Hazardous Waste Section

File Room Document Transmittal Sheet

Your Name:	Mary Siedlecki
EPA ID:	N C D 0 0 3 1 8 5 2 3 8
Facility Name:	Alcatel
Document Group:	Groundwater (GW)
Document Type:	Other (O)
Description:	Sampling and Analysis Plan March 2013
Date of Doc:	3/11/2013
Author of Doc:	Amec

File Room Use Only

	Month	Day	Year	
Date Recieved by File Room:				Scanner's Initials:
Date Scanned:				

March 11, 2013

Ms. Mary Siedlecki, Hydrogeologist
NC Department of Environment and Natural Resources
Hazardous Waste Section, Waste Management Division
1646 Mail Service Center
Raleigh, North Carolina 27699-1646

Reference: **GROUNDWATER SAMPLING AND ANALYSIS PLAN**
FORMER ALCATEL SOURCING FACILITY
2912 WAKE FOREST ROAD, RALEIGH, NC
FACILITY ID NO.: NCD 003-185-238

Dear Ms. Siedlecki:

On behalf of Alcatel-Lucent USA, Inc., AMEC Environment & Infrastructure, Inc. is pleased to submit a copy of the Groundwater Sampling and Analysis Plan for the former Alcatel facility located at 2912 Wake Forest Road in Raleigh, North Carolina.

For your convenience we have also included a compact disc that contains an electronic version of the report. If you have any questions or comments regarding this report, please do not hesitate to contact me at (919) 381-9900.

Sincerely,

AMEC Environment & Infrastructure, Inc.

Harold M. Thurston, L.G.
Senior Project Manager

Cc: Steve Oberkrom – Alcatel-Lucent USA, Inc.

AMEC Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, NC 27703
www.amec.com
Tel – (919) 381-9900
Fax – (919) 381-9901

GROUNDWATER SAMPLING AND ANALYSIS PLAN
FORMER ALCATEL FACILITY
2912 WAKE FOREST ROAD
RALEIGH, NORTH CAROLINA 27609
NCD 003-185-238

Submitted To:
North Carolina Department of Environment
and Natural Resources
Division of Waste Management,
Hazardous Waste Section

Prepared For:
Alcatel-Lucent USA Inc.
2301 Sugar Bush Road
Raleigh, North Carolina 27612-3382

Prepared by Consultant:
AMEC Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, North Carolina 27703

March 11, 2013

AMEC Project No. 565280000

Bonani Langan, P.E.
Remediation Engineer

Harold M. Thurston, L.G.
Senior Project Manager

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Site History 1
1.2 Scope of Sampling Effort 1
1.3 Project Organization 1
1.4 Sampling and Analysis Plan Objectives 2

2.0 BACKGROUND 2
2.1 Site Description 2
2.2 Operational History 3
2.3 Previous Investigations/Regulatory Involvement 3
2.4 Site Geology and Hydrogeology 5
2.5 Environmental and/or Human Impact 6

3.0 PROJECT DATA QUALITY OBJECTIVES 6
3.1 Task and Problem Identification 6
3.2 Data Quality Objectives (DQOs) 6
3.3 Data Quality Indicators (DQIs) 7
3.4 Data Review and Validation 7
3.5 Data Management 8
3.6 Assessment Oversight 8

4.0 SAMPLING RATIONALE 9
4.1 New and Replacement Well Installation 9
4.2 Groundwater Sampling 10

5.0 REQUEST FOR ANALYSES 11
5.1 Analyses Narrative 11
5.2 Analytical Laboratory 12

6.0 FIELD METHODS AND PROCEDURES 12
6.1 Field Equipment 12
6.1.1 List of Field Equipment 12
6.1.2 Calibration of Field Equipment 13
6.2 Field Screening 13
6.3 Groundwater Sampling 14
6.3.1 Water level Measurements 14
6.3.2 Purging 14
6.3.3 Well Sampling 15
6.4 Decontamination Procedures 15

7.0 SAMPLE CONTAINERS, PRESERVATION AND STORAGE 16
7.1 Water Samples 16
7.2 IDW Management and Disposal 16

TABLE OF CONTENTS (CONTINUED)

8.0 SAMPLE DOCUMENTATION AND SHIPMENT 17
8.1 Field Notes and Forms 17
8.2 Labeling, Sample Chain of Custody, Preservation and Shipment 17

