessments and evaluations. She has also assisted in groundwater modeling efforts and database development and management for large sites. Her experience in the design and implementation of field investigations was important to developing a site-specific risk-based remediation approach. Ms. Waldhauer has assisted in the negotiation of an Administrative Order on Consent in...
Region VII that provides for the implementation of a focused groundwater RU/FS and evaluation of the need for removal actions at over 70 environmental assessment units. Her duties over the last several years include management of cost and project controls for large-scale multi-phased projects.

**RCRA RFA/RFI/Closure and Post Closure Monitoring**

Ms. Waldhauer has considerable experience in the development and implementation of RCRA Facility Investigation (RFI) and Closure/Post Closure Monitoring Work Plans. She has successfully managed various assessment and detection groundwater monitoring programs for RCRA units in industrial settings. She has experience in the preparation of several Region V EPA-approved RFI work plans and supporting documents. In addition, she has practical experience in the design and construction of RCRA approved groundwater monitoring networks, and has implemented work plans under the requirements of Administrative and Consent Orders in Region V.

**SELECTED PROJECTS**

**Overview**

- Managed four RCRA Groundwater Monitoring Programs for RCRA units at a government owned uranium enrichment facility in southern Ohio. The program consisted of quarterly groundwater sampling at each unit to track migration and concentrations of VOCs and radionuclides.

- Managed a RCRA Groundwater Quality Assessment Project at a large industrial site in southwestern Ohio. Project involved using current and historic sampling data to delineate groundwater flow and quality at multiple units for report preparation and submittal to EPA.

- Managed a RCRA Detection Monitoring Program for a settling lagoon at an auto parts plant in southwestern Ohio. Data collected during semiannual data collection events were statistically evaluated to determine the presence/absence of significant changes in groundwater quality.

- Quality Assurance (QA) Officer and management support for an RFI at an auto parts manufacturing facility in southwestern Ohio. Responsibilities included audits of field programs to ensure adherence to strict quality control procedures and reviews of field documents for completeness and validity. Management responsibilities included cost and schedule controls for internal milestones and external deadlines. Primary author of a Phase I RFI report.

- Primary author of Closure and Post-Closure Monitoring Plans for a cleanup area and residual waste landfill at a plumbing ware foundry in east-central Ohio.
Tracked sampling and analytical costs for a multi-task industrial project in EPA Region VII. Collection, laboratory analysis and validation of soil, vapor, and groundwater samples were controlled and documented through the development of a sample tracking system.

Assisted in the development of two environmental database systems to manage large volumes of collected data. The system utilizes electronic deliverables from subcontracted laboratories to streamline the stringent quality control checks associated with manual data input. The database provides easy access to current and historical environmental sample data.

Managed Phase I and Phase II environmental site assessments at several sites in Central Ohio to facilitate real estate transactions and document due diligence on behalf of prospective buyers.

Assisted in negotiation of a CERCLA administrative order of consent that required an RI/FS for groundwater and removal action evaluations at numerous operating and historical units.

Developed strategy for completion of risk-based elevations at each of 81 operating and historical process units.

Developed strategy for completion of a phase RI/FS focused on groundwater. The phased approach focused on groundwater. The phased approach divided the field effort into a hydraulic study of groundwater at the perimeter of the site and a groundwater quality study for areas where groundwater is transported off-site.

Conducted several ongoing complex tasks regulated under various environmental jurisdictions including the RI/FS, Removal Action Process, State UST Monitoring Programs, and in-house and voluntary housekeeping projects.
JUAN M. VELASCO

Project Manager/Geologist

EDUCATION/REGISTRATION
M.S. - Geology, University of Missouri at Rolla, 1986
B.S. - Geology, Bowling Green State University, 1982
Ground Water Hydrology, Wright State University, 1992
Certified Professional Geologist, State of Indiana (Certification No. 1231), 1992
American Institute of Professional Geologists, CPG No. 9481, 1995

PUBLICATION

FIELDS OF SPECIALIZATION
- Facility Characterization
- Field Investigations
- Environmental Sampling
- Monitoring Well Installation
- Underground Storage Tank Release Investigations
- State Underground Storage Tank Regulations
- Hydrogeologic Data Interpretation
- Remedial Systems
- Document Development/Preparation
- Cost Estimate Development and Evaluation

EXPERIENCE SUMMARY
Mr. Velasco has ten years experience in the environmental consulting field. Throughout his career, Mr. Velasco has successfully managed a wide variety of CERCLA environmental investigations throughout U.S. EPA Regions V and VII, state superfund sites, as well as site assessments of hydrocarbon-contaminated sites. Mr. Velasco has also managed a variety of hydrocarbon-contaminated sites where remedial technologies have been successfully implemented. He has also conducted numerous site audits throughout U.S. EPA Regions V and VII, and has extensive experience dealing with federal and state regulatory agencies.

SELECTED PROJECTS
- Project Manager for a state superfund site in southwest Ohio. The investigative phase of the project included delineation of a 1.5-mile long volatile organic compound (VOC) plume, evaluation of sensitive receptors within the vicinity of the plume (including municipal and private-water supply wells), aquifer characterization,
groundwater modeling, extensive negotiations with the community and regulatory agencies. Interim remedial actions implemented in this project include: installation of four capture areas to address contamination within the source areas, protect sensitive receptors, and prevent further migration of the VOC plume; implementation of a groundwater sampling program to evaluate effectiveness and impact of the capture areas on groundwater quality; and extensive groundwater modeling. Successfully negotiated with the Ohio EPA implementation of alternate interim remedial actions to installing an additional capture area.

- Project Manager for a site investigation and remediation project at a hydrocarbon-contaminated site located in central West Virginia. The investigative phase of the project included extensive interaction with the U.S. EPA and state regulatory agencies, installation of monitoring well networks, soil and groundwater sampling to delineate extent of hydrocarbon contamination and direction of plume migration. The remedial phase of this project involved aquifer characterization, installation of recovery wells throughout the site and installation of a remedial system. Hydrocarbon contamination was remediated using a Vacuum Enhanced extraction system combined with Air Stripping to treat hydrocarbon vapors recovered.

- Project Manager for a natural bioattenuation study at a hydrocarbon-contaminated site in central West Virginia. The project involved collection of quarterly field data and presentation of results to the state regulatory agency. Field and project management efforts were instrumental in obtaining approval from the state regulatory agency to discontinue use of a remedial system.

- Project Manager for a hydrocarbon-contaminated site in Columbus, Ohio, where a risk-based approach was implemented as an alternative to other investigative/remedial techniques. Project consisted of identifying sensitive receptors around the facility, evaluating exposure routes and determining acceptable risk levels for hydrocarbon components identified in the subsurface. This approach eliminated the need to conduct further subsurface investigation and the implementation of a corrective action plan.

- Successfully negotiated with the state regulatory agency against implementing additional site investigation activities at a hydrocarbon-contaminated site in northwest Ohio. Explanation of site hydrogeologic conditions and extent of plume migration led to implementation of removal action and site closure within 90 days.
• Implemented interim corrective measures at a diesel fuel spill at a truck refueling facility located in southern Ohio. The primary project objectives included recovery of separate-phase product, determine the horizontal and vertical extent of product migration, identification of sensitive receptors and routes of exposure, characterization of the site hydrogeology and extensive contact with the state regulatory agency.

• Hydrogeologic characterization of a sanitary landfill in Southeast Ohio. Project included a comprehensive study of the surface and subsurface hydrogeological setting of the site; identification of sensitive receptors surrounding the sanitary landfill; identification of potential exposure routes; installation of monitoring well networks, and slug testing of the aquifer underlying the facility.

• Project Manager for a carbon-tetrachloride plume delineation investigation in Southeast Nebraska. Project involved extensive sampling of groundwater supply wells to evaluate groundwater quality and identify potential sources of carbon-tetrachloride contamination. Use of historical aerial photographs in conjunction with a soil gas survey was instrumental in identifying the source and extent of contamination.

• Team member representing a Fortune 500 client at a City Council Meeting in Grove City, Ohio. Field data generated during field work was presented to the City Council and the Ohio EPA, eliminating the need to conduct additional site investigations and/or corrective action plans for the facility.

• Participated in subsurface investigation field work in Quadrants III and IV at the U.S. Department of Energy - Portsmouth Diffusion Plant in Piketon, Ohio. Field work included collection of surface-water and groundwater samples, as well as soil samples utilizing hand augers and hollow-stem auger drilling techniques.

• Quadrants III and IV report writing team member. Involved in the preparation of the "Technical Approach And Unit Investigations" and "Conclusions And Proposed Additional Investigation" sections for Quadrants III and IV field investigation report for the U.S. Department of Energy - Portsmouth Diffusion Plant, Piketon, Ohio.

• Project Manager for numerous Phase I Site Assessments throughout U.S. EPA's Regions V and VII. The primary objectives of the investigations conducted were to identify potential environmental liabilities which could pose problems for the title holder. Projects involved site evaluation, historical title search for the property under investigation and use of historical aerial photographs to identify potential sources of contamination on site.
DAVID L. KULIKOWSKI
Project Hydrogeologist

CREDENTIALS/REGISTRATION

M.S. Geology, The Ohio State University, 1985
B.S. Geology, Eastern Illinois University, 1982
American Institute of Professional Geologists, CPG-9884

FIELDS OF SPECIALIZATION

- Database Development
- Information and Data Management
- Records Management
- Document Review, Document Development/Preparation
- Cost Estimate Development and Evaluation
- Cost Analysis
- Cost and Schedule Variance Analysis
- Radiological and Chemical Analyses
- Characterization/Monitoring Well Installation

EXPERIENCE SUMMARY

Mr. Kulikowski has twelve years of experience in geology and hydrogeology. His primary expertise has focused on the development and design of information and data management systems and their application to hydrogeologic investigations. During the development of these information systems, Mr. Kulikowski has also focused on methodologies to provide cost and variance analysis reports for a multi-million dollar, large-scale RCRA Facility Investigation project. He has successfully developed these systems based on a sound understanding of the relationship of field data requirements to a computerized information system acquired through his extensive experience in groundwater, soil and sediment sampling and characterization/monitoring well installation. His combined knowledge of field methods and computer program development have allowed him to monitor and manage both technical and budgetary data on a large-scale RCRA Facility Investigation with an overall budget of approximately $35 million segregated into over 100 project tasks. Mr. Kulikowski's database system has been highly recognized by the U.S. Department of Energy as being an extremely efficient and effective method for managing all data aspects of an RCRA Facility Investigation. This unique system has enabled project staff to monitor the status of all project tasks on a weekly basis. The close monitoring of all project activities and budgetary information has enabled more effective management of the project and has also enhanced client communication.
SELECTED PROJECTS

Portsmouth Gaseous Diffusion Plant

Database Development: Developed an RFI database management system designed to track the progress of all field activities and the status of thousands of analytical samples collected during the course of a RCRA Facility Investigation at the U.S. DOE Portsmouth Gaseous Diffusion Plant in southern Ohio. This system also allows for real-time tracking of all quality control-related activities associated with field operations. This system has been highly recognized by U.S. DOE as being a very organized, efficient and effective system to maintain all data aspects associated with the RFI.

Cost and Schedule Variance Analysis: Designed and implemented a weekly and monthly cost/schedule variance reporting system for the Portsmouth Gaseous Diffusion Plant RCRA Facility Investigation. This project has a total budget of approximately $35 million and is segregated into more than 100 separate project tasks. Budgetary data in each report is provided with only a one week lag period, providing the client current and accurate budget information. This reporting has also resulted in significant savings to the client due to the highly controlled monitoring of budgetary information by project managers.

RFI Document Review and Preparation: Managed the production of four separate RFI reports. The combined reports discussed sediment, soils, surface-water and groundwater analytical results, environmental risks and hydrogeology associated with approximately 100 solid waste management units. Analytical results were derived from Phase I and II investigations which occurred over approximately four years. The report involved extensive coordination and management of approximately 50 people divided into reporting teams which included the following tasks; data interpretation and validation, graphics, risk assessment, groundwater modeling and report production. Reporting deadlines established by the U.S. EPA, Ohio EPA and U.S. DOE were aggressive, and time and budget management systems were consulted on a daily basis. All reporting deadlines were successfully met.

Quadrants I and II RFI Phase I: Served as Technical/QA Manager Phase I RFI played a key role. Planning and implementing a large-scale field effort consisting of approximately 100 field personnel and 10 drill rigs. Responsibilities associated with the position included establishing training programs; conducting surveillance of field operations; and managing, reducing, and reducing large volumes of field and analytical data generated during the RFI. This work also entailed the development of computer programs to evaluate and report data according to client requests.
Alcoa-Davenport Works

Severed as task manager for risk-based concentration (RBC) reports for approximately 80 CERCLA units. Responsibilities included database management, the statistical evaluation of unit-specific data sets, and the development of a stream-lined approach for the RBC part process. The work also involved the development of a master schedule to track the progress of the RBC reports and other groundwater monitoring activities proposed at the site.

Other Projects

Nuclear Waste Repository

Facility Characterization: Mr. Kulikowski was involved with feasibility studies focused on characterizing the environmental settings of proposed locations for a high-level nuclear waste repository. His duties entailed ground-water modeling of the Texas panhandle and the establishment of a representative stratigraphic column for a proposed high-level nuclear waste repository. He employed computer programming and modeling skills, statistical analyses, geophysical log interpretation, and extensive literature reviews.

SELECTED PUBLICATIONS


REBECCA HOEY  
Project Hydrogeologist

CREDENTIALS/REGISTRATION

Graduate courses in Hydrogeology  
B.A. Geology, The College of Wooster, 1988

PROFESSIONAL AFFILIATIONS/REGISTRATION

National Groundwater Association  
OSHA Supervisors Training, 1993  
Government Security Clearance DOE Level L

FIELDS OF SPECIALIZATION

- Field Investigations  
- RCRA Program/Remedial Action/RCRA Facility Investigation  
- Environmental Sampling (sampling and analytical methods)  
- Characterization/Monitoring Well Installation  
- Environmental Database Management  
- QA/QC Oversight, Planning, and Records Management  
- Technical Support (various graphics applications, data presentation)  
- Groundwater Modeling

EXPERIENCE SUMMARY

Ms. Hoey has specialized in the design, development and management of technical database applications associated with the storage and retrieval of environmental data, as well as development and implementation of quality assurance and quality control procedures for both data management and environmental sampling activities. She has served as laboratory coordinator for various sampling activities, and has developed data collected specifications and quality assurance requirements necessary to support data project data quality objectives for field investigations. Her experience includes performing groundwater modeling tasks and reviewing groundwater modeling applications. Her experience with report preparation includes data presentation and interpretation, technical writing and report organization.
SELECTED PROJECTS

- Coordinated onsite and offsite laboratories, managed the analytical data validation program, and managed analytical database organization for a RCRA Facility Investigation at a large industrial site in southern Ohio.
- Performed database development and graphic construction for incorporation into a GIS designed to store and retrieve environmental data for an RFI in southern Ohio.
- Performed database development and data management for an RFI for an industrial site in northwestern Ohio.
- QA/QC Manager for multi-phase field investigations during an RFI. Tasks included oversight of field QA/QC procedures and supervision of a team of QA Officers. Performed regular internal audits of field sampling and data management activities.
- QA/QC Manager and Laboratory Coordinator for a study investigating alpha and beta radiation readings in site groundwater.
- Primary author of Quality Assurance Project Plans for a variety of field investigations.
- Provided graphic data presentations of geologic and analytical data during various field investigations.
- Performed data management and statistical evaluation of analytical results from a CERLCA facility in the midwest.