9.0 QUALITY CONTROL 19
9.1 Field Sampling QA/QC 19
9.2 Field Duplicate Samples 20
9.3 Matrix Spikes and Matrix Spike Duplicates (MS/MSD) 20
9.4 Field/Equipment Blanks 20
9.5 Trip Blanks 20
9.6 Laboratory QA/QC 21
9.7 Laboratory Blanks 21
9.8 Laboratory Duplicate Samples and MS/MSD 21
9.9 Blank Spikes and Laboratory Control Samples 22
9.10 Surrogate Recovery and Internal Standards Performance 22
9.11 GC/MS Tuning 22
9.12 Laboratory Instrument Calibration 22
9.13 Compound Identification and Quantitation 23

10.0 FIELD HEALTH AND SAFETY 23

11.0 REFERENCES 24

FIGURES

Figure 1 Site Location
Figure 2 Site Map

TABLES

Table 1 Well Construction Details
Table 2 Monitoring Well Schedule
Table 3 Typical Groundwater Limits and Standards for Constituents of Concern
Table 4 Typical Quality Control Requirements and Corrective Actions
Table 5 Field Equipment Manufacturer's Calibration Requirements

APPENDICES

Appendix A Prism Laboratories, Inc. Quality Assurance Plan
Appendix B AMEC Standard Operating Procedures
Appendix C Health and Safety Plan

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared by AMEC Environment & Infrastructure, Inc. (AMEC) for the former Alcatel USA Sourcing, Inc. (Alcatel) to complement the Corrective Measures Study (CMS) prepared by AMEC (AMEC, 2010) for the facility. The former Alcatel site ("site") is located at 2912 Wake Forest Road, Raleigh, Wake County, North Carolina (Figure 1).

1.1 Site History

The former site consists of approximately 24 acres with storage and maintenance buildings, parking areas and landscaped areas on the property. The manufacturing facility that once occupied the site produced telecommunications equipment and consisted of electroplating operations until 1990.

The site was sold in July 2003 to ITB Holdings, LLC and is currently not occupied. However, Alcatel maintains ownership of the environmental liability. The former Alcatel facility continues to operate under a Resource Conservation and Recovery Act (RCRA) Hazardous Waste Permit (NCD 003-185-238), which was reissued on August 31, 2007, by the North Carolina Department of Environment and Natural Resources (NCDENR), Division of Waste Management (DWM), Hazardous Waste Section (HWS).

Alcatel began voluntarily assessing soil and groundwater impact on the property in 1989. Assessment results indicate an apparent release of tetrachloroethene (PCE) and 1,1,1-trichloroethane (1,1,1-TCA) which contained the stabilizer 1,4-dioxane. Currently, concentrations of 1,1,1-TCA in the groundwater are below the North Carolina Administrative Code 15A Subtitle 2L Section .0202 (g) (2L Groundwater Standard) across the site; however, daughter products of this compound are present. Compounds currently present at concentrations in the groundwater above their respective 2L Standard include 1,4-dioxane, 1,1-dichloroethene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), PCE, trichloroethene (TCE), and vinyl chloride.

1.2 Scope of Sampling Effort

Samples will be collected from 16 monitoring wells across the site. The samples will be analyzed for the presence of volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method 6200D and 1,4-dioxane using USEPA Method 8260 with Selective Ion Method (SIM).

1.3 Project Organization

The individuals participating in the project and their specific roles and responsibilities are provided below.

Title/Responsibility	Name	Phone Number
NCDENR Hazardous Waste Section Head	Bud McCarty	(919) 707-8202
NCDENR Hazardous Waste Section Project Manager	Mary Siedlecki	(919) 707-8208
Alcatel Lucent USA, Inc., Remediation Manager	Steve Oberkrom	(816) 600-2152
Alcatel Lucent USA, Inc., Facilities Planning Manager	Dikran Kabbendjian	(919) 850-6248
AMEC Quality Assurance Manager	Harold Thurston, LG	(919) 381-9900
AMEC Project Manager	Bonani Langan, PE	(919) 381-9900
AMEC Geoscientist	Mike McKenna	(919) 381-9900

1.4 Sampling and Analysis Plan Objectives

The purpose of the SAP is to provide a document that focuses on groundwater sample collection following the implementation of the corrective measure as described in the CMS. This SAP includes a summary of the methods, sampling procedures, Quality Assurance/Quality Control (QA/QC) procedures, sample schedule and reporting requirements to be implemented at the facility.