PUBLICATIONS

APPENDIX B

QUALITY ASSURANCE MANAGEMENT PLAN
FOR ENVIRONMENTAL SERVICES
QUANTERRA ENVIRONMENTAL SERVICES

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SOP-1 CALIBRATION AND USE OF THE PORTABLE pH METER

Scope: This procedure describes the calibration of a standard pH meter and the determination of pH in aqueous media.

Purpose: The purpose of this procedure is to provide a uniform basis for calibration of field pH meters and ensure continuity between field personnel. Additionally, the method provides quality control steps necessary for obtaining reliable and representative pH readings.

Equipment Needed: pH meter, buffers, polypropylene beakers, paper towels, calibration logs, field logs, distilled water, thermometer, and extra batteries.

Procedures:

Calibration

1. Check to make sure batteries are fully charged.

2. Turn meter on and allow it to stabilize for 3 to 5 minutes.

3. Select pH buffers 7, 4, and 10 and check temperatures of each. Record pertinent information on field calibration logs.

4. Place 10 ml. of each buffer in a pre-labeled container.

5. Clean pH probe with stream of distilled water.

6. Place probe in pH 7 buffer and stir gently.

7. Adjust temperature knob to read measured temperature and then adjust the calibration knob until 7.00 is displayed in the readout window.

8. Remove probe and clean with distilled water.

9. Place probe in second calibration buffer in the expected sample pH range (i.e., if sample is expected to be pH 6, use pH 4 buffer) and repeat calibration process.

10. Remove probe, rinse with distilled water and check reading in the pH 7.00 buffer. If reading is off by more than 0.05 pH units recalibrate as described above.
11. Rinse probe and insert in groundwater sample. Record reading on appropriate field forms.

12. This calibration procedure should be performed:
   • Approximately every 2 hrs. of steady use
   • Following significant ambient temperature changes
   • When meter reads erratically
   • At beginning and end of sampling day use.

13. When the meter is moved to a new sampling location, a single-point calibration should be performed with pH Buffer 7.

QA/QC REQUIREMENTS:
Quadruplicate pH and temperature measurements are to be collected for each aqueous sample matrix at a frequency of 10% (i.e. 1 in 10 investigative measurements) or one per day, whichever is greater.

NOTE: In the event that the referenced equipment model is unavailable for use during sampling activities, comparable instruments or equipment will be operated per associated operator’s instructions.
SOP-2 CALIBRATION AND USE OF THE PORTABLE FIELD SPECIFIC CONDUCTANCE METER

Scope: This procedure describes the calibration and use of a portable field specific conductance meter for obtaining measurements in aqueous media.

Purpose: The purpose of this procedure is to provide a uniform means for calibration and operation of portable field specific conductance meters between field personnel. Additionally, the method provides quality control steps necessary for obtaining reliable and representative readings.

Equipment Needed: Conductivity meter, reference solutions, polypropylene beaker, thermometer, distilled water

Procedures:

Calibration

1. Check to make sure batteries are fully charged.
2. Turn meter on and allow it to stabilize for 3 to 5 minutes.
3. Determine the temperature of the reference solution.
4. Set temperature compensation knob on meter to temperature of reference solution.
5. Adjust standardized knob on meter to read value of reference solution.
6. Remove probe and rinse with distilled water. Blot dry the end of the probe.

Meter Usage

1. With instrument calibrated, set indicator knob to highest range.
2. Pour approximately 50 to 100 ml. of aqueous sample into a polypropylene beaker.
3. Clean conductivity probe with a stream of distilled or distilled water.
4. Measure the temperature of the sample and set temperature compensatory to the temperature of the sample.
SOP-2 CALIBRATION AND USE OF THE PORTABLE FIELD SPECIFIC CONDUCTANCE METER
(continued)

5. Immerse probe in sample and stir gently.

6. Select appropriate scale range.

7. Record sample number, date, time, project, and resulting conductivity value on appropriate field logs.

8. Thoroughly rinse probe with stream of distilled or distilled water and then blot the probe dry.

9. This calibration procedure should be performed:
   - Approximately every 2 hrs of continual use
   - Following significant ambient temperature changes
   - When the meter reads erratically
   - At the beginning and end of sampling day use.

QA/QC REQUIREMENTS:
Quadruplicate SCON and temperature measurements are to be collected for each aqueous sample matrix at a frequency of 10% (i.e. 1 in 10 investigative measurements) or one per day, whichever is greater.

NOTE: In the event that the referenced equipment model is unavailable for use during sampling activities, comparable instruments or equipment will be operated per associated operator's instructions.


SOP-3 CALIBRATION AND USE OF THE FLAME IONIZATION DETECTION

Scope: This procedure describes the methodology to be used for the calibration and use of the Flame Ionization Detector (FID) meter for field headspace analysis and health and safety monitoring.

Purpose: The purpose of this procedure is to develop and maintain good quality control in field operations and to create uniformity between field personnel involved with FID use.

Equipment Needed: FID meter (OVA Model 128 Century Organic Vapor Analyzer), calibrant gases (OVA-Methane: 100 ppm), FID calibration log, and flow meter.

Procedures:

1. Check battery condition by moving the INSTR switch to the BATT position.

2. Move pump switch to "On" position, then place instrument in vertical position and check sample flow rate indication. The normal range is 1.5 to 2.5 units. If less, check filters.

3. Open the hydrogen tank valve and the hydrogen supply valve. Wait one minute for hydrogen to purge the system.

4. Depress igniter button until burner lights. Do not depress igniter button for more than six seconds (if burner does not ignite, let hydrogen flow for one minute and again attempt ignition).

5. After ignition, allow approximately five minutes for instrument warm-up, the meter should display a normal background hydrocarbon concentration between 5 and 10 ppm.

6. To shut down the FID, perform the following:
   a. Close the hydrogen supply valve.
   b. Close the hydrogen tank valve.
   c. Move the INSTR switch and pump switch to "off".
   d. Instrument is now in the shut down configuration.
SOP-3 CALIBRATION AND USE OF THE FLAME IONIZATION DETECTOR
(continued)

INSTRUMENT DAILY CALIBRATION:

1. Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT dial set to 300, and allow 20 minutes for warm up and stabilization.

2. Use the CALIBRATE ADJUST (zero) knob to adjust the meter reading to zero.

3. Introduce a methane sample of a known concentration (100 ppm) and adjust trimpot R32 so the meter reading corresponds to the known sample.

4. Extinguish the flame by blocking the exhaust ports or turning the hydrogen supply and pressure valves off.

5. Leave CALIBRATE Switch on x10 position and use CALIBRATE ADJUST (zero) knob to adjust Readout meter reading to 4 ppm.

6. Move the CALIBRATE Switch to the X1 position and using trimpot R31, adjust Readout meter to 4 ppm.

7. Move CALIBRATE Switch to X10 position again. Use CALIBRATE ADJUST (zero) knob to adjust Readout meter to 40 ppm.

8. Move CALIBRATE Switch to X100 position and use trimpot R33 to adjust Readout meter to 4 ppm.

9. Move CALIBRATE Switch back to X10 scale. Rezero Readout meter to 0 ppm.

10. Unit is now balanced over the full range.

INSTRUMENT CALIBRATION CHECK:

1. Once the FID is operating properly, place the readout scale to the X10 position.

2. Connect the tube of the calibration gas (100 ppm methane) to the end of the probe of the FID.
SOP-3 CALIBRATION AND USE OF THE FLAME IONIZATION DETECTOR
(continued)

3. Open the valve of the calibration gas. Read the concentration on the readout dial. It should read approximately 10 ppm (1 ppm on the X100 scale or 100 ppm on the X1 scale). NOTE: Concentration should be within ±20% of actual concentration.

SAMPLE MEASUREMENT:

1. Place the meter scale to the X1 position. This will allow for most sensitive, quick response in detecting airborne contaminants.

2. Before entering a contaminated area, determine background concentration. This concentration should be used as a reference to readings made in the contaminated area. Under no circumstance should one attempt to adjust the zero or span adjustments while the instrument is being operated in the field.

3. Take measurements in contaminated area, recording readings and locations. Should readings exceed the X1 scale, switch to the X10 or X100 scale. Return the instrument switch to the X1 position when readings are reduced to that level. Record all measurements on the Daily Log.

NOTE: The instrument will not function properly in extreme cold or hot conditions. If meter readings become erratic, attempt to recalibrate or use a different meter.

QA/QC REQUIREMENTS:
The instrument must undergo a 2-point calibration as described above every morning before commencement of field work. In addition, a calibration check must be performed every hour during use of the instrument. The readings from the FID will only be used in selection of proper PPE during field work and in selecting initial field-GC analytical parameters for sample analysis in the field.

REFERENCE: Modified from TSAI, U.S.EPA Region V, QAS.

NOTE: If the referenced equipment model is unavailable for use during sampling activities, comparable instruments or equipment will be operated per associated operator’s instructions.
SOP-4 COMBUSTIBLE GAS INDICATOR (MSA EXPLOSIMETER - MODEL 2A)

Scope: This procedure describes the methodology for the use of the combustible gas indicator for health and safety monitoring.

Purpose: The purpose of this procedure is to develop and maintain good quality control in field operations and to create uniformity between field personnel involvement with combustible gas indicator use.

Equipment Needed: Calibrant gases - 40% LEL (Methane 2%) and 50% LEL (Methane 2.5%).

Procedure:

INSTRUMENT SET-UP:

The MSA Explosimeter is set in its proper operating condition by the adjustment of a single control. This control is a rheostat regulating the current to the Explosimeter measuring circuit. The rheostat knob is held in the "OFF" position by a locking bar. This bar must be lifted before the knob can be turned from "OFF" position.

1. Lift the end of the rheostat knob "ON-OFF" bar and turn the rheostat knob one quarter turn clockwise.

   This operation closes the battery circuit (there will be an initial deflection of the meter pointer). The meter pointer may move rapidly upscale and then return to a point below ZERO, or drop directly below ZERO.

2. Flush fresh air through the instrument.

   The circuit of the instrument must be balanced with air free of combustible gases or vapors. Five squeezes of the aspirator bulb are sufficient to flush the combustion chamber. If a sampling line is used, an additional two squeezes will be required for each ten feet of line.

3. Adjust rheostat knob until meter pointer rests at zero.

   Clockwise rotation of the rheostat knob causes the meter pointer to move up scale. A clockwise rotation sufficient to move the meter pointer considerably above zero should be avoided as this subjects the detector filament to an excessive current that may shorten its life.
SOP-4 COMBUSTIBLE GAS INDICATOR (MSA EXPLOSIMETER - MODEL 2A)
(continued)

Note:
When the meter pointer remains below zero and cannot be brought up to ZERO even when the control rheostat is turned to its extreme clockwise position, the batteries must be replaced.

If the pointer of the indicating meter moves to the extreme right side of its scale when the instrument is turned on and cannot be adjusted to ZERO, the detector filament may be burned out and should be replaced.

INSTRUMENT USAGE:
1. Readjust meter pointer to zero if necessary by turning rheostat knob.
2. Aspirate sample through instrument until highest reading is obtained.

   Approximately five squeezes of the bulb are sufficient to give maximum deflection. If a sampling line is used add two squeezes for each ten feet of line. This reading indicates the concentration of combustible gases or vapors in the sample.

INSTRUMENT DAILY CALIBRATION:
1. Attach the flow control to the calibration gas tank.
2. Connect the hose to the flow control and to the instrument inlet fitting.
3. Open the flow control valve.
4. Record the meter reading after it stabilizes. NOTE: It is not necessary to operate the aspirator bulb to obtain the calibration sample. Depending on which calibration gas is used, the instrument reading should be within one of the following ranges:

   2.0% Methane: 42 to 60%
   2.5% Methane: 54 to 75%

NOTE: In the event that the referenced equipment model is unavailable for use during sampling activities, comparable instruments or equipment will be operated per associated operator's instructions.
SOP-5 CALIBRATION AND USE OF NEOTRONICS MULTI GAS INDICATOR METER (MGI)

Scope: This procedure describes the methodology for the use of the MGI for health and safety monitoring.

Purpose: The purpose of this procedure is to develop and maintain good quality control in field operations and to create uniformity between field personnel involved with MGI use.

Equipment Needed: Neotronics meter and calibration gas.

Procedure:

INSTRUMENT USAGE:

Switch on the Neotronics meter by pressing the "power" button. The meter will go through a self-test sequence (6 seconds) and then go into the Oxygen Measurement mode. By pressing the "select" button, the Time On and Explosive Gas Measurement (LEL/LFL) modes can be viewed. In a "normal" fresh air atmosphere, the instrument should read approximately 20.5% oxygen and 0% LEL.

The instrument continuously monitors both gas modes when on. A normally operating instrument will emit a short audible beep every ten seconds and flash the visual alarm lamp to indicate proper operation. If the instrument does not produce the beep and signal flash, it should NOT be used.

During drilling or sampling activities, the meter should be placed as close to the borehole/sample site as practical; the meter should be allowed to run continuously during site work. The aspirator attachment may be used to sample air from within a borehole if required by the HSO.

ERROR MESSAGES:

a. If the Explosive Gas Sensor malfunctions, the meter will emit a continuous audible alarm and read "Flt" on its LCD readout with a side legend of "EXP." If this occurs, do not use the instrument.
b. If the meter LCD reads a side legend of "BAT" there is approximately one hour of battery life left in the unit. When the unit LCD goes blank and the unit emits a continuous audible alarm, the battery is completely discharged. The battery should be fully recharged (5 hours) as described in the instrument manual.

c. If the unit is exposed to gas levels exceeding its readout capability, the following will be displayed:

- Flammable Gas - "EEE"
- Oxygen - "OFL"

If either of these messages occurs, immediately vacate the work area and contact the RFI Field Manager.

DAILY EXPLOSIVE GAS SENSOR CALIBRATION CHECK:

To check calibration of the explosive gas detection element use Neotronics' standard calibration gas mixture of 1.5% Methane in Air, using the following procedure:

1. Switch on monitor and allow auto-check cycle to complete.
2. Select explosive gas display, as described above.
3. Position test gas cylinder needle through second from bottom grill slot against the edge of the bronze sinter on the back of the meter and inject gas.
4. When the meter reaches alarm point, it will emit the audible alarm condition, display "EXP" and 30% LEL, (1.5% Methane in air) ± 7% and flash the red alarm light.
5. If the correct reading cannot be achieved, check that the needle is correctly positioned and that gas is still being emitted from the cylinder.
6. If the meter fails to respond to the test gas, do NOT use the meter.
7. Record all results on the MGI Calibration Check Log.
SOP-5 CALIBRATION AND USE OF NEOTRONICS MULTI GAS INDICATOR METER (MGI)
(continued)

DAILY OXYGEN SENSOR CALIBRATION CHECK:

1. A response check of the oxygen sensor can be made by exhaling at a normal breathing rate into the sensor (normal breath contains approximately 17% oxygen). If the meter does not read 17% ± 3%, do NOT use the meter.

2. Record all results on the MGI Calibration Check Log.

NOTE:
All meters will be calibrated by the leasing company before use. Meters which require recalibration will be returned to the leasing company for surveying.

All meters are pre-programmed with the following alarm settings:

- Oxygen: 19.5% deficiency
- 23% excess; and
- Flammable Gas: 20% LEL.

In the event that the referenced equipment model is unavailable for use during sampling activities, comparable instruments or equipment will be operated per associated operator’s instructions.
SOP-6 NOISE METER PROCEDURES

Scope: This procedure describes the methodology for the use of the noise meter for health and safety monitoring.

Purpose: The purpose of this procedure is to develop and maintain good quality control in field operations and to create uniformity between field personnel involved with noise meter use.

Equipment Needed: Realistic 33-2050 noise meter and paperwork.

Procedure:

1. Turn the meter to the "ON" position and perform a battery check by setting the "RANGE" switch in the "BATT" position.

2. If the meter does NOT deflect into the red "BATTTEST" region of the scale, replace the batteries.

3. Set the "RANGE" setting to 90. At this setting, when the meter reads "0" the actual noise level is 90 dB. If the meter reads "+10", the actual noise level is 100 dB. During use, position the meter so that the user, meter and sound source form an imaginary right angle with the meter at its crux.

4. An initial noise survey will be conducted at a rate of one per site per day. This survey will include one reading while the rig is in operation, and one ambient reading. Record these readings on the Daily Log.

QA/QC REQUIREMENTS:
The noise level meter undergoes a one-time calibration at the factory and does not require field calibration. The meter readings will be used for proper selection of hearing protection during the field operations.

NOTE: In the event that the referenced equipment model is unavailable for use during sampling activities, comparable instruments or equipment will be operated per associated operator's instructions.
SOP-7 DECONTAMINATION OF SUBMERSIBLE PUMPS

Scope: These procedures describe methodologies to be followed in decontaminating submersible pumps used during development and purging of monitor wells.

Purpose: This procedure is designed to minimize the introduction of contaminants into monitor wells and eliminate cross contamination between them.

Equipment Needed: Paper towels, disposable gloves, distilled water, plastic sheeting, micro soap, potable water, pump container, wash brush, clean garbage can, short discharge line.

Procedure:

1. Remove, pump, hoses, and cord from well and place on plastic sheeting.

2. Rinse outside of pump, safety line and discharge line with soap solution and scrub with a wash brush to remove excess debris. The pump and discharge line will be decontaminated by pumping 3 to 5 gallons of soap and distilled water solution through the pump and discharge line. Pump clean distilled water to rinse interior of the discharge line and pump.

3. Triple-rinse pump with distilled water.

4. Remove the pump from the container and place on plastic sheeting.

5. Wash the electrical cord with soapy water and rinse with potable water.

6. Rinse pump and electric cord with distilled water one final time and place in a heavy duty plastic garbage bag.
SOP-8 DECONTAMINATION OF SAMPLING AND PURGING BAILERS

Scope: This procedure describes methodologies to be followed to ensure proper decontamination of bailers used for sampling and/or purging monitor wells.

Purpose: The purpose of this procedure is to establish a uniform method that provides quality control in the field and limits cross contamination between wells.

Equipment Needed: Bailer, pliers, distilled water, elongated bottle brush, micro soap, trash bags, screw driver, paper towels.

Procedures:

1. Disassemble bailer by removing top and bottom portions with a pair of pliers and/or screw driver. Wrap the end fitting with paper towels to prevent damage to the seals within the end caps.

2. Wash each piece with a dilute micro soap/water solution. Scrub all parts with a bottle brush to remove traces of chemicals and sediments.

3. Reconstruct bailer, partially fill with a dilute micro soap solution, cover ends of the bailer with hands, and shake vigorously for 1-2 minutes.

4. After the final wash, rinse the bailer three times with distilled water.

5. Store the cleaned bailer in a new trash bag until it is used.

6. If disposable HDPE bailers are used for sampling or purging of the well, simply discard the bailer in approved waste container.
SOP-9 DECONTAMINATION OF M-SCOPE

Scope: This procedure describes methodologies to be followed to ensure proper decontamination of water level indicators.

Purpose: The purpose of this procedure is to establish a uniform method that provides quality control in the field and limits cross contamination between wells.

Equipment Needed: Distilled water and micro solution.

Procedures:

1. Scrub device with distilled water/Micro soap solution and rinse with distilled water.
2. After rinse, wipe with clean paper towel.
3. Equipment should be wrapped in plastic to prevent contamination during long-term storage.
SOP-10 DECONTAMINATION OF GLASS, STAINLESS STEEL OR METAL SAMPLING EQUIPMENT

Scope: This procedure describes methodologies to be followed to ensure proper decontamination of glass, stainless steel, or metal sampling equipment used during sampling activities.

Purpose: The purpose of this procedure is to establish a uniform method that provides quality control in the field and limits cross contamination between wells.

Equipment Needed: Distilled water, micro solution, organic solvent (methanol, acetone or other), and brushes.

Procedures:

1. Wash equipment thoroughly with Micro soap solution and distilled water using a brush to remove any particulate matter or surface film, if required.

2. If a oily or tarry residue is present after washing with the Micro soap solution and distilled water, wash equipment thoroughly with an organic solvent (methanol, acetone or other) using a separate brush to remove any particulate matter or surface film.

3. Rinse equipment three times thoroughly with distilled water and allow to air dry as long as possible.

4. Wrap equipment with plastic or aluminum foil to prevent contamination during long-term storage.
SOP-11 RINSEATE BLANK COLLECTION

Scope: This procedure describes methodologies to be followed to ensure proper collection of rinseate blanks.

Purpose: The purpose of this procedure in the field and provides for the collection of valid QC samples.

Equipment Needed: Distilled water and sample containers.

Procedure - Re-Usable Equipment:

1. Decontaminate equipment (split-spoons, bailer, etc.) according to SOP-8 or SOP-10.

2. Following the final distilled water rinse, again rinse the sampling device with distilled water this time washing the rinseate into sample containers for laboratory analysis.

3. All rinseate blanks must be handled and analyzed in the same manner as investigative samples. Record details of rinseate blank collection on a Water Sampling Log.

QA/QC REQUIREMENTS:
One rinseate blank sample must be collected from five percent of the investigative samples per sample matrix.

Procedure - Disposable Sample Equipment:

1. Remove bailer from its factor-sealed packaging.

2. Thoroughly rinse the bailer with distilled water washing all rinseate into appropriate sample containers for laboratory analysis.

3. All rinseate blanks must be handled and analyzed in the same manner as investigative samples. Record details of rinseate blank collection on a Water Sampling Log.

QA/QC REQUIREMENTS:
One rinseate blank sample must be collected per case of disposable bailers.

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SOP-12 REPPLICATE SAMPLE COLLECTION

Scope: This procedure describes methodologies to be followed to ensure proper collection of replicate samples.

Purpose: The purpose of this procedure is to establish a uniform method that provides quality control in the field and provides for the collection of valid QC samples.

Equipment Needed: Sample containers.

Procedures:

1. Immediately following collection of a sample for analysis of a particular analytical fraction (e.g., VOCs) fill a second sample container(s) for the same analysis using the same sample collection procedures. This process should be repeated for each remaining analytical fraction to be sampled.

2. Label the sample with its duplicate sample I.D.

3. All duplicate samples should be handled and analyzed in the same manner as investigative samples.

QA/QC Requirements:

One replicate sample from each sample matrix (groundwater, surface-water, soil, sediment, etc.) must be collected from ten percent (10%) of the investigative samples.
SOP-13 COLLECTION OF HAND-AUGERED SOIL/SEDIMENT SAMPLES

Scope: The operating procedure describes the ways and means of obtaining a soil sample from a boring via a stainless steel hand-auger sampler.

Purpose: The purpose of this procedure is to assure good quality control in field operations, uniformity between different field personnel and to allow traceability of possible cause of errors in analytical results.


Procedures:

1. Place plastic sheeting near work area.

2. Using stainless steel hand auger, collect soil samples from locations and depths prescribed in the appropriate field sampling plan.

3. Record all details of sample collection on a Soil/Sediment/Sludge Sampling Log.

4. Collect samples into appropriate bottles supplied by the analytical laboratory. Label each bottle with the following information: date, time of sampling, sample ID, analytical method, sampler initials and method of preservation. Print all information accurately and legibly. Complete Chain-of-Custody forms. If headspace soil sample is required, follow the procedures listed in SOP-5.

5. Place samples in containers as needed, and pack with ice in coolers (when appropriate) as soon as possible.

6. Decontaminate the hand auger as outlined in SOP-10.
SOP-14 SOIL SAMPLING FROM BORINGS

Scope: The operating procedure describes the ways and means of obtaining a soil sample from a boring via a split-spoon sampler.

Purpose: The purpose of this procedure is to assure good quality control in field operations, uniformity between different field personnel and to allow traceability of possible cause of errors in analytical results.

Equipment Needed: Split-spoon sampler, tape measure, hand lens, sample/core log, log book, sample containers with labels, chain-of-custody record, stainless-steel knife or trowel, disposable gloves and plastic sheeting.

Procedures:

1. Place sheeting down in a designated area where the split-spoon sampler will be opened.
2. Position split-spoon sampler over point to be sampled.
3. Hammer sampler using a 130 pound weight with a 30-inch drop (as detailed in ASTMD 1586-84 "Penetration Test and Split-Barrel Sampling of Soils").
4. Count and record the number of blows required to penetrate 6 inches, 12 inches, 18 inches, and 24 inches.
5. Remove the sampler, open and extract the sample. If VOA is to be conducted on the sample, immediately transfer it to a sample jar, leave no head space and tightly cap. Fill out sample label. If a headspace soil sample is required, follow the procedures listed in SOP-15.
7. If there is insufficient soil for the required analysis, contact field management for further instructions.
8. Place sample in sample jar, label and record on Chain-of-Custody Record. Place in iced cooler.
9. Clean split-spoon sampler per SOP-10.
SOP-15 FIELD ANALYSIS OF SOIL SAMPLE HEADSPACE FOR VOLATILE ORGANICS

Scope: This procedure describes methodologies to be utilized in measuring organic vapors emitted from soils collected in split-spoon samplers. Results will be used to characterize volatile organic composition with depth.

Purpose: The purpose of this procedure is to maintain uniformity between field personnel performing the measurements and to ensure the representativeness of readings obtained.

Equipment Needed: Personal protective equipment, organic vapor analyzer, wide-mouth sample jars, plastic bags, rubber bands, field data forms.

Procedures:

1. Split-spoon samples are collected as per SOP-14 and packaged in a plastic ziplock baggie or a wide-mouth sample jar. The baggie or jar is labeled to document boring number, depth range.

2. The plastic baggie is sealed or the glass jar is capped with a plastic bag or aluminum foil and a rubber band.

3. The air-tight sample container is then allowed to warm to enhance the liberation of soil gases into the available jar headspace.

4. Calibrate and prepare for use a FID and/or PID as per SOP-3 and SOP-30, respectively.

5. Puncture top of the plastic cover with the monitor probe and allow headspace gases to be drawn through the unit.

6. Record the highest response obtained on an appropriate sampling log.

7. Seal the plastic baggie or remove the punctured plastic bag and seal jar with the proper lid.

8. Allow instrument to return to zero and repeat procedure for next sample.
SOP-16 SURFACE-WATER SAMPLING

Scope: This procedure describes methodologies to be followed when collecting surface water samples for water quality assessment.

Purpose: The purpose of this procedure is to provide a uniform means for collecting representative and good quality surface water samples for field and laboratory analyses.

Equipment Needed: Personal protective equipment, water sampling logs, pH meter, temperature meter, specific conductance meter, glass, HDPE or stainless steel dipper, appropriately labeled and preserved sample containers.

Procedures:

1. Identify and locate the surface-water sampling location.
2. Record the sampling location, time, date, and other pertinent information on a water sampling log.
3. Approach sampling location from a downflow direction. Take special care within three to four feet of the actual sampling location so as not to disturb fine sands and silts which might affect analyses.
4. Immerse a clean dipper slow into the total depth of water. Avoid splashing if possible.
5. Slowly lift the dipper from the water surface. Avoid floating materials.
6. Remove the cap from the sample bottle and tilt the bottle slightly.
7. Pour the sample slowly from the dipper down the inside of the sample bottle. Avoid splashing of the sample. Assure that any suspended matter in the sample is transferred quantitatively to the sample bottle. Leave adequate air space in the bottle to allow for expansion, except VOA vials.
8. Place samples in containers as needed, and pack with ice in coolers as soon as possible.
9. Discard gloves and any other disposable equipment used to prevent cross contamination between sampling locations.
10. Decontaminate the beaker per SOP-10 between sample sites.
SOP-17 SEDIMENT SAMPLING TECHNIQUES

Scope: This operating procedure describes ways and means of obtaining sediment samples in waterborne deposits.

Purpose: The purpose of this operating procedure is to assure good quality control in field operations, uniformity between different field personnel, and a means to allow traceability of errors in analytical results.

Equipment Needed: Stainless steel soil recovery auger (AMS Model) or soil shovel, field log book, sample log, water proof pens, sample containers, disposable gloves.

Procedures:

1. Prepare a sketch illustrating pertinent site features and all observed surface drainage pathways. Use arrows to record flow direction and note approximate flow volumes and water turbulence.

2. Procure the stainless steel soil recovery auger or soil shovel and proceed to the furthest downstream sampling location.

3. Describe the channel conditions (depth, width, configuration, and deposits) in the field log book.

4. Put on disposable gloves and auger/shovel into the sediment to a depth of 12 inches. Recover the sample and place sediment in appropriate sample jar. Repeat until the jar is full. Replace the lid, tighten securely and rinse the jar with distilled water.

5. Label the sample with project name, date, sample number, and sampler's initials. Record pertinent information in the field log book.

6. Decontaminate sampler as per SOP-10.

7. Proceed to the next upstream location.
SOP-18 DEVELOPMENT OF MONITOR WELLS

Scope: These procedures describe the methodologies to be followed for the development of monitor wells placed in unconsolidated material.

Purpose: The purpose of outlining this procedure is to assure that each newly-constructed monitor well is properly developed so as to provide representative groundwater samples.

Procedure 1 - Hand Bailer Method

Equipment Needed: Personal protective equipment, Teflon stainless steel, or disposable high density polyethylene (HDPE) bailer, M-Scope, rope, 5-gallon bucket, pH meter, conductivity meter, thermometer, turbidity meter and Pyrex cup.

Procedure:

1. Begin development only after the well has been completed and the grout plug has cured for at least 24-hours.

2. Measure depth to water and total depth of well as per SOP-20.

3. Calculate the volume of water initially in the well based on:

   \[ v = \pi (R^2 h) \times 7.48 \]

   where:

   \( v \) = volume of water in well (gallons)
   \( R \) = radius of well (feet)
   \( h \) = height of column of water (feet)

4. Connect rope to bailer allowing sufficient length to reach bottom of well.

5. Insert bailer into well.

6. Take pH, specific conductance, turbidity and temperature readings during the evacuation process and record the readings obtained on appropriate field logs. Make note of changes in clarity and odor.
SOP-18 DEVELOPMENT OF MONITOR WELLS
(continued)

7. Continue to take indicator measurements for the duration of time required to evacuate three to five well volumes of groundwater.

8. The well will be considered developed once three to five well volumes of groundwater have been removed from the well, and/or pH, specific conductance, turbidity and temperature have stabilized. These parameters will be considered stabilized when two successive measurements of pH are within 0.5 units, temperature within 0.5 degrees Celsius, specific conductance is within 10% and turbidity is within 10%.

9. Remove all development materials and secure the well.

Procedure 2 - Pump Method

Equipment Needed: Personal protective equipment, pump and hoses, generator, surge block arrangement, M-Scope, pH meter, conductivity meter, thermometer, turbidity meter and Pyrex cup.

Procedure:

1. Begin development only after the well has been completed and the grout plug has cured for at least 24-hours.

2. Measure depth to water and total depth of well as per SOP-20.

3. Calculate the volume of water initially in the well based on:

   \[ v = \pi (R^2h) \times 7.48 \]

   where:

   \[ v = \text{volume of water in well (gallons)} \]
   \[ R = \text{radius of well (feet)} \]
   \[ h = \text{height of column of water (feet)} \]

4. A clean submersible pump with accompanying discharge line and safety rope is lowered to a level 2-3 feet above bottom of the well.
SOP-18 DEVELOPMENT OF MONITOR WELLS
(continued)

5. Take pH, specific conductance, turbidity and temperature readings during the evacuation process and record the readings obtained on appropriate field logs. Make note of changes in clarity and odor.