Groundwater sampling at the site will occur on a routine basis as detailed in Section 4.0. A major component of this SAP is to provide a site sampling strategy to complement the CMS that will:

- Evaluate the long term effectiveness of source area treatment with respect to groundwater restoration, treatment effectiveness, and estimated time to complete restoration;
- Monitor the reduction in the toxicity, mobility and mass of the contamination in groundwater as a result of the source area treatment; and
- Meet monitoring and reporting equipments to satisfy community and state acceptance criteria of the CMS groundwater remedy selected.

2.0 BACKGROUND

2.1 Site Description

The former Alcatel site and facility is located at 2912 Wake Forest Road, Raleigh, Wake County, North Carolina (Figure 1). The former site consists of approximately 24 acres with storage and maintenance buildings, parking areas and landscaped areas on the property. The 234,000 square foot building which was located on the property was demolished in early 2012 (Figure 2).

2.2 Operational History

The Kellogg Corporation, a division of ITT, began operating at the facility in 1958, producing telecommunications equipment. In 1987, Alcatel bought the facility. Electroplating was conducted at the facility until 1990 as part of printed circuit board manufacturing operations.

Alcatel operated under a RCRA permit for wastes with the following waste codes: F001, F002, F005, F006, F008, D001, D002, and D008. Under the RCRA permit, Alcatel was authorized for the following:

- Store the wastes described above in 55-gallon containers on two uncovered pads at the site;
- Perform drying of dewatered wastewater treatment sludge by evaporation while stored in a roll-off container located on the former sludge treatment container storage pad;
- Perform maintenance of in-ground holding tanks that received aqueous solutions of tin, lead, copper, chromium, nickel, mineral acid, caustics, and ammonium bifluoride wastes from the circuit board manufacturing processes; and,
- Treat wastes and rinse water at the on-site waste water treatment plant (WWTP) prior to discharge to the municipal WWTP system.

The printed circuit board manufacturing operations at Alcatel ceased in 1990. At that time, all circuit board manufacturing equipment was decommissioned and sold. Structures associated with the manufacturing process, such as holding tanks and plating trenches, were decontaminated and decommissioned following the shut-down of manufacturing operations. The WWTP was also closed and decontaminated in 1991. The former WWTP equalization basin was converted into a chilled water storage tank unit, which was then used as part of the facility heating, ventilating, and air-conditioning (HVAC) system. The remaining WWTP equipment was dismantled and removed from the site. The area was decontaminated and a level concrete floor was poured over the existing floor. The area was converted for use as a maintenance area. In 2012, the remaining structure was razed.

2.3 Previous Investigations/Regulatory Involvement

Alcatel began voluntarily assessing soil and groundwater impact on the property in 1989. Since that time, several documents have been prepared that detail the environmental conditions and have been used in the preparation of the 2010 CMS and this SAP. These documents include:

- *RCRA Facility Investigation for AOC#1 and AOC #2*, National Environmental Technologies, Inc., February 1996.
- *Interim Corrective Measures Plan for AOC #1 and AOC #2*, National Environmental Technologies, Inc., February 1996.
- *Phase II RCRA Facility Investigation*, Triangle Environmental, Inc., November 1998.

- *Corrective Measures Study*, TRC Environmental Corporation, January 2002.
- *Revised Corrective Measures Study*, TRC Environmental Corporation, May 2003.
- Interim Measures Progress Reports, Periods October 2001 through October 2009, TRC Environmental Corporation and AMEC Earth and Environmental, Inc.
- *Soil and Limited Groundwater Assessment Report and Soil Excavation Workplan*, AMEC Earth and Environmental, Inc., July 2009.
- Evaluation of Alcatel USA Sourcing, Inc. Status Under the RCRA Info Corrective Action Environmental Indicator Event Codes (CA725 and CA750), Techlaw, Inc. for USEPA, July 2009.
- *Soil Excavation Report*, AMEC Earth & Environmental, Inc., April 2010
- *Corrective Measures Study*, AMEC Earth & Environmental, Inc., October 2010
- *Interim Measures Progress Reports,* AMEC Environment & Infrastructure, Inc., 2010, 2011

Assessment results indicated that an apparent release of PCE and 1,1,1-TCA, which contained the stabilizer 1,4-dioxane, occurred at some point in time or over an extended period of time. Currently, concentrations of 111-TCA in the groundwater are below the 2L Groundwater Standards across the site; however, daughter products of this compound are present. Compounds currently present in groundwater at concentrations above their respective 2L Standards include 1,4-dioxane, 1,1-DCE, 1,1-DCA, PCE, TCE, and vinyl chloride.