6. The pump is turned on and the well is pumped at a rate that will not drop the static water level greater than 5-foot or cause the well to go dry.

7. The well will be considered developed once three to five well volumes of groundwater have been removed from the well, and/or pH, specific conductance, turbidity and temperature have stabilized. These parameters will be considered stabilized when two successive measurements of pH are within 0.5 units, temperature within 0.5 degrees Celsius, specific conductance is within 10% and turbidity is within 10%.

8. At this time, the pump apparatus is removed from the well.

9. Remove all development materials and secure the well.

Note: If appreciable quantities of fine sediments interfere with the pump performance, the water can be bailed until the water is of sufficient quality to pump.

Procedure 3 - Air Lift Method

Equipment Needed: Personal protective equipment, air compressor and hoses, pH meter, conductivity meter, turbidity meter, thermometer, 5-gallon bucket, M-Scope, and a Pyrex cup.

Procedure:

1. Begin development only after the well has been completed and the grout plug has cured for at least 24-hours.

2. Measure depth to water and total depth of well as per SOP-20.

3. Calculate the volume of water initially in the well based on:

\[ V = (R^2 \pi h \times 7.48) \]

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SOP-18 DEVELOPMENT OF MONITOR WELLS
(continued)

where:
\[ v = \text{volume of water in well (gallons)} \]
\[ R = \text{radius of well (feet)} \]
\[ h = \text{height of column of water (feet)} \]

4. A 1/4- or 1/2-inch high pressure air line is secured to the outside of an inert, 3/4-inch discharge line, such that approximately 1-foot of the smaller diameter high-pressure line has been inserted into the downhole end of the discharge line. The secured lines are then lowered to the bottom of the well and the air line is connected to the compressor.

5. Compressed air is slowly delivered to the line after passing through a filter that removes residual oil. Increase the air pressure until water begins to come out of the discharge line.

6. Take pH, specific conductance, turbidity and temperature readings during the evacuation process and record the readings obtained on appropriate field logs. Make note of changes in clarity and odor.

7. The pump is turned on and the well is pumped dry, if possible. At this time, the pump apparatus is removed from the well.

8. Remove all development apparatus and secure the well.
SOP-19 MONITOR WELL PURGING

Scope: This procedure describes acceptable methodologies for purging standing water in monitor wells so that representative groundwater samples can be collected.

Purpose: The purpose of describing this procedure is to create uniform purging procedures between field personnel, provide groundwater representative of the aquifer from which it came, and maintain proper quality control practices.

Equipment Needed: Measuring tape or electric water-level indicator tape, generator, field forms, plastic garbage bags, polypropylene rope, stainless steel submersible pump, Teflon bailer, or HDPE disposable bailer, stopwatch, pH meter, conductivity meter, temperature meter, turbidity meter, disposable polypropylene beakers, Pyrex beakers or disposable cups.

Procedures:

1. Locate and identify the monitor well to be purged.
2. Unlock protective casing and remove well cap.
3. Analyze well headspace to detect organic vapors for selection of appropriate level of personnel protection equipment.
4. Measure depth to water and total depth of well. Record information on appropriate field logs.
5. Calculate the volume of water initially in the well based on:

   \[ V = \pi (R^2h) \times 7.48 \]

   where:
   - \( V \) = Volume of water in well (gallons)
   - \( R \) = Radius of well (feet)
   - \( h \) = Height of column of water (feet)

6. Prepare a precleaned pump for well purging and insert pump or intake line into well. If purging using the hand bailer method attach polypropylene rope to bailer and insert into well.
SOP-19 MONITOR WELL PURGING
(continued)

7. Lower the pump, electric cord, and safety line or intake line into the well to a depth where water is encountered. As the pump discharge line is lowered, wipe it with paper towels dampened with distilled water to remove any debris which may be adhering to its surface.

8. Connect the pump's electric line to the generator, if necessary, and turn the submersible pump on. Be sure that the discharge line is down gradient of the well and that discharge is into a proper storage container.

9. Lower the pump, intake while it is running, to the midpoint region of the saturated level of an open borehole or to the mid-screen point in cased monitor wells.

10. Mark time when pumping began in field book and on sampling log. Measure flow rate by means of a stopwatch and a flow meter, weir, or calibrated bucket.

11. Take pH, specific conductance, turbidity, and temperature readings during the evacuation process (initial reading and after each well volume) and record the readings obtained on appropriate sampling logs.

12. Continue to take indicator measurements for the duration of time required to evacuate three to five well volumes.

13. Once three to five well volumes of groundwater has been removed from the well and/or pH, specific conductance, turbidity and temperature have stabilized, slowly remove the pump intake from the saturated zone. The well will be considered stabilized when two successive measures of pH are within 0.5 units, temperature within 0.5 degrees Celsius, specific conductance is within 10%, and turbidity is within 10% or five well volumes are removed.

14. When the standing water above the region where the pump intake was set has been cleared and the pump breaks suction turn the pump off and remove it from the well.

15. Pull off pump rope and intake line and properly dispose of them. If purging by the Hand Bailer Method, remove bailer and rope once 3 to 5 well volumes have been removed and all parameters have stabilized.
SOP-20 MEASURING WATER-LEVELS WITH AN M-SCOPE

Scope: This operating procedure outlines the method used to measure water levels with an electronic water level indicator.

Purpose: The purpose of this procedure is to assure good quality control in field operations and uniformity among different field personnel taking water level measurements.

Equipment Needed: M-Scope, decontamination equipment, water sampling log, folding ruler (if needed).

Procedures:

1. Check that the M-Scope battery is functional.

2. Decontaminate the probe and tape per SOP-9.

3. Locate and identify the monitor well to be measured.

4. Remove cap from well and check for the measuring-point mark.

5. Analyze well headspace to detect organic vapors for selection of appropriate level of personnel protection equipment.

6. Lower the probe into the center of the well until a contact with the water surface is indicated, either by audible alarm, light, or meter deflection.

7. Mark and hold the tape at the measuring point and repeat the measurement.

8. Read off the measurement and record. If the tape only has five foot markers, measure the distance to the measured point with a folding ruler. Measurements should be made to the ±0.01 feet.

9. Retract the tape by winding onto the spool. Wipe tape with a clean cloth and distilled water as it comes out of the well.

QA/QC REQUIREMENTS:
Quadruplicate water level measurements are to be collected at a frequency of 10% (i.e. 1 in 10 investigative measurements) or one per day, whichever is greater.
SOP-21 MEASURING OIL WATER INTERFACE LEVELS WITH AN INTERFACE PROBE

Scope: This operating procedure outlines the method used to measure water/product levels with an interface probe.

Purpose: The purpose of this procedure is to assure good quality control in field operations and uniformity among different field personnel taking water/product level measurements.

Equipment Needed: Interface probe, decontamination equipment, water sampling log, folding ruler (if needed).

Procedures:

1. Check that the interface probe battery is functional.

2. Decontaminate the probe and tape per SOP-9 until residual product is removed (a methyl alcohol soaked towel may be required). Dry with a clean cloth.

3. Remove cap from well and check for the measuring-point mark and for any sharp edges which may damage tape.

4. Lower the probe into the well until a contact with the product or water surface is indicated by an audible alarm. Record measurement. Product contact results in a steady alarm, water is indicated by a broken alarm.

5. Continue to lower the tape and measure the product/water interphase. Record measurement, at each phase change until the bottom of the well is reached.

6. Retract the tape by winding onto the spool. Rinse with methyl alcohol and then distilled water with a clean paper towel as it comes out of the well.
SOP-22 GROUNDWATER SAMPLING FROM MONITOR WELLS

Scope: This procedure describes the methodology for collecting representative groundwater samples for laboratory analyses from both open-borehole wells and unconsolidated aquifer-screened wells.

Purpose: The purpose of describing this procedure is to provide a uniform methodology for the collection of good quality and representative groundwater samples.

Equipment Needed: Personal protective equipment; field sampling forms; water filtering equipment; pH, temperature, conductivity, and turbidity meters; portable FID and/or PID; disposable HDPE bailer or Teflon bailer, plastic trash bags, properly preserved and labeled sample containers; disposable polypropylene beakers; and decontamination equipment.

Procedures:
1. Locate and identify the well to be sampled. Record pertinent information on appropriate sampling logs, including date, well identification number, weather, time, and samplers initials.
2. Unlock protective casing and remove well cap. Monitor the wellhead upon opening well cap to detect emitted organic vapors. Select appropriate level of personal protection based on IDLHs and TLVs of pertinent chemicals.
3. Purge well prior to sampling as described in SOP-19.
4. Once well is purged, tie a new piece of polypropylene rope on the end of a clean bailer if a submersible pump was used for evacuation.
5. Gently lower bailer to depth from which well evacuation was performed. Remove three bailer volumes of water and discard store for proper disposal.
6. Proceed to fill sample containers, beginning with containers for volatile organics. Sample will be transferred to each volatile organic sample jar in a single pour to reduce volatilization. Fill remaining sample containers which require no filtering by portioning aliquots of water into each container to ensure homogeneity.
7. Set aside an aliquot of groundwater sufficient to fill sample containers requiring filtering.
8. Collect an aliquot of water to perform field tests such as pH, specific conductance, turbidity, and temperature. Record all readings on appropriate field forms.

9. Collect groundwater samples requiring large sample volumes (i.e., semi volatiles, extractable organics) then unfiltered metals (total metals).

10. Lastly collect groundwater samples for unfiltered metals and inorganics such as nitrates, (nitrite, sulfates, etc.)

11. Filter collected groundwater sample as appropriate.

12. If inadequate water is present in the well to fill the required sample containers, the sampling crew will return periodically within 24 hours until adequate sample volume is obtained and field parameters measured. Groundwater will be collected for individual analyses in the order outlined in steps 6 through 11 of SOP-22, as required.

13. Complete remaining information on field forms.

14. Store samples in coolers with ice at 4°C.

15. Decontaminate filtering equipment and bailer. Discard bailer rope, towels, and other disposable equipment.

16. Replace well cap and lock protective casing.
SOP-23 GROUNDWATER SAMPLING -- DOMESTIC WELLS

Scope: This procedure describes ways and means of obtaining groundwater samples from private domestic wells, public water-supply wells, industrial-supply wells, or other wells specifically designed to deliver a continuous water supply to a consumer.

Purpose: This procedure is to assure good quality control in field operations, uniformity between different field personnel, and means to allow traceability of possible causes of error in analytical results.

Equipment Needed: Sampling containers with labels, waterproof marker, field tracking form, pH meter, conductivity meter, filter equipment.

Procedures:

1. Locate the well or housing by plotting or otherwise denoting it on a U.S.G.S. topographic map.

2. Sketch the site, including roads, driveways, house and building locations, well location, north arrow, land use, and any other pertinent observations.

3. From the owners, determine the age of the well, depth, existence and size of in-line pressure tanks, existence and type of in-line water treatment, well driller, existence of a "water well completion report form," knowledge of taste/odor/corrosion problems in the area, type and age of piping, past land uses in the area, existence and location of owner's and neighbor's septic system, existence of any other wells, buried tanks, or former buried tanks on-site, and any other pertinent details.

4. Select a faucet for sampling in as direct a line to the well as possible. Do not choose a faucet following water purifiers, softeners, filters, or neutralizers.

5. Open the faucet and estimate the discharge (time/volume method may be employed).

6. Note starting time on the field log book and allow the water to run long enough to drain the pressure bank and piping, or five minutes, whichever is shortest. Note completion time.

7. After 15 minutes of purging, decrease the discharge to affect non-turbulent flow and obtain a sample for field determination of pH, and conductivity. Refer to SOP-1 and SOP-2 for these procedures. DO NOT completely shut off the water flow until all samples have been taken.
8. Under non-turbulent flow conditions, obtain VOA samples by completely filling the sample vial with a minimum of agitation. Leave no headspace in the container.

9. Slightly increase the discharge rate, if needed, to efficiently fill the remainder of the sample containers.

10. Note on the sample tracking form any circumstances concerning the samples or sampling which may affect analytical results (e.g., in-line pressure or holding tanks).
SOP-24 FILTRATION OF AQUEOUS SAMPLES

Scope: The procedure describes the method for filtering aqueous samples to remove suspended particulate matter which may interfere with chemical analyses.

Purpose: The purpose of this procedure is to provide representative water samples free from suspended particulates which otherwise may interfere with chemical analyses. Additionally, the method provides a uniform procedure which eliminates variability between filtering personnel.

Equipment Needed: Peristaltic pump, 0.45 micron filter, silicon or tygon tubing, distilled water, glass or plastic container, sampling forms, and disposable polyvinyl chloride (PVC) gloves.

Procedures:

1. Prepare for filtering by assembling a clean piece of tygon or silicon tubing to the peristaltic pump. The tubing should be long enough to access the sample to be filtered and the sample bottle.

2. Attach a clean 0.45 micron filter to the effluent end of the tubing. Make sure the arrow on the filter is pointing in the direction of intended flow.

3. Pour the sample to be filtered into a clean container and rinse. Pour adequate sample volume to be filtered into rinsed container.

4. Insert the influent end of the tubing into the container holding the unfiltered sample.

5. Turn on the peristaltic pump and allow flow through the filter for 5 to 10 seconds.

6. Remove sample bottle cap and allow the filtered sample to flow into the appropriate labeled and preserved sample container.

7. Upon filling the sample bottles, place the sample in an iced cooler as soon as practical.

8. Complete all field records making note of any problems or peculiarities.

9. Dispose of used tubing and filter. Dispose of unfiltered sample container or clean with a micro soap wash followed by a triple rinse of distilled water.

GERAGHTY & MILLER, INC.
SOP-25 LOW FLOW GROUNDWATER SAMPLING

Scope: This procedure describes the methodology for the collection of groundwater samples using low flow techniques.

Purpose: The purpose of this procedure is to develop and maintain good quality control in field operations and to create uniformity between field personnel involved in low flow groundwater sampling.

Equipment Needed: Pump, tubing, water level indicator, timer watch, graduated cylinder (accurate to 100 ml), table of pump and transfer tubing volumes, necessary paperwork, personal protective equipment; field sampling forms; water filtering equipment; pH, temperature, conductivity, redox, and dissolved oxygen meters or a flow through cell; and turbidity meter; portable FID and/or PID; plastic trash bags, properly preserved and labeled sample containers; beakers; and decontamination equipment.

Applicability: This SOP covers the collection of groundwater samples from monitoring wells using a low flow technique to minimize the disturbance of particulate matter in the well. This method may be used to collect samples for total metals analysis, organic analysis including volatile organic compounds, and general water chemistry parameters. This method may also be used for the collection of samples for dissolved metals analysis by the addition of a field filtration step.

The presence of the disturbed particulate matter in a groundwater sample will have an affect on the analytical results for total metals. Kearl et al. (1994) recommends using a low flow procedure to obtain representative samples of the total mobile metal load in the groundwater, which includes the dissolved and colloidal portions. The disturbance of the particulate matter in the well is minimized by using a pump and tubing to purge and sample the well, inserting (or installing) the pump or tubing in the well at least one day prior to sampling, low flow purging the well prior to sampling, and then sampling the well at a low flow rate (100 mL/min)(Kearl et al., 1994).
This SOP does not address health and safety, water level measurements, decontamination, field filtration, sample preservation, sample bottle filling, chain-of-custody, field parameter analysis, pump operation and maintenance, or laboratory analysis. Refer to other applicable SOPs, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan, as appropriate. Refer to pump manufacturer's operation and maintenance manual for pump operating procedures.

**Pump Selection:**

The type of pump or tubing inserted into the well to low flow purge and sample will have an impact on the chemistry of groundwater samples. A pump or tubing attached to a portable pump and inserted into the well may be used. A peristaltic pump may be used, but there is a potential for degassing of the sample. This is especially important for samples to be analyzed for volatile organic compounds. Other pumps may be found to be suitable on a task specific basis. The pump and transfer tubing selected for use must be composed of materials that will not affect the sample quality (i.e., stainless steel and teflon) and utilizes a pumping action that also will not significantly impact sample quality (i.e., positive displacement without aeration). See Parker (1994) for recent summary of the impacts of sampling devices on sample quality.

**Definitions:**

*Dedicated Pump* - A permanently installed pump.

*Dissolved Metals* - The water sample is filtered in the field prior to the preservation step, and then analyzed in the laboratory.

*Low Flow Purging* - The purging of two "volumes" of water through the sample pump, and transfer tubing only. A "volume" is the amount of water contained in the sample pump and the transfer tubing when completely full. Low flow purging is performed with the pump intake located at the midpoint of the well screen. Purging of three or more well volumes from the entire well is not performed because groundwater is moving through the well screen, and so purging is not necessary to obtain a representative sample if a low pumping flow rate is used.

*Total Metals* - The water sample is not filtered in the field prior to the preservation step, and then analyzed in the laboratory.
SOP-25 LOW FLOW GROUNDWATER SAMPLING
(continued)

Total Mobile Metals Load - This is essentially the same as for total metals except that special techniques (i.e., low flow sampling) have been employed to minimize the potential for the presence of non-mobile particulates in the water sample. The water sample is expected to contain the dissolved and colloidal metals being transported in the groundwater.

Procedure:

1. Unlock well, remove cap and let stand for 10 minutes. Measure the water level in the well and the total depth of the well (Skip total depth measurement for dedicated pump situation). Record measurements in field notes. Skip to 6 if a dedicated pump is in use. Note: It may be appropriate to obtain a complete round of water levels from each of the monitoring wells at the site prior to sampling any of the wells.

2. Review the well construction log and determine the depth of the well screen midpoint below the top of casing and the total depth of the well. Record in field notes.

3. Compare the measurement of total depth of the well with the well construction log and previous measurements, if any, to determine available length of well screen.

4. Insert the pre-cleaned pump and/or tubing into the well to the midpoint of the well screen. Record installation time in field notes.

5. Let well stand undisturbed for at least 30 minutes after pump and/or tubing installation.

6. Start pump at the lowest possible flow rate and adjust the pumping rate to approximately 100 mL/min. Record pump start time in field notes. Verify the flow rate with the graduated cylinder (or equivalent) by collecting the water from the discharge line for one minute. Record results in field notes. Manage the collected water according to site requirements.

7. Monitor water level to verify that little or no drawdown is occurring in the well. If desired, the flow rate may be increased to up to 300 mL/min in more permeable formations as long as minimal drawdown is observed in the well. Record measurements and flow rates in field notes.

8. Purge a minimum of two volumes of water at a flow rate of approximately 100 mL/min from the pump and transfer tubing. Record purge volume target and actual volume in field notes. Manage purge water according to site requirements.
SOP-25 LOW FLOW GROUNDWATER SAMPLING
(continued)

9. Obtain field parameter measurements after each volume of water is purged and record on the appropriate form. Purging will continue until a minimum of two volumes of water have been removed and/or the field parameters stabilize.

10. Collect sample at low flow rate (100 mL/min) for laboratory analysis directly into the appropriate sample container. If inadequate water is present in the well to fill the required sample containers, the sample crew will return periodically within 24 hours until adequate sample volume is obtained and field parameters measured. Groundwater will be collected for individual analyses in the order outlined in steps 6 through 11 of SOP-22, as required.

11. Obtain a final set of field parameter measurements

12. Turn off pump. Remove portable pump and/or tubing from well and decontaminate or dispose.

13. Replace cap on well and protective casing lock well.
SOP-26 CALIBRATION AND USE OF THE TURBIDITY METER

Scope: This procedure describes the calibration and the use of a turbidity meter for obtaining measurements in aqueous media.

Purpose: The purpose of this procedure is to provide a uniform means for calibration and use of turbidity meters between field personnel. Additionally, the method provides quality control steps necessary for obtaining reliable and representative readings.

Equipment Needed: Turbidity meter, reference solutions, calibration log, clean Pyrex cup, and turbidity sample vials.

Procedures:

Calibration

1. Gently fill a sample vial with a 40 NTU standard at ambient temperature.
2. Insert the vial into the measurement chamber on the turbidity meter.
3. Check to be sure that the vial is seated in the bottom of the chamber.
4. Close the chamber door.
5. Wait approximately 15 seconds.
6. Adjust the standardization control on the turbidity meter to read 40 NTU.
7. After calibration, analyze a blank sample of distilled/deionized water.
8. Record the result on the calibration log.

Meter Usage:

1. Collect 50 to 500 ml of sample into a clean Pyrex cup.
2. Allow the sample to equilibrate to ambient temperature for approximately 1 minute.
3. Pour the sample into the sample vial provided with the turbidity meter.
4. Rinse the vial with this water and then discard the water in the vial.
SOP-26 CALIBRATION AND USE OF THE TURBIDITY METER
(continued)

5. Fill the vial to the top by gently pouring additional sample into the vial. Avoid agitation of the sample during this process.

6. Cap the vial and wipe the outside of the vial with a clean absorbent wipe. Do not touch the sides of the vial as smudges or smears on the vial can result in inaccurate measurements.

7. Insert the sample vial into the measurement chamber.

8. Check to be sure the vial is seated properly in the bottom of the chamber.

9. Close the chamber door.

10. Wait 15 seconds.

11. Record the NTU value displayed. If the NTU value is greater than 200 NTU, record the value as ">200 NTU".

12. If the NTU reading is less than 5.0 NTU, recalibrate the meter with a 5.0 NTU standard and reanalyze the sample using the above procedure.

13. After NTU measurements are complete, discard sample and rinse sample vial with deionized water.

QA/QC REQUIREMENTS:

The turbidity meter should be calibrated at the beginning of each day with a 40 NTU standard. Meter calibration should be checked with a 40 NTU standard solution every four hours. If the reading is greater than ±1 NTU (> 2%) of standard, repeat calibration process. Quadruplicate NTU measurements are to be collected for each aqueous sample matrix at a frequency of 10% (i.e. 1 in 10 investigative measurements) or one per day, whichever is greater. The precision of the readings must be within ±10%. Standard solution should be replaced in accordance with manufacturer recommendations.
SOP-27. SLUG TEST

Scope: This procedure defines the requirements for conducting and analyzing slug tests.

Purpose: The purpose of this procedure is to provide a uniform basis for conducting slug tests and to ensure the continuity between field personnel. Additionally, the method provides quality control steps necessary for obtaining reliable and representative readings.

Equipment Needed: Water-level measuring device (M-Scope, weighted tape, etc.), stopwatch (if needed), pressure transducer and data recorder (if needed), slug device, field data forms, decontamination equipment and supplies.

Procedures:

Preparation:
1. Open the locking and vented caps and inspect the wellhead. Note in particular the condition of the surveyed reference mark, if any.
2. Measure and record the static water level and the depth to the bottom of the well. Record this data on the appropriate field data form.
3. If a transducer and analog or digital recorder are to be used to measure water-level changes, calibrate the transducer at two different depths in the well. Calibration depths should be widely separated. Leave the transducer at the lower calibration point.

Falling-Head Slug Test:
1. Switch on the data recorder, or set the water-level meter probe near the level at which water is expected to rise.
2. Rapidly lower the slug into the water.
3. Record fall in water level vs. time. If a transducer and recording device are used, record depth at predetermined intervals for the first 2 minutes or longer, based on aquifer conditions. If using a water-level indicator and stopwatch, record depth-time data at the fastest rate possible for the first 5 minutes of well recovery. Subsequent recording intervals may be adjusted to suit the rate of well recovery.
SOP-27 SLUG TEST

Scope: This procedure defines the requirements for conducting and analyzing slug tests.

Purpose: The purpose of this procedure is to provide a uniform basis for conducting slug tests and to ensure the continuity between field personnel. Additionally, the method provides quality control steps necessary for obtaining reliable and representative readings.

Equipment Needed: Water-level measuring device (M-Scope, weighted tape, etc.), stopwatch (if needed), pressure transducer and data recorder (if needed), slug device, field data forms, decontamination equipment and supplies.

Procedures:

Preparation:

1. Open the locking and vented caps and inspect the wellhead. Note in particular the condition of the surveyed reference mark, if any.

2. Measure and record the static water level and the depth to the bottom of the well. Record this data on the appropriate field data form.

3. If a transducer and analog or digital recorder are to be used to measure water-level changes, calibrate the transducer at two different depths in the well. Calibration depths should be widely separated. Leave the transducer at the lower calibration point.

Falling-Head Slug Test:

1. Switch on the data recorder, or set the water-level meter probe near the level at which water is expected to rise.

2. Rapidly lower the slug into the water.

3. Record fall in water level vs. time. If a transducer and recording device are used, record depth at predetermined intervals for the first 2 minutes or longer, based on aquifer conditions. If using a water-level indicator and stopwatch, record depth-time data at the fastest rate possible for the first 5 minutes of well recovery. Subsequent recording intervals may be adjusted to suit the rate of well recovery.
SOP-27 SLUG TEST
(continued)

4. Continue recording depth-time data until the well has recovered to nearly the static water level. When using data recorders, it is advisable to check and record the reading every few minutes to ensure that data are being properly recorded.

5. Record the time of test completion on the field data forms. If a data recorder with random access memory (RAM) or erasable programmable read only memory (EPROM) was used, record the file name used.

6. Decontaminate all equipment according to the appropriate SOP. Clean up the site, and close and lock the well before leaving.

Note: Both rising- and falling-head slug tests may be carried out in the same operation by first measuring the rate of water-level fall immediately after slug insertion, then measuring the rate of water-level rise after slug withdrawal. Be sure that the well has recovered to the static water level before conducting the rising-head test.

Rising-Head Slug Test:

1. Lower the slug into the water until it is fully submerged. Allow the well to re-equilibrate to static water level.

2. Turn on the data recorder, if used, or verify the static water level has been reestablished with a water-level meter.

3. Withdraw the slug quickly, but avoid surging. Record the time of withdrawal to the second. Start the stop watch, if used, at the instant the slug is withdrawn.

4. Record the rise in water level vs. time. If a transducer and recording device are used, record depth at predetermined intervals for the first 2 minutes or longer, based on aquifer conditions. If using a water-level indicator and stopwatch, record depth-time data at the fastest rate possible for the first 5 minutes of well recovery. Subsequent recording intervals may be adjusted to suit the rate of well recovery.

5. Continue recording depth-time data until the well has recovered to nearly the static water level. When using data recorders, it is advisable to check and record readings every few minutes to ensure that data are being properly recorded.

6. Record the time of test completion in the field data forms. If a data recorder with RAM or EPROM memory was used, record the file name used.
7. Decontaminate all equipment according to the appropriate SOP. Clean up the site, and close and lock the well before leaving.

RESTRICTIONS/LIMITATIONS:

In wells in which the static water level and water levels induced during testing are above the top of the screened or open hole interval, both the rising-head and falling-head tests should be conducted to provide a check of results.

Falling-head slug tests are invalid in wells in which the static water level is at or below the top of the screened or open-hole interval.
SOP-28 TREATING WELL PURGEWATER WITH CARBON UNITS

Scope: This procedure defines the requirements for the use of carbon units for treating well purgewater.

Purpose: The purpose of this procedure is to provide a uniform basis for treating well purgewater with carbon units and to ensure continuity between field personnel.

Equipment Needed: Carbon unit, submersible pump with flow control, generator, submersible pump discharge line (i.e. garden hose), carbon unit discharge line (i.e. garden hose), 55 gallon drums as required to contain all purge water, sample bottles.

Procedures:

1. Prior to purging each well requiring carbon-unit treatment, attach purgewater-discharge line to the submersible pump and the carbon unit inflow port.

2. Attach carbon unit discharge line to the carbon unit outflow port. Place the outflow end of the carbon unit discharge line into an empty 55 gallon drum.

   Note: When using more than one carbon unit, connect the outflow end of the carbon unit discharge line to the next carbon unit inflow port. Repeat step 2.

3. Begin purging well. If carbon unit connections show signs of leakage, reduce discharge flow. The discharge flow rate should not be greater than 8 gallons per minute.

4. Upon filling a 55 gallon drum, place the outflow end of the carbon unit discharge line into another empty 55 gallon drum. Repeat as required.

5. While filling the last required drum, collect a confirmation sample from the outflow end of the carbon unit discharge line to insure that the carbon unit has effectively removed any constituents of concern during purging.

6. When the required purgewater has been removed from the well, and a confirmation sample has been collected, turn off the submersible pump.

7. Seal all 55 gallon drums filled with purgewater.

8. Review confirmation sample results upon receiving them.
SOP-28 TREATING WELL PURGEWATER WITH CARBON UNITS
(continued)

If the constituent(s) of concern has not been detected, or it is below it's maximum contaminant level (MCL), then the purgewater contained in the 55 gallon drums may be discharged to the ground, away from the well head.

If the constituent(s) of concern has been reported above it's MCL, then the contained purgewater must be treated using a new carbon unit(s). Repeat the steps listed above using a new carbon unit(s).

9. All drums and equipment should be moved to their designated location upon discharging the purgewater.
SOP-29 MEASUREMENT OF TEMPERATURE FOR AQUEOUS MEDIA

Scope: This procedure describes the methods to be used for measuring the temperature of aqueous media while monitoring stabilization of parameters during well purging and during the sample collection process.

Purpose: The purpose of this procedure is to develop and maintain good quality in field operations and to create uniformity between field personnel performing temperature measurements.

Equipment Needed: Thermometer (or temperature probe on meter), log book, small beaker or sample jar, distilled water.

Procedures:

1. Rinse thermometer or temperature probe with distilled water.
2. Pour sufficient amount of sample to cover probe tip into sample jar or beaker.
3. Place thermometer or temperature probe in sample.
4. Allow thermometer or temperature probe to equilibrate to the sample temperature (approximately 5-10 seconds).
5. Read and record temperature in log book or on appropriate field forms.
6. Rinse thermometer or temperature probe with distilled water.
**SOP-30 CALIBRATION AND USE OF THE PHOTO IONIZATION DETECTOR**

**Scope:** This procedure describes the methodology to be used for the calibration and use of the Photo Ionization Detector (PID) meter for field headspace analysis and health and safety monitoring.

**Purpose:** The purpose of this procedure is to develop and maintain good quality control in field operations and to create uniformity between field personnel involved with PID use.

**Equipment Needed:** PID meter (HNu model P1 101 with 10.2 eV lamp), calibrant gases (isobutylene: 20-200 ppm and 0-20 ppm), PID calibration log, and flow meter.

**Procedures:**

1. Prior to calibration, check the function switch on the control panel to make sure it is in the "off" position. The probe nozzle is stored inside the instrument cover. Remove cover plate by pulling up on the pins that fasten the cover plate.

2. Remove the nozzle from the cover. Assemble probe by screwing nozzle into casing.

3. Attach probe cable to instrument box inserting 12 pin interface connector of the probe cable into the connector on the instrument panel. Match the alignment keys and insert connector. Turn connector in clockwise direction until a distinct snap and lock is felt.

4. Turn the function switch to the "battery check" position. When the battery is charged, the needle should read within or above the green battery arc on the scale plate. If the needle is below the green arc or the red "LED" comes on, the instrument should be recharged prior to making any measurements.