Several groundwater remedial methods have been employed at the site over the years. The most significant is a groundwater pump and treat remediation system that began operating in 1997. At one time, the remediation system consisted of injection wells, recovery wells, containment recovery wells, and a treatment facility. Although the historical operation of the pump and treat groundwater remediation system has been successful and reduced the concentration of constituents of concern (COCs) in the groundwater, the removal rate has steadily decreased over the past several years leading to asymptotic conditions where groundwater contamination levels remain above the 2L Groundwater Standards.

Two soil remedial efforts were performed following the initial identification of contamination source areas that contain the COCs. The first removal action was conducted in 1990-1991, and the second in September 2009. A total of 437 tons of soil was excavated, transported and disposed of off-site at a regulated treatment facility as documented in the AMEC report (AMEC, April 2010).

A Corrective Measures Study (CMS) was issued by AMEC in October 2010 outlining a new remediation action plan to target the residual VOCs in groundwater at the former Alcatel facility. The CMS presented a method to treat the contaminated residual aquifer matrix soil using in-situ chemical oxidation (ISCO) via soil blending. The in-situ ISCO soil blending was completed in April 2012. In accordance with the CMS, following the completion of the source area treatment,

monitored natural attenuation (MNA) will be utilized to address the remaining portion of the plume. Under the selected MNA alternative, groundwater monitoring will be conducted for several years to evaluate the overall effectiveness of the source reduction following in-situ soil remediation. In accordance with the approved updated CMS, this SAP has been prepared to describe the scope, schedule, sampling methods, subsequent reporting as required by the CMS and quality assurance and quality control (QA/QC) measures that will comprise the groundwater monitoring program described herein.

2.4 Site Geology and Hydrogeology

The site environmental setting and geologic framework is based on numerous assessment activities that began in 1989. Since that time, 52 monitoring, 22 recovery, and 9 injection wells have been installed at the site. Many of the wells have since been abandoned. A summary of construction details of both the existing and abandoned wells are presented in Table 1.

The stratigraphic information that supports the site geologic framework has been collected from borehole information and data, and indicates that there are three main lithologic units at the site. These units from most shallow to deep consist of and are described as follows:

- Unconsolidated Saprolite Unit: Consists of sand, silt and some clay which extends from ground surface to depths ranging from 20 to 25 feet below land surface (ft bls). Saprolite has the relic structure of the parent rock type.
- Partially Weathered Rock (PWR) Unit: This unit serves as a transition zone or gradational contact from the saprolite to the underlying competent rock and ranges from 6 to 16 feet thick. This unit is considered a transitional zone and grades in density and has similar characteristics as saprolite material with dense rock zones having gravel size material, to less weathered soft granite or gneiss rock. Relict parent rock structure is more prevalent within this unit.
- Competent Bedrock Unit: Consists of Intrusive Felsic Granite to a Biotite Gneiss or Schist. This unit is often fractured and bedding planes prevalent and density characteristics of fresh competent rock.

Hydrogeologically, the saprolitic unit functions as an unconfined aquifer zone where fluid flow is controlled by the aquifer matrix material, and the PWR and bedrock as a partially confined aquifer zone controlled by fractures and bedding planes in the rock. Thus, groundwater velocities are controlled by the material type. More specifically, hydraulic conductivity (K) values in saprolite are significantly less (i.e., average 3.99 ft/day) compared to PWR and bedrock K values that average 19.4 ft/day.

Groundwater piezometric head levels collected from site monitoring wells are used to measure horizontal and vertical groundwater flow direction. The previous groundwater level, which is converted to elevation head data, indicates that horizontal saprolitic groundwater flow (i.e., shallow zone) is towards the southwest, and PWR and bedrock flow (i.e., deep zone) is towards the south/southwest. Vertical groundwater flow measurements collected from nested monitoring

wells installed in each unit or aquifer zone indicate that flow is generally upward at the site except for a downward component that exists in wells noted near Six Forks Road on the downgradient edge of the site.

2.5 Environmental and/or Human Impact

The RCRA Facility Investigation (RFI) identified that groundwater VOC contamination extended over two aquifers, the unconsolidated and the bedrock. Both plumes extend beyond the southern site property boundary. The extent of the contamination within the unconsolidated aquifer extends 9.75 acres laterally. Within the bedrock aquifer, the lateral extent of the contamination was 10.5 acres. Although the groundwater contamination extends onto several other properties, the area is supplied with municipal water; therefore, no groundwater supply wells are located within a two-mile radius of the site. As such, there are no known pathways for human exposure to groundwater.