5. Turn the function switch to the "on" position. In this position, the UV light source should be on. To verify, gaze at the end of the probe for a purple glow. *Do not look directly at the lamp itself.* If the lamp does not come on refer to the instruction manual.

6. To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counter clockwise rotation yields a downsacle deflection. (Note: No zero gas is needed since this is an electronic zero adjustment.) If the span adjustment is changed during instrument calibration, the zero should be rechecked and adjusted. If necessary, wait 15 to 20 seconds to ensure that the zero reading is stable. Readjust as necessary.
SOP-30 CALIBRATION AND USE OF THE PHOTON IONIZATION DETECTOR

(continued)

Instrument Daily Calibration:

1. Insert one end of T tube into probe. Insert second end of probe into calibration gas in the 20-200 ppm range. The third end of probe should have the rotameter (bubble meter) attached.

2. Set the function switch in the 0-200 ppm range. Crack the valve on the pressured calibration gas container until a slight flow is indicated on the rotameter. The instrument will draw in the volume required for detection with the rotameter indicating excess flow.

3. Adjust the span potentiometer so that the instrument is reading the exact value of the calibration gas. (Calibration gas value is labeled on the cylinder.)

4. Turn instrument switch to the standby position and check the electronic zero. Reset zero potentiometer as necessary following step 6 above.

5. Record on field-data sheet all original and readjusted settings.

6. Set the function switch to 0-20 ppm. Remove the mid-range (20-200 ppm) calibration gas cylinder and attach the low range (0-20 ppm) calibration gas cylinder as described above.

7. Do not adjust the span potentiometer. The observed reading should be ±3 ppm of the concentration specified for the low range calibration gas. If this is not the case, recalibrate the mid range scale repeating Step 1 through 6 above. If the low range reading consistently falls outside the recommended tolerance range, the probe light source window likely needs cleaning. Clean window according to instruction manual. When the observed readings is within the required tolerances, the instrument is fully calibrated.

Instrument Calibration Check:

1. Exit the exclusion zone and turn meter to "on" position. Check that the meter is reading a value of zero.

2. Insert one end of T-tube into probe and other end into calibration gas. The third end of the T-tube should be attached to a flow meter.

3. Crack the valve on the calibration gas and read the value shown by the instrument. Record the value and calibrant gas concentration and a field-data sheet.
SOP-30 CALIBRATION AND USE OF THE PHOTO IONIZATION DETECTOR
(continued)

4. If the value shown by the instrument is greater than ±20% of the calibrant gas concentration, take meter outside of exclusion zone and recalibrate as outlined above.

Sample Measurement:

1. Place function switch in 0-20 ppm range for field monitoring. This will allow for most sensitive, quick response in detecting airborne contaminants.

2. Before entering a contaminated area, determine background concentration. This concentration should be used as a reference to readings made in the contaminated area. Under no circumstance should one attempt to adjust the zero or span adjustments while the instrument is being operated in the field.

3. Take measurements in contaminated area, recording readings and locations. Should readings exceed the 0-20 scale, switch the function switch to the 0-200 or 0-2,000 range as appropriate to receive a direct reading. Return the instrument switch to the 0-20 range when readings are reduced to that level. Record measurements on field-data sheet.

Note: The instrument will not function properly in high humidity or when the window to the light housing is dirty. If the instrument response is erratic or lower than expected, recalibrate or obtain a different meter and calibrate as outlined above.

4. When finished, reverse Steps 1 through 6 in "Instrument Setup" section to shut down the instrument.

QA/QC Requirements:

The instrument must undergo a 2-point calibration as described above every morning before commencement of field work. In addition, a calibration check must be performed every hour during use of the instrument. The readings from the PID will only be used in selection of proper PPE during field work and in selecting initial field-GC analytical parameter for sample analysis in the field.
SOP-31 VERTICAL AQUIFER SAMPLING THROUGH
A DUAL INFLATABLE PACKER

1. Check the condition of the well and lock for any damage or evidence of tampering, and record.

2. Remove the well cap.

3. Measure the depth to water with an electronic water-level device from the top of casing and record the measurement in the logbook. Measure the depth to the bottom of the well at this time (in order to determine if the bottom of the packers are at the bottom of the well). Record the Depths on the water sampling log.

4. Decontaminate the packers and pump assembly, and measure the length of the packer and pump assembly. Lower the packer and pump to the bottom of the well. Measure the depth to the top of the packer. Compare the depth measured to the top of the packer with the total depth less the length of the packer and pump assembly. Make adjustments until the packer is located at the bottom of the well. If the packer can not be set at the bottom of the well, record the pump interval and proceed with the groundwater sampling as follows.

5. Inflate the packer with bottled nitrogen and note the pressure, check the pressure to ensure that the packer pressure stays constant. do not inflate the pressure above the manufacturer’s recommended upper limit.

6. Start purging the well with pump set at low flow rate. Avoid surging. Observe air bubbles displaced from discharge tube to assess progress of steady pumping until water arrives at the surface. Record the start time on the water sampling log.

7. Measure the depth to water in the well again. If the measurement has changed more than 1/100th of a foot, check and record the measurement again.

8. The water level in the well should be monitored during purging, and ideally, the purge rate should equal the well recharge rate so that there is little or no draw-down in the well. (The water level should stabilize for the specific purge rate.) Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump to avoid affecting well draw-down. The well should not be purged dry. If the recharge rate of the well is so low that the well is purged dry, then wait until the well has recharged to a sufficient level and collect the appropriate volume of water for the sample with the pump.

9. During well purging, use the flow-through cell to monitor the pH, temperature, specific conductivity, dissolved oxygen, and oxidation-reduction potential. These field parameters should be recorded every 3 to 5 minutes. Visually estimate the turbidity of the groundwater samples as the water is delivered to the flow-through cell. If the field parameters measured using the flow-through cell fail to stabilize, continue to purge the well until they stabilize or three well volumes are removed.
10. A groundwater sample will be collected when either of the criteria listed below occur:
   - The field parameters stabilize to within 10 percent of the mean of three consecutive
     meter readings taken at least three minutes apart.
   - Three well volumes have been purged regardless if the meter readings have
     stabilized.

11. Once the field parameters have stabilized, collect the samples directly from the end of
    the discharge tube. Volatile organic compounds (VOCs) and analytes that degrade by
    aeration should be collected first. All sample bottles should be filled by allowing the
    water from the discharge tube to flow gently down the inside of the bottle with minimal
    turbulence. Cap each bottle as it is filled, and place in iced cooler. Record sample
    completion time on the sampling log. Turn off the pump and release the pressure in the
    packers.

12. The packer and pump assembly should be carefully raised ten feet in the well. The depth
    of the packer and pump assembly should be checked using a water level meter to
    determine the location of the top of the packer and pump assembly. The depth to the
    top of the assembly should be adjusted to locate the pump intake ten feet above the
    previous pump intake.

13. Repeat steps 5, 6, 7, 8; 9, 10, 11, 12 until the last interval is sampled.

14. Decontaminate the packer, pump and tubing using a steam cleaner and a laboratory-
    grade solution, conduct multiple rinses using potable water. Collect equipment blank as
    necessary.

15. Close and lock the well.
APPENDIX D

DATA FORMS
• Example Sample Collection Form
• Surface Soil/Sediment/Sludge Sampling Log
• Boring/Core Log
• Well Construction Log (Unconsolidated)
• Well Construction Log (Shallow Bedrock)
• Well Construction Log (Intermediate or Deep Bedrock)
• Monitoring Well Development Log
• Water Sampling Log
• Daily Log
• Sampling/Drilling Checklist
• Daily Safety Meeting and Exclusion Zone Roster
• Waste Management Report
• Groundwater Waste Management Summary
• Water Level/Pumping Test Record
• QA Review Record
• QA/QC Sample Packet Form Checklist (Soil Borings)
• QA/QC Sample Packet Form Checklist (Monitoring Wells - Unconsolidated)
• QA/QC Sample Packet Form Checklist (Monitoring Wells - Consolidated)
• QA/QC Sample Packet Form Checklist (Well Development)
• QA/QC Sample Packet Form Checklist (Well Sampling)
• QA/QC Sample Packet Form Checklist (Sediments/Sludge/Hand Augering)
• QA/QC Sample Packet Form Checklist (Surface Water/Waste Water)
• QA/QC Sample Packet Form Checklist (Geoprobe Sampling)
• Geraghty & Miller Sample Label
• Geraghty & Miller Chain-of-Custody
• Geraghty & Miller Chain-of-Custody Seal
• pH Buffer Values for Temperature Variations
• Specific Conductance Values for Temperature Variations
**EXAMPLE SAMPLE COLLECTION FORM**

**SAMPLE GROUP:** INVEST

**SAMPLE LOCATION:** SAMPLE

<table>
<thead>
<tr>
<th>SMPLID</th>
<th>BLINDID</th>
<th>MATRIX</th>
<th>ANALYSES</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLE1</td>
<td></td>
<td>SOIL</td>
<td>TCL/TAL</td>
<td></td>
</tr>
<tr>
<td>SAMPLE2</td>
<td></td>
<td>SOIL</td>
<td>METALS</td>
<td></td>
</tr>
<tr>
<td>SAMPLE4</td>
<td></td>
<td>SOIL</td>
<td>METALS</td>
<td></td>
</tr>
</tbody>
</table>

**SAMPLE GROUP:** QA

**SAMPLE LOCATION:** SAMPLE

<table>
<thead>
<tr>
<th>SMPLID</th>
<th>BLINDID</th>
<th>MATRIX</th>
<th>ANALYSES</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLE3</td>
<td>DUP_ ___ _ 96_</td>
<td>SOIL</td>
<td>METALS</td>
<td>DUPLICATE</td>
</tr>
<tr>
<td>SAMPLE1</td>
<td>EB_ ___ _ 96_</td>
<td>WATER</td>
<td>TCL/TAL</td>
<td>RINSEATE</td>
</tr>
<tr>
<td>SAMPLE3</td>
<td>FB_ ___ _ 96_</td>
<td>WATER</td>
<td>METALS</td>
<td>FILTER BLANK</td>
</tr>
<tr>
<td></td>
<td>TB_ ___ _ 96_</td>
<td>WATER</td>
<td>VOCs</td>
<td>TRIP BLANK</td>
</tr>
<tr>
<td></td>
<td>FSB_ ___ _ 96_</td>
<td>WATER</td>
<td>VOCs</td>
<td>FIELD BLANK</td>
</tr>
</tbody>
</table>

**NOTE:** Data presented above is for example purposes only

Sampler: ___________________________ Company: ___________________________ Date: ___/___/____

Sampler: ___________________________ Company: ___________________________ Date: ___/___/____
SURFACE SOIL/SEDIMENT/SLUDGE SAMPLING LOG

Project/No.: Alcoa-Davenport Works/OH

Site Location: 

Sample Location: 

Weather: 

Sampling Method and Material: 

<table>
<thead>
<tr>
<th>Depth (inches)</th>
<th>HNU (ppm)</th>
<th>OVA (ppm)</th>
<th>Soil/Sediment/Sludge Description*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks

Sampling Personnel/Company

*Define color, soil type, minor constituents, plasticity, moisture content.

**Moisture Content**

- DRY - very low moisture content, “running sand”
- MOIST - intermediate moisture content, grains darkened by surface water
- WET - visible free water, soil sample from a water-bearing zone

**Plasticity (Define fine-grained soil only)**

- NON-Plastic - 1/8” (3mm) thread can not be rolled
- LOW - 1/8” (3mm) thread barely can be rolled
- MEDIUM - 1/8” (3mm) thread easily and quickly rolled
- HIGH - 1/8” (3mm) thread takes time and kneading to be rolled
**BORING/CORE LOG**

- **Project:**
- **Site Location:** ALCOA-DAVENPORT WORKS
- **Boring/Well ID:**

<table>
<thead>
<tr>
<th>Sample/Core Depth (ft below land surface)</th>
<th>Core Recovery (feet)</th>
<th>Time</th>
<th>Blows per 6 inches</th>
<th>HNU (ppm)</th>
<th>OVA (ppm)</th>
<th>Sample/Core Description*</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Total Depth Augered:** feet
- **Hole Diameter:** inches
- **Total Depth Sampled:** feet
- **Hammer Weight:** 140 lbs.
- **Depth to Bedrock:**
- **Drilling Method:**
- **Drilling Fluid Used:**

- **Drilling Contractor**
- **Driller:**
- **Helper:**
- **Type of Sample/Coring Device:**
  - 2 in. x 2 ft. & 3 in. x 2 ft. split spoon
- **Sampling Interval:**

---

**Moisture Content**
- **DRY** - very low moisture content, "running sand"
- **MOIST** - intermediate moisture content, grains darkened by surface water
- **WET** - visible free water, soil sample from a water-bearing zone

**Plasticity** (defines fine-grained soil only)
- **NON-PLASTIC** - 1/8" (3mm) thread cannot be rolled
- **LOW** - 1/8" (3mm) thread barely can be rolled
- **MEDIUM** - 1/8" (3mm) thread easily and quickly rolled
- **HIGH** - 1/8" (3mm) thread takes time and kneading to be rolled

---

*Define color, soil type, minor constituents, plasticity, moisture content.*
# BORING/CORE LOG

(Continued)

**Boring/Well ID:**

**Site Location:** ALCOA-DAVENPORT WORKS

**Prepared by:**

<table>
<thead>
<tr>
<th>Sample/Core Depth (ft below land surface)</th>
<th>Core Recovery (feet)</th>
<th>Blows per 6 inches</th>
<th>HNU (ppm)</th>
<th>OVA (ppm)</th>
<th>Sample/Core Description*</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/ / /</td>
<td>/ / /</td>
<td>/ / /</td>
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<td>/ / /</td>
</tr>
</tbody>
</table>

*Define color, soil type, minor constituents, plasticity, moisture content.

**Moisture Content**
- **DRY** - very low moisture content, "running sand"
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**Plasticity (Defines fine-grained soil only)**
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- **HIGH** - 1/8" (3mm) thread takes time and kneading to be rolled
# Log of Boring: CHSB-5

## ALCOA/86 INCH LINE

### Davenport, Iowa

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Blows (/6 in.)</th>
<th>Recovery (Feet)</th>
<th>OVA- (ppm)</th>
<th>Sample</th>
<th>Graphic Log</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CONCRETE: floor.</td>
</tr>
<tr>
<td>3-4-5</td>
<td></td>
<td>0.3</td>
<td>NR</td>
<td></td>
<td></td>
<td>SAND &amp; GRAVEL: dry, brn, f-cs sand, silt, clay, f-cs gravel, crumbly.</td>
</tr>
<tr>
<td>3-4-3-8</td>
<td></td>
<td>1.3</td>
<td>0.0</td>
<td></td>
<td></td>
<td>CLAY: gray clays with tr f-cs gravel, dry-damp, cohesive, pliable.</td>
</tr>
<tr>
<td>2-2-3-2</td>
<td></td>
<td>0.8</td>
<td>0.0</td>
<td></td>
<td></td>
<td>Same as above with no tr gravel.</td>
</tr>
<tr>
<td>1-1-2-3</td>
<td></td>
<td>1.3</td>
<td>0.0</td>
<td></td>
<td></td>
<td>CLAY: gray clays (10%), clay (90%), pliable, cohesive, damp.</td>
</tr>
<tr>
<td>15-</td>
<td></td>
<td>1.5</td>
<td>0.0</td>
<td></td>
<td></td>
<td>CLAY &amp; SILT: gray clays (10%), clay (85%), damp, cohesive, pliable.</td>
</tr>
<tr>
<td>1/50 (3&quot;)</td>
<td></td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td>CLAY: dk gray dry clay (90%), silt (10%); moist, cohesive, pliable.</td>
</tr>
</tbody>
</table>

### Notes:
- **OVA readings presented are results of headspace analyses.**
- **Limestone bedrock at 13.0 ft.**

---

**Drilling Co.:** Terracon  
**Geologist:** R. Astle  
**Total Depth:** 13.25  
**Surface Elev.:**  
**Datum:** Feet, MSL  
**Begin Drilling:** 7/22/91  
**End Drilling:** 7/22/91  
**Converted to Well:** No  
**Well Name:**  
**Well Coor.:**  
**South Coor.:**  
**Remarks:** Continuous Split-Spoon Sampling.
WELL CONSTRUCTION LOG
(UNCONSOLIDATED)

Above Ground Casing: Flush Mount

Pea Gravel

Locking Protective Cap

Well Stick-up: ft. Above Land Surface

LAND SURFACE

Sackrete

-inch Diameter Borehole

Well Riser, inch inside Diameter, (Stainless Steel / PVC)

Bentonite-Amended Cement Slurry

Total # of 94lb Bags Cement

Total Pounds Bentonite

Top of Bentonite Seal: ft. (BLS)*

Top of Sand Pack: ft. (BLS)*

Top of Screen: ft. (BLS)*

ft of -inch inside diameter,
PVC well screen slot size

Sand Pack: # Bags,
Grainsize

Bottom of Screen: ft. (BLS)*

-Inch Bottom Cap

Bottom of Borehole: ft. (BLS)*

*BLS = Below Land Surface

Project:

Site Location: Alcoa-Davenport Works

Well ID:

Installation Date(s):

Drilling Method: Hollow Stem Auger

Drilling Contractor:

Remarks:

Grout used to set casing will be 2-5% by weight bentonite amended cement (2 pint jars of bentonite per 94 lb bag type 1 cement).

Constructed By:

Company:
**WELL CONSTRUCTION LOG**

**(SHALLOW BEDROCK)**

- **Above Ground Casing**: ______, **Flush Mount**: ______
- **Locking Protective Cap**
- **Well Stick-up**: ______ ft. Above Land Surface
- **LAND SURFACE**
- **Sackrete**
- **Pea Gravel**
- **ft. Above Land Surface**
- **Well Slick-up Surface**
- **LAND SURFACE**
- **Drill Through LAND SURFACE**
- **Sackrete**
- **-inch Diameter Borehole**
- **Well Riser**: ______-inch inside Diameter, (Stainless Steel / PVC)
- **-inch Diameter Outer Steel Casing**
- **Bentonite-Amended Cement Slurry**
  - Total # of 94lb Bags Cement: ______
  - Total Pounds Bentonite: ______
  - Total # of 94lb Bags Cement: ______
  - Total Pounds Bentonite: ______
- **Top of Bedrock**: ______ ft. (BLS)*
  - **Formation**: ______
- **Bottom of Outer Steel Casing**: ______ ft. (BLS)*
  - **-inch Diameter Borehole**
- **Top of Bentonite Seal**: ______ ft. (BLS)*
- **Top of Sand Pack**: ______ ft. (BLS)*
- **Top of Screen**: ______ ft. (BLS)*
  - **PVC well screen, slot size**: ______
- **Sand Pack**: ______ # Bags, **Grainsize**: ______
- **Bottom of Screen**: ______ ft. (BLS)*
  - **Inch Bottom Cap**
- **Bottom of Borehole**: ______ ft. (BLS)*

* BLS = Below Land Surface

---

**Project:**

**Site Location:** *Alcoa-Davenport Works*

**Well ID:** ____________________________

**Installation Date(s):** __________________

**Drilling Method:** *Hollow Stem (air compressor)/ Air Rotary*

**Drilling Contractor:** __________________

**Remarks:**

Grout used to set casing will be 2-5% by weight bentonite amended cement (2 pint jars of bentonite per 94 lb bag type 1 cement).

**Total of 94lb Bags Cement**: ______

**Total Pounds Bentonite**: ______

**Top of Bedrock**: ______ ft. (BLS)*

**Bottom of Outer Steel Casing**: ______ ft. (BLS)*

**Top of Bentonite Seal**: ______ ft. (BLS)*

**Top of Sand Pack**: ______ ft. (BLS)*

**Top of Screen**: ______ ft. (BLS)*

**PVC well screen, slot size**: ______

**Sand Pack**: ______ # Bags, **Grainsize**: ______

**Bottom of Screen**: ______ ft. (BLS)*

**Inch Bottom Cap**

**Bottom of Borehole**: ______ ft. (BLS)*

**BLS = Below Land Surface**

---

**Geraghty & Miller, Inc.**

---

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WELL CONSTRUCTION LOG
(INTERMEDIATE or DEEP BEDROCK)

Project:

Site Location: Alcoa-Davenport Works

Well ID: __________________________

Installation Date(s): __________________________

Drilling Method: Hollow Stemed air compressor/Air Rotary

Drilling Contractor: __________________________

Remarks:
Grout used to set casing will be 2.5% by weight bentonite amended cement (2 pint jars of bentonite per 94 lb bag type I cement).

Top of Bedrock ________ ft. (BLS)*
Formation __________________________

Bottom of Outer Steel Casing ________ ft. (BLS)*

_______-inch Diameter Borehole

Bentonite-Amended Cement Slurry
Total # of 94 lb Bags Cement __________
Total Pounds Bentonite __________

Bentonite-Amended Cement Outer Casing Slurry
Total # of 94 lb Bags Cement __________
Total Pounds Bentonite __________

Top of Bedrock ________ ft. (BLS)*
Formation __________________________

Bottom of Outer Steel Casing ________ ft. (BLS)*

_______-inch Diameter Borehole

_______-inch Diameter Inner Steel Casing

Bottom of Inner Steel Casing ________ ft. (BLS)*

Top of Open Hole ________ ft. (BLS)*

_______-inch Diameter Borehole

_______-inch Diameter Outer Steel Casing

_______-inch Diameter Borehole

Top of Land Surface ________ ft.

Bottom of Borehole ________ ft. (BLS)*

Bottom of Well ________ ft. (BLS)*

* BLS = Below Land Surface

Construcled By: __________________________

Company: __________________________
MONITORING WELL DEVELOPMENT LOG

Project: ____________________________
Site Location: ALCOA-DAVENPORT WORKS
Well ID: ____________________________
Date: ______/____/19
Developers: ____________________________

Calibration Check:

pH Meter ID: ______________
pH 4.0 = ______ at ______ °C
pH 7.0 = ______ at ______ °C
pH 10.0 = ______ at ______ °C

Specific Conductivity Meter ID: ______________
Standard ______ (umhos/cm) at ______ °C
Reading ______ (umhos/cm) at ______ °C

Well Casing Volumes (gal/ft):
2 in. = 0.16
5 in. = 1.02
8 in. = 2.61
4 in. = 0.65
6 in. = 1.47

<table>
<thead>
<tr>
<th>Time</th>
<th>Interval Volume Purged (gal)</th>
<th>pH</th>
<th>Specific Conductivity (umhos/cm)</th>
<th>Temp (°C)</th>
<th>HNU (ppm)</th>
<th>OVA (ppm)</th>
<th>Turbidity (NTU)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>0</td>
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</table>

1. All measurements taken from top of well casing, unless otherwise noted.
2. Take a duplicate water-level measurement once per day or every five wells, whichever is greater.
3. Take quadruplicate pH, specific conductance, and temperature readings once per sample location.
4. Calibrated specific conductivity and pH vary with temperature. Refer to specific conductivity and pH temperature variance tables included in this packet.
**MONITORING WELL DEVELOPMENT LOG**

(Continued)

Site Location: *ALCOA DAVENPORT WORKS*

Well ID: ______________

<table>
<thead>
<tr>
<th>Time</th>
<th>Interval Volume Purged (gal)</th>
<th>pH</th>
<th>Specific Conductivity (umhos/cm)</th>
<th>Temp (°C)</th>
<th>HNU (ppm)</th>
<th>OVA (ppm)</th>
<th>Turbidity (NTU)</th>
<th>Comments</th>
</tr>
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<tbody>
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</tbody>
</table>
### WATER SAMPLING LOG

**PROJECT:**

**SITE LOCATION:** ALCOA-DAVENPORT WORKS

**SAMPLE LOCATION:**

**SAMPLING PERSONNEL:**

**DATE:** / /19

**TIME SAMPLING BEGAN:**

**TIME SAMPLING COMPLETED:**

**COMPANY:**

---

**EVACUATION DATA**

<table>
<thead>
<tr>
<th>Total sounded depth of well below MP (ft.)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplicate (ft.)</td>
<td></td>
</tr>
<tr>
<td>Depth to Water Below MP (ft.)</td>
<td></td>
</tr>
<tr>
<td>Duplicate (ft.)</td>
<td></td>
</tr>
<tr>
<td>Water column in well (ft.)</td>
<td></td>
</tr>
<tr>
<td>Diameter of casing inches gal/ft</td>
<td></td>
</tr>
</tbody>
</table>

**Well Volume**

<table>
<thead>
<tr>
<th>Gallons purged prior to sampling</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>calculated actual</td>
<td></td>
</tr>
</tbody>
</table>

**Well Casing Volumes (gal/ft.)**

- 2 in. = 0.16
- 4 in. = 0.65
- 5 in. = 1.02
- 6 in. = 1.45
- 8 in. = 2.61

**FILTER SIZE (MICRONS) FOR METALS SAMPLES ONLY**

- 5
- 5.0
- None

---

**FIELD PARAMETERS PER WELL VOLUME PURGED**

<table>
<thead>
<tr>
<th>Well Volume Interval</th>
<th>pH</th>
<th>Spec. Cond. (μmhos/cm)</th>
<th>Temp (°C)</th>
<th>HNU (ppm)</th>
<th>OVA (ppm)</th>
<th>Turbidity (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1</td>
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<tr>
<td>5</td>
<td></td>
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</tbody>
</table>

**COLOR, ODOUR, APPEARANCE**

- Color
- Odor
- Appearance

**MARKS:**

**NOTE:** pH and specific conductivity varies with temperature. Refer to pH and specific conductivity temperature variance charts included in this packet. For health and safety purposes, water samples are not to be checked for odor.
DAILY LOG

BACKGROUND READINGS

SITE LOCATION: ALCOA-DAVENPORT WORKS

HNU Meter ID
Calibration Gas Lot# ____________________________
Background ____________________________ ppm
OVA/HNU Meter ID______________________________
Calibration Gas Lot #______________________________
Background: ____________________________ ppm
MGI Meter ID: ________________________________
Background: ________________________________
Noise Meter ID: ________________________________
Background: ________________________________ dB
During Drilling: ________________________________ dB

NOTE: OVA/HNU calibration must be checked once every four hours.

Sample Location:__________________________

All Personnel Present:
________________________________________
________________________________________
________________________________________

Company:__________________________________

Weather:__________________________________
Temperature:______________________________
Wind:____________________________________

Level of Protection:__________________________

<table>
<thead>
<tr>
<th>TIME</th>
<th>COMMENTS/ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Page 1 of ___
## DAILY LOG
(continued)

Date ___/___/19___
Page ___ of ___
SITE LOCATION: **ALCOA-DAVENPORT WORKS**
SAMPLE LOCATION: ____________

<table>
<thead>
<tr>
<th>TIME</th>
<th>COMMENTS/ACTIVITIES</th>
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<tbody>
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</tr>
</tbody>
</table>
Date ____/____/19____
Page ____ of ____
SITE LOCATION: **ALCOA-DAVENPORT WORKS**
SAMPLE LOCATION: ________________

<table>
<thead>
<tr>
<th>TIME</th>
<th>COMMENTS/ACTIVITIES</th>
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<tbody>
<tr>
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</tr>
</tbody>
</table>
# SAMPLING/DRILLING CHECKLIST

**PROJECT:**

**SITE LOCATION:** ALCOA-DAVENPORT WORKS

**SAMPLE LOCATION:**

**DATE:** ___/___/19___

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>OK/NA</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring equipment signed out</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Health and Safety Plan (HASP) present</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Sampling Plan available</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Ice packs, temperature bottles, and trip blanks placed in cooler</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Sampling/monitoring equipment clean and operational</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Well materials steam cleaned and wrapped in plastic for transport to the site</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Contractor equipment clean and operational</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Drilling equipment steam cleaned</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Integrity of well noted</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Sample area prepared; plastic placed around well; gasoline generators placed downwind</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Field/health and safety instruments calibration checked and documented</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Sample containers labeled; preservatives added, if necessary</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Appropriate PPE donned</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>QA/QC samples collected according to sampling procedures</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Samples stored at 4°C in coolers for transport to lab</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Sampling log, sample collection form, and chain-of-custody forms completed and signed</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Reusable equipment decontaminated; non-reusable equipment disposed of in appropriate manner</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Well secured and locked</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Drums properly closed and labeled</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Waste management report completed</td>
<td>☐ ☐</td>
<td></td>
</tr>
<tr>
<td>Monitoring equipment signed in</td>
<td>☐ ☐</td>
<td></td>
</tr>
</tbody>
</table>
DAILY SAFETY MEETING
AND
EXCLUSION ZONE ROSTER

DATE: __/___/19__
SAMPLE LOCATION:

<table>
<thead>
<tr>
<th>TIME IN</th>
<th>ATTENDED DAILY SAFETY MEETING</th>
<th>NAME</th>
<th>SIGNATURE</th>
<th>FULLY DECON</th>
<th>TIME OUT</th>
</tr>
</thead>
<tbody>
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</table>

NOTE: All field personnel are required to attend the daily safety meeting regardless of exclusion zone entry.
# WASTE MANAGEMENT REPORT

**DATE:** ___/___/19___  
**PROJECT:** ______________________  
**SITE LOCATION:** ALCOA-DAVENPORT WORKS  
**SAMPLE LOCATION ID:** ______________________

<table>
<thead>
<tr>
<th></th>
<th>Number of Full Drums</th>
<th>Number of Partial Drums (Record Volumes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOIL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOIL (SUSPECTED PCB-CONTAMINATED WASTE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WASHWATER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BURNABLES (PPE, plastic, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUNDWATER *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTHER (EXPLAIN)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL NUMBER OF DRUMS</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Prepared by: ____________________________

MAKE SURE THE FOLLOWING INFORMATION IS LABELED ON EACH DRUM BEFORE LEAVING SITE.

1. SAMPLE LOCATION ID  
2. START DATE  
3. FILLED OR FINISH DATE  
4. DEPTH OF DRILL CUTTINGS (if applicable)

* Groundwater Waste Management Summary must be completed per well location following groundwater sampling activities.
Date: ___/___/19

Project: __________________________

Well ID: __________________ Well Location: __________________________

Total Number of Drums: ______ Estimated Total Volume: ________________

Drum IDs: __________________________

**Historical Sampling Information**

<table>
<thead>
<tr>
<th>Contaminants</th>
<th>Concentrations</th>
<th>Sampling Event/Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Field Action:**

- [ ] No carbon treatment necessary.
- [ ] Carbon treatment to below MCL.
- [ ] Oily-waste relinquished to on-site waste treatment personnel.

**Carbon Treatment Results:**

- [ ] Not applicable.
- [ ] Treatment results meet treatment standards.
- [ ] Treatment results do not meet treatment standards. Groundwater will be retreated.

Retreatment date (if applicable): ___/___/19

- [ ] Retreatment results meet treatment standards.

**Disposal Action:**

- [ ] Disposal of water on ground (on-site).
- [ ] Relinquish waste-water to on-site waste treatment personnel.