3.0 PROJECT DATA QUALITY OBJECTIVES

The project data quality objectives (DQOs) are intended to be qualitative and quantitative statements. DQOs are designed to establish data collection procedures, analysis techniques [respective of data quality indicators (DQIs)] and evaluation techniques. As such, this section of the SAP will focus on data quality requirements and the standards for which they will be measured against. Groundwater quality data collected from this site will be compared to the respective compound or element for which there is a groundwater quality standard established in NCDENR groundwater standards 15A NCAC 2L .0202(c). Where no 2L Groundwater Standard exists for a compound detected in a sample, the most recent USEPA regulatory protection goal (RPG) look up table will be used to determine the appropriate RPGs. If RPGs are not present, the analysis method detection limit (MDL) will serve as the target clean-up level, or a site-specific RPG may be established and approved by NCDENR RCRA.

3.1 Task and Problem Identification

As part of the CMS remedy for groundwater restoration for this site, groundwater samples will be collected, analyzed and reported. Data sets will undergo QA/QC and reported as required within the CMS. The selected monitoring wells located on the former Alcatel site will be sampled on a semi-annual basis for two monitoring events and then annual monitoring will begin to support the DQOs for groundwater restoration. The proposed monitoring wells are listed on Table 2 showing sample depth, sample order, analysis methods and QA/QC requirements expected from the sample set.

3.2 Data Quality Objectives (DQOs)

DQOs are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision making process. DQOs define the total acceptable uncertainty in the data for each specific activity conducted during the investigation. The

uncertainty includes both sampling error and analytical error. Ideally, zero uncertainty is desired; however, the variables associated with the process (field and laboratory) inherently contribute to the uncertainty of the data. The overall objective is to keep the total uncertainty within an acceptable range that will not hinder the intended use of the data. The QA/QC requirements have been established such that there will be a high degree of confidence in the measurements.

Table 3 identifies all the contaminants of concern at the site, their associated action levels and the source of the action level. If any contaminant is found above the 2L Groundwater Standards specified in Table 3, then it will continue to be monitored on an annual basis.

3.3 Data Quality Indicators (DQIs)

DQIs are defined by the accuracy, precision, completeness, representativeness, comparability and MDLs established for the sample or sample set. This is often referred to as quality control criteria established for various aspects of data gathering, sampling or analysis. In defining DQIs specifically for the project, the level of uncertainty associated with each measurement is defined by the activity required to complete the task. As such, samples submitted for laboratory analysis will be submitted to Prism Laboratories, Inc. (Prism) located in Charlotte, NC and the DQIs will be documented within the laboratory's Sample QA/QC Procedures as required by the National Environmental Laboratory Accreditation Conference (NELAC) Certification Process and documented in the laboratory's Quality Assurance Plan (Prism, April 2012). DQIs will be based on the laboratory analyzing and reporting results based on Level 2 reporting limits as defined in EPA SW 846 documentation. The laboratory Quality Assurance Plan (QAP) can be found in Appendix A.

3.4 Data Review and Validation

Data collected in the field and provided by the laboratory, will be reviewed by an AMEC senior manager following generation of the data and prior to entering the data into the project record. Field data will be reviewed to identify anomalies or outliers that must be accounted for during data interpretation.

The AMEC Project Manager will decide if data validation is to be performed on environmental samples collected during this project. If necessary, data validators from AMEC will provide data validation services. Data validation will be performed utilizing typical QA/QC criteria established in this SAP, as listed in the quality control requirements and corrective actions listed in Table 4, the analytical methods, and laboratory established criteria. Data validation will be performed by a third party AMEC environmental specialist not directly involved with the project and is knowledgeable of the validation process as outlined in SW 846 documentation. The laboratory will provide additional or supplemental information if requested by the data validators.

If data review indicates data that does not meet data quality objectives, corrective actions will be determined and implemented. Possible corrective actions associated with the rejection of data may include reanalysis, resampling, no action but monitor the data more closely next quarter, etc.

3.5 Data Management

Data will be generated in the laboratory and the field as described in Sections 3.4 and 4.2. The laboratory will maintain information (hardcopy and/or electronic) that will be used to permanently record all laboratory data including: sample ID's, analytical results, detection limits, analytical methods, and other related data. The laboratory-generated data will be entered into the laboratory database management system and presented in data packages. The laboratory will perform the data review process, in accordance with their QAP. Validation of the sample data may be performed as described in Section 3.5.

A project file will be maintained for all data generated as part of this project. This file will be maintained by AMEC. At a minimum, this file will include originals or copies of:

- Final documents;
- Laboratory analytical reports;
- Field notebooks;
- Borehole and well completion logs;
- Chain of custody documentation;
- QA/QC audit reports;
- Data validation/data quality assessment reports;
- Correspondence; and
- Data generated from field measurements or analyses.

The laboratory will supply electronic data deliverables to AMEC and these files will be placed on a secure network drive in dedicated project folders that are routinely backed-up. The network drive is protected by AMEC firewalls, and is available only to authorized users. Files produced by AMEC will also be stored on the secure network drive in the appropriate folders. The AMEC Project Manager will be responsible for assuring project files are updated as needed. The AMEC Raleigh office Information Technology (IT) support personnel will be responsible for file back-up and security. Microsoft® Office products are used for production of reports and databases. Other software, e.g., AutoCAD or ArcView, may be used in support of site assessments. Project files will be archived by AMEC for a period of five years.

AMEC staff will obtain electronic data deliverables directly from the laboratory in spreadsheet format (in addition to the case narrative submittals) which will be used as templates for a final spreadsheet compilation of sample results, with supplementary columns added for comparison to appropriate screening or remediation criteria. Results exceeding project criteria will be highlighted for easy reference. Such compilations will be cross-checked by another individual, unless the data are used directly from the lab with no manipulation. Spreadsheet software such as Microsoft® Excel or Access will be used.

3.6 Assessment Oversight

The Quality Assurance (QA) Manager will be responsible for overall project QA. He will review project plans and revisions to such plans to maintain proper QA throughout the investigation. In addition, the QA Manager, or his/her designee, will be responsible for performance and system

audits, data processing activities, data processing QC, data quality review, corrective actions of data quality and SAP issues, and coordinating the QA/QC efforts between AMEC and the laboratory.

Routine laboratory and field performance will be monitored through the analysis of field/equipment and laboratory blanks, spiked samples, laboratory control samples, laboratory and field duplicates, and performance evaluation samples. The laboratory Quality Control (QC) Coordinator designated by the laboratory, in conjunction with the AMEC Project Manager, will formulate corrective actions in the event QC limits specified in the QAP, provided in Appendix A, are exceeded. The results of system audits will be documented in project reports.

At the discretion of the AMEC Project Manager, field and laboratory performance audits consisting of on-site performance evaluations will be performed during the field program and during laboratory analyses. The audits will be performed by the AMEC Project and/or QA Manager. The audits will evaluate the adherence of the field and laboratory programs to the QA program outlined in this SAP. The results of the field and laboratory audits will be documented. These reports and any corrective actions, which were implemented as a result of the audits, will be included in the project report. Audit findings will be tracked until corrective actions have been completed to the satisfaction of the AMEC Project Manager. Audit issues will be resolved promptly, depending on the severity of the finding, so that impacts to project deadlines can be minimized.

4.0 SAMPLING RATIONALE

The rationale behind the additional investigation involving the groundwater sampling scope is referenced in Section 7.0 of the CMS. As such, this SAP is to provide details on sampling locations, analytes of concern, sampling methods, subsequent reporting and quality control measures that will comprise the groundwater monitoring program for the subject site. This SAP also provides details of the installation of replacement monitoring wells destroyed during the remediation scope and required to supplement the existing groundwater monitoring network.

4.1 New and Replacement Well Installation

As a result of the most recent remedial activities, AMEC abandoned approximately five existing monitoring wells (MW-13d, MW-13s, MW-13sr, MW-14d, and MW-2d). Additionally, four monitoring wells were installed as part of the CMS to target areas of concern (MW-22s, MW-23s, MW-24s and MW-24d). A replacement well for MW-2d was also installed (MW-2dr). These wells will be sampled as part of the groundwater monitoring program. A detailed list of monitoring wells to be sampled is outlined in Section 4.2.

4.2 Groundwater Sampling

The proposed work is based upon the completion of the remedial activities described in the CMS. The groundwater monitoring program will include samples from the unconsolidated and bedrock aquifers. The variety of sampling intervals will provide the most thorough data depicting the delineation of the contaminants. Refer to Figure 2 for the location of the wells on-site.

Prior to collecting groundwater samples during each sampling event, water levels will be measured throughout the site. This will include gauging static water levels in the following monitoring wells:

- MW-2dr
- MW-2s
- MW-2sk
- MW-2ik
- MW-3d
- MW-3sk
- MW-3dk
- MW-4s
- MW-4d
- MW-5sk
- MW-9sk
- MW-9dk
- MW-11
- MW-12s
- MW-12dk
- MW-16d
- MW-17i
- MW-18i
- MW-19i
- MW-20i
- MW-21i
- MW-22s
- MW-23s
- MW-24s
- MW-24d

After the above listed monitoring wells have been gauged, 10 shallow monitoring wells and 6 deep monitoring wells will be sampled. The monitoring wells will be sampled semi-annually for one year in April and October 2013 and annually, thereafter. The following monitoring wells will be sampled during each monitoring event:

- MW-2dr
- MW-2s
- MW-3d
- MW-4s
- MW-4d
- MW-5sk
- MW-9sk
- MW-9dk
- MW-12s
- MW-12dk
- MW-18i
- MW-19i
- MW-21i
- MW-22s
- MW-23s
- MW-24s

Table 2 depicts the wells to be sampled, the depths at which the samples are to be taken and the analytes of concern at each well. Groundwater will be withdrawn from the monitoring wells using a low-flow pump with the intake located near the center of the well screen. The depth to the center of the well screen will dictate the sample collection method. Deeper wells will be sampled using a submersible pump, while shallow wells will be sampled using a peristaltic

pump. The pump effluent will pass through a flow-through chamber containing probes to monitor water quality parameters. The monitored parameters will include temperature, pH, conductivity, oxidation-reduction potential (ORP), dissolved oxygen (DO) and turbidity. With the exception of turbidity, these parameters will be measured with a Hanna 9828 (or similar) water quality meter. Turbidity will be measured with a Hanna 98703 (or similar) turbidimeter.

The pumping rate will be maintained between 100 to 300 milliliters per minute (mL/min) to maintain minimal drawdown effects and to limit suspension of any fine-grained sediments or aeration of the water being sampled. The water level in the well will be carefully monitored to document that drawdown does not increase during purging. Drawdown and water quality parameters will be monitored and recorded approximately every three to five minutes. Water quality parameters will be documented on AMEC groundwater sampling forms. Purge water will be collected in 5-gallon buckets and subsequently transferred to steel 55-gallon drums.

Sampling will be performed by disconnecting the down-hole tubing, prior to the flow-through cell, and placing it into the appropriate certified-clean laboratory sample containers. New disposable or dedicated sample tubing will be used at each well.

Samples will be obtained first from monitoring wells in the historically least-contaminated area and progress toward the historically most-contaminated area. The order of preferred sampling is also included in Table 2.

5.0 REQUEST FOR ANALYSES

Groundwater samples will be analyzed by the laboratory for VOCs by USEPA SW-846 Method 6200 and 1,4-dioxane by USEPA SW-846 8260 with SIM. All of the samples will be submitted to the same lab for a standard turnaround time (10 business days). Table 2 identifies the necessary container types, sample volumes, preservatives, and analytical holding times for each parameter. QC samples (trip blanks, equipment blanks, and duplicates) are also listed on Table 2.

5.1 Analyses Narrative

As enumerated in Table 2, groundwater samples will be taken at 16 locations. Duplicate samples will be obtained from the final monitoring well of each day. Collection of field duplicate samples provides for the evaluation of the laboratory's precision performance by comparing analytical results of two samples from the same location. Field duplicate samples are also collected to evaluate field sample collection precision procedures. Trip blanks are collected to establish that the transport of sample bottles to and from the field does not result in the contamination of the sample from external sources. Field equipment blanks will be obtained at the culmination of the sampling event, after all monitoring well samples have been obtained. Field equipment blanks demonstrate that sampling equipment has been properly prepared and cleaned before field use and that cleaning procedures between samples are sufficient to

minimize cross-contamination. The field equipment blank will be obtained by running analyte-free water (provided by laboratory) through the pump and collecting the sample at the pump discharge. As shown in Table 2, each groundwater sample (including QC samples) will be analyzed for VOCs by USEPA SW-846 Method 6200 and 1,4-dioxane by USEPA SW-846 8260 with SIM.

5.2 Analytical Laboratory

The laboratory will utilize the analytical methods and additional requirements listed in this SAP, unless justification for another method is provided and the AMEC Project Manager agrees to the change. Table 2 provides a list of sample preparation and analytical methods, while Table 3 provides the most recent MDLs and reporting or equivalent limits. A copy of the Prism Laboratories, Inc.'s QAP is presented in Appendix A.

The limits listed in Table 3, or the most recent laboratory control limits, will be used to evaluate samples. In addition, the quality control requirements and corrective actions listed in Table 4, which augment the method requirements, are to be followed by the laboratory, unless changes deemed appropriate and necessary are agreed upon by the laboratory and the AMEC Project Manager. The laboratory will provide AMEC with a data deliverable within the amount of time indicated on the chain-of-custody record unless the laboratory informs AMEC that it cannot meet the necessary turnaround time. Typically, standard 10 days will be preferred turnaround time.

6.0 FIELD METHODS AND PROCEDURES

Groundwater samples will be collected in order to assess the groundwater conditions and concentrations of 1,1,1-TCA and its daughter products, as well as the concentration of 1,4-dioxane. Throughout sampling procedures, field personnel will don clean, disposable gloves prior to each new sample location and gloves will be replaced any time they become ripped or excessively dirty. The subsequent sections discuss the field equipment to be utilized, field screening techniques, groundwater sampling methods and decontamination procedures. Sample tracking and shipping will be discussed in Section 8.

6.1 Field Equipment

6.1.1 List of Field Equipment

The equipment that will be used in the field to collect groundwater samples or support groundwater sampling activities include:

- Peristaltic Pump, silicon tubing, ¼" LDPE tubing, and battery;
- Submersible Pump, 3/8" LDPE tubing, and battery;
- Water quality meter and flow-through cell;
- Turbidimeter;
- Bailer; and

- Decontamination supplies including clean buckets, scrub brushes, Liquinox, distilled water, isopropyl alcohol.

Since field equipment may be rented on an as-needed basis, make and model numbers are not available for inclusion in this SAP. The specific sampling equipment used will be recorded in sampling logs by the sampling personnel. This information will not be included in the data reporting packages but will be used during data validation.

Spare parts for AMEC-owned equipment will be maintained in the Durham, NC office. Spare parts for rental equipment will typically not be available, unless routinely supplied by the manufacturer or vendor. The AMEC Project Manager will make decisions on whether the availability of spare parts is a priority for a given investigation. His/her decision will dictate how this issue is handled.

6.1.2 Calibration of Field Equipment

Field equipment used during this project will be calibrated in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Equipment to be used for field sampling will be examined to confirm that it is in good operating condition. This includes checking the manufacturer's operating manual and the instructions for each instrument to confirm that the maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed, if applicable, so that the notations on any prior equipment problems are not overlooked, and all necessary repairs to equipment have been carried out.

In general, instruments will be calibrated daily prior to use and will be recalibrated as required. All the calibration procedures performed will be documented in the field logbook or equivalent.

The calibration will be performed at the intervals specified by the manufacturer. In the event an internally calibrated field instrument fails to meet calibration parameters, it will be returned to the manufacturer for service. If calibration cannot be attained or control limits are not met in the field, field personnel will attempt to acquire a replacement instrument or will contact the AMEC Project Manager for resolution. Corrective actions will be decided on a case-by-case basis. In the case of equipment rented from a supplier, the supplier often calibrates the equipment prior to shipment. This initial calibration is sufficient until conditions or the manufacturer's equipment manual dictate re-calibration.

Specific calibration parameters are listed in Table 5.

6.2 Field Screening

Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Screening data provide analyte identification and quantitation, although the quantitation may be relatively imprecise. Examples of screening data include temperature, pH, conductivity, and turbidity measurements generated in the field for groundwater sampling. Refer to AMEC SOP FP-D-3, Monitor Well Sampling, in Appendix B for procedures for collecting field

parameters. Screening data (points or set) may provide some useful information, but that information by itself may not be sufficient to support project decision-making because the amount of uncertainty (due to sampling, analytical, or other considerations) is greater than what may be tolerable. When data that would be considered screening quality (if considered in isolation) are combined with other information or additional data that manage the relevant uncertainties, the combined data/information package becomes more effective for use in decision-making.

6.3 Groundwater Sampling

Groundwater sampling consists of collecting a set of water level measurements from all the wells on site to accurately map the direction of groundwater flow. After all the water levels have been collected, well purging and sampling will occur at the wells selected as part of the SAP. For the collection of VOCs, low-flow sampling will occur using a peristaltic or submersible pump. Low-flow sampling is defined by low pumping rates (usually less than 1 liter/minute) to minimize low water-level drawdowns.

6.3.1 Water level Measurements

Prior to the start of the sampling event, AMEC will measure the static water levels in each well. Water levels will be measured in the wells known to have the least amount of contamination first and will move progressively toward wells with increasing concentrations of contamination. Water-level meters will be decontaminated after use at each well. Pressure caps shall be opened prior to measuring depth to water to allow the water table to reach equilibrium. Depth to water will be measured from the northern edge of the top of casing to the nearest 0.01 feet. The water level meter will emit a constant