**Attachments (if applicable):** Treatment analytical results
# WATER LEVEL/PUMPING TEST RECORD

**PROJECT**

**WELL**

**SITE**

**SCREEN**

**MEASURING POINT**

**DESCRIPTION**

**HEIGHT ABOVE GROUND SURFACE**

**STATIC**

**MEASURED WITH**

**DATE/TIME**

**WATER LEVEL**

**DRAWDOWN**

**START OF TEST**

**PUMPING WELL**

**RECOVERY**

**END OF TEST**

**DISTANCE FROM WELL MEASURED TO PUMPING WELL**

**DISTANCE MEASURED TO PUMPING WELL (r)**

<table>
<thead>
<tr>
<th>DATE &amp; TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>WELL OR (mins)</td>
</tr>
<tr>
<td>HELD (ft)</td>
</tr>
<tr>
<td>WET (ft)</td>
</tr>
<tr>
<td>DEPTH TO WATER (ft)</td>
</tr>
<tr>
<td>s (ft)</td>
</tr>
<tr>
<td>DEW. (ft)</td>
</tr>
<tr>
<td>CORR. (ft)</td>
</tr>
<tr>
<td>ART. (ft)</td>
</tr>
<tr>
<td>Q (gpm)</td>
</tr>
<tr>
<td>MANOMETER (in)</td>
</tr>
<tr>
<td>REMARKS</td>
</tr>
</tbody>
</table>

1) Dewatering Correction  2) Equivalent Artesian Drawdown  3) pH, Spec. Cond., Temp., Weather, Sand, Turbidity, etc.
<table>
<thead>
<tr>
<th>Item #</th>
<th>QA Deficiencies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Item #</th>
<th>Corrective Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
QA/QC SAMPLE PACKET FORM CHECKLIST
SOIL BORINGS

FORMS
☐ QA REVIEW RECORD
☐ SAMPLE COLLECTION FORM
☐ BORING CORE LOG(S)
☐ DAILY LOG(S)
☐ SAMPLING/DRILLING CHECKLIST
☐ DAILY SAFETY MEETING AND EXCLUSION ZONE ROSTER
☐ QUANterra LAB CHAIN-OF-CUSTODY
☐ NET CHAIN-OF-CUSTODY
☐ OTHER CHAIN-OF-CUSTODY-
☐ FEDERAL EXPRESS AIRBILL COPY
☐ WASTE MANAGEMENT REPORT (Submit a copy to Waste Management)

NOTE:
Forms should be organized in packets in the order listed above.

UPON RECEIPT OF A PACKET:
- Remove waste management report and place in waste management report in-box
- Place forms in order, making sure that all are present and add QA/QC record
- Review forms for completeness (see daily log in memos)
- Add Quanterra and NET COC forms
- Return to appropriate personnel for corrections
- Fill out QA Review Record and mark upper right-hand corner of each sheet the quadrant number and site location
- Keep record of packet submission dates
QA/QC SAMPLE PACKET FORM CHECKLIST
MONITORING WELLS (UNCONSOLIDATED)

FORMS

☐ QA REVIEW RECORD
☐ SAMPLE COLLECTION FORM
☐ BORING CORE LOG(S)
☐ DAILY LOG(S)
☐ SAMPLING/DRILLING CHECKLIST
☐ DAILY SAFETY MEETING AND EXCLUSION ZONE ROSTER
☐ QUANterra LAB CHAIN-OF-CUSTODY
☐ NET CHAIN-OF-CUSTODY
☐ OTHER CHAIN-OF-CUSTODY-
☐ FEDERAL EXPRESS AIRBILL COPY
☐ WASTE MANAGEMENT REPORT (Submit a copy to Waste Management)
☐ WELL CONSTRUCTION LOG (UNCONSOLIDATED)

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- Place forms in order, making sure that all are present and add QA/QC record
- Review forms for completeness (see daily log memos)
- Add Quanterra and NET COC forms
- Return to appropriate personnel for corrections
- Fill out QA Review Record and mark upper right-hand corner of each sheet quadrant
  number and site location
- Keep record of packet submission dates
QA/QC SAMPLE PACKET FORM CHECKLIST
MONITORING WELLS
(CONсолИDАTED)

FORMS
- QA REVIEW RECORD
- SAMPLE COLLECTION FORM
- BORING CORE LOG(S)
- DAILY LOG(S)
- SAMPLING/DRILLING CHECKLIST
- DAILY SAFETY MEETING AND EXCLUSION ZONE ROSTER
- SPECIAL OCCURRENCES LOG
- QUANterra LAB CHAIN-OF-CUSTODY
- NET CHAIN-OF-CUSTODY
- OTHER CHAIN-OF-CUSTODY_____________________
- FEDERAL EXPRESS AIRBILL COPY
- WASTE MANAGEMENT REPORT (Submit a copy to Waste Management)
- WELL CONSTRUCTION LOG (CONSOLIDATED)

NOTE:
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- Review forms for completeness (see daily log memos)
- Add Quanterra and NET COC forms
- Return to appropriate personnel for corrections
- Fill out QA Review Record and mark upper right-hand corner of each sheet quadrant number and site location
- Keep record of packet submission dates

monwelco.bt
QA/QC SAMPLE PACKET FORM CHECKLIST
WELL DEVELOPMENT

FORMS

☐ QA REVIEW RECORD
☐ WELL DEVELOPMENT LOG(S)
☐ DAILY LOG(S)
☐ SAMPLING/DRILLING CHECKLIST
☐ DAILY SAFETY MEETING AND EXCLUSION ZONE ROSTER
☐ WASTE MANAGEMENT REPORT (Submit a copy to Waste Management)
☐ TEMPERATURE VARIATIONS FOR PH AND SPECIFIC CONDUCTANCE VALUES

NOTE:
Forms should be organized in packets in the order listed above.

UPON RECEIPT OF PACKET:
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- Place forms in order, making sure that all are present and add QA/QC record
- Review forms for completeness (see daily log memos)
- Return to appropriate personnel for corrections
- Fill out QA Review Record and mark upper right-hand corner of each sheet quadrant number and site location
- Keep record of packet submission dates
QA/QC SAMPLE PACKET FORM CHECKLIST
WELL SAMPLING

FORMS
☐ QA REVIEW RECORD
☐ SAMPLE COLLECTION FORM
☐ WATER SAMPLING LOG
☐ DAILY LOG(S)
☐ SAMPLING/DRILLING CHECKLIST
☐ QUANTERRA LAB CHAIN-OF-CUSTODY
☐ NET CHAIN-OF-CUSTODY
☐ OTHER CHAIN-OF-CUSTODY-
☐ FEDERAL EXPRESS AIRBILL COPY
☐ WASTE MANAGEMENT REPORT (Submit a copy to Waste Management)
☐ TEMPERATURE VARIATIONS FOR PH AND SPECIFIC CONDUCTANCE VALUES

NOTE:
Forms should be organized in packets in the order listed above.

UPON RECEIPT OF PACKET:
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- Review forms for completeness (see daily log memos)
- Add Quanterra and NET COC forms
- Return to appropriate personnel for corrections
- Fill out QA Review Record and mark upper right-hand corner of each sheet quadrant number and site location
- Keep record of packet submission dates
QA/QC SAMPLE PACKET FORM CHECKLIST
SEDIMENTS/SLUDGE/HAND AUGERING

FORMS

☐ QA REVIEW RECORD
☐ SAMPLE COLLECTION FORM
☐ SURFACE SOIL/SEDIMENT/SLUDGE SAMPLING LOG(S)
☐ DAILY LOG(S)
☐ SAMPLING/DRILLING CHECKLIST
☐ DAILY SAFETY MEETING AND EXCLUSION ZONE ROSTER
☐ QUANterra LAB CHAIN-OF-CUSTODY
☐ NET CHAIN-OF-CUSTODY
☐ OTHER CHAIN-OF-CUSTODY- ________________
☐ FEDERAL EXPRESS AIRBILL COPY
☐ WASTE MANAGEMENT REPORT (Submit a copy to Waste Management)

NOTE:

Forms should be organized in packets in the order listed above.

UPON RECEIPT OF PACKET:

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- Place forms in order, making sure that all are present and add QA/QC record
- Review forms for completeness (see daily log memos)
- Add Quanterra and NET COC forms
- Return to appropriate personnel for corrections
- Fill out QA Review Record and mark upper right-hand corner of each sheet quadrant
  number and site location
- Keep record of packet submission dates
QA/QC SAMPLE PACKET FORM CHECKLIST
SURFACE WATER/WASTE WATER

FORMS

☐ QA REVIEW RECORD
☐ SAMPLE COLLECTION FORM
☐ WATER SAMPLING LOG
☐ DAILY LOG(S)
☐ SAMPLING/DRILLING CHECKLIST
☐ DAILY SAFETY MEETING AND EXCLUSION ZONE ROSTER
☐ QUANterra LAB CHAIN-OF-CUSTODY
☐ NET CHAIN-OF-CUSTODY
☐ OTHER CHAIN-OF-CUSTODY- ________________________
☐ FEDERAL EXPRESS AIRBILL COPY
☐ TEMPERATURE VARIATIONS FOR PH AND SPECIFIC CONDUCTANCE VALUES
☐ WASTE MANAGEMENT REPORT (Submit a copy to Waste Management)

NOTE:
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- Fill out QA Review Record and mark upper right-hand corner of each sheet quadrant number and site location
- Keep record of packet submission dates
QA/QC SAMPLE PACKET FORM CHECKLIST
GEOPROBE SAMPLING

FORMS

☐ QA REVIEW RECORD
☐ SAMPLE COLLECTION FORM
☐ SOIL SAMPLING LOG
☐ WATER SAMPLING LOG
☐ DAILY LOG(S)
☐ SAMPLING/DRILLING CHECKLIST
☐ DAILY SAFETY AND EXCLUSION ZONE ROSTER
☐ QUANterra LAB CHAIN-OF-CUSTODY
☐ NET CHAIN-OF-CUSTODY
☐ OTHER CHAIN-OF-CUSTODY-
☐ FEDERAL EXPRESS AIRBILL COPY
☐ WASTE MANAGEMENT REPORT (Submit a copy to Waste Management)
☐ TEMPERATURE VARIATIONS FOR PH AND SPECIFIC CONDUCTANCE VALUES

NOTE: Forms should be organized in packets in the order listed above.

UPON RECEIPT OF PACKET:

- Remove waste management report and place in waste management report in-box
- Place forms in order, making sure that all are present and add QA/QC record
- Review forms for completeness (see daily log memos)
- Add Quanterra and NET COC forms
- Return to appropriate personnel for corrections
- Fill out QA Review Record and mark upper right-hand corner of each sheet quadrant number and site location
- Keep record of packet submission dates
ALCOA DAVENPORT WORKS

GERAGHTY & MILLER, INC.
Environmental Services

Project No: 
Date: ___/___/9 Time: ___:
Sample ID: 
Analysis: 
Preservative: Matrix: 
Collection Mode: 
Sampler(s): ___________________________
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Sample Code:  
L = Liquid;  
S = Solid;  
A = Air

Relinquished by:  
Organization:  
Date / / Time  
Seal Intact?  
Yes No N/A

Received by:  
Organization:  
Date / / Time  
Seal Intact?  
Yes No N/A

Relinquished by:  
Organization:  
Date / / Time  
Seal Intact?  
Yes No N/A

Received by:  
Organization:  
Date / / Time  
Seal Intact?  
Yes No N/A

Special Instructions/Remarks:

Delivery Method:  
☐ In Person  
☐ Common Carrier  
☐ Lab Courier  
☐ Other  
SPECIFY
### pH Buffer values for temperature variations.

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Specific Conductance Values for Temperature Variations.

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*Values are for the 1413 Micro mhos/cm standard.*
APPENDIX E

LABORATORY REPORTABLES
LABORATORY REPORTING REQUIREMENTS

I. LABORATORY REPORTABLES:

The following information will be included in the data package for each sample where applicable:

A. General Information:
   1. The results of samples analyses.
   2. The parameters of interest.
   3. The method of analysis.
   4. The detection limits of analyses.
   5. A master list of laboratory tracking I.D. numbers correlated with field sampling I.D. numbers and sample analyses batch identification to correlate QA samples to sample analysis batch.
   6. Sample collection date.
   7. Sample received date.
   8. Sample preparation/extraction date.
   9. Sample analysis date.
  10. Copy of the chain-of-custody form signed by the laboratory sample custodian.
  11. A narrative summary identifying any QA or sample problems encountered, sample manipulation (dilutions), and the corrective action taken.
  12. Sequential measurement readout records.
  13. Digestion logs.
  15. Raw data calculation worksheets.

B. Inorganics Analyses:

For inorganic analyses involving the use of atomic absorption (flame of furnace), inductively coupled plasma (ICP), ion chromatograph (IC), light (visible or ultraviolet), spectrophotometric methods, other turbidimetric, gravimetric, and autoanalyzer procedures, the following QA data should be provided where applicable:

1. Concentration of calibration curve standards.
2. Results of sample specific initial and continuing calibration verification standards (ICVS and CCVS), percent recoveries, and expected values.
3. Results of sample specific laboratory control samples (LCS) spiked into a reagent water and carried through the preparation method prior to analysis (may also be called QC check sample or digested spike), expected value, percent recovery, and control limits.
4. Results of method (laboratory control) blank analyses.
5. Results of interference check sample (ICS) analyses and expected values (ICP) only.
6. Results of a dilution check sample and the expected value (ICP only).
7. Results of laboratory duplicate analyses.
8. Results of sample-specific matrix spike (digested spike) analyses.
9. Results of sample-specific analytical (posted-digested) spike analyses (furnace AAS only).
Organic Analyses

1. Gas Chromatography (GC):

   For analyses by GC, the following should be provided where applicable:

   a. Results of blanks:
      1. Water blanks: purgeables analysis;
      2. Sample preparation extraction (method) blanks;
      3. Trip blanks.

   b. Results of latest independent QC check samples analyzed, expected value, and percent recovery;

   c. Results of matrix spikes and calculated percent recovery, control limit, and source—matrix spikes must be sample-specific for submitted sample batches;

   d. Results of matrix spike duplicates, calculated percent recoveries for matrix spike duplicate, relative percent difference (RPD) between matrix spike and matrix duplicate, control limits, and source; if matrix spike duplicate analyzed—matrix spike duplicates must be sample-specific for submitted sample batches;

   e. Results of laboratory duplicates, RPD, control limits, and source (lab duplicates must be sample specific for samples submitted);

   f. Results of surrogate spikes, percent recoveries, control limits, and source;

   g. Results of blank spike analysis for organic matrix spike parameters not meeting matrix spike recovery requirements.

2. Gas Chromatography/Mass Spectrometer (GC/Mass Spec.);

   For analyses by GC/Mass Spec., the following should be provided where applicable:

   a. Results of tuning with BFB or DFTPP that indicates compliance with acceptance criteria;

   b. Results of initial and continuing calibration standards for all volatile organic and semi-volatile organic compounds as appropriate, including results of system performance check compounds (SPCC) and calibration check compounds (GCC);
c. Results of water blanks, extraction (method) blanks analyses and trip blanks;

d. Results of matrix spike and matrix spike duplicates, percent recoveries, and control limits--matrix spikes must be sample-specific for submitted sample batches;

e. Results of surrogate spike recoveries, and control limits;

f. Results of calculation of relative percent difference (RPD) between matrix spike/matrix spike duplicate and RPD control limits;

g. Results of latest independent quality control (EPA or NBS traceable) check samples analyzed (include Lot. no. and manufacturer of standard source), and the control value expected for each parameter;

h. Results of blank spike analysis for matrix spike or matrix spike duplicate parameters not meeting recovery requirements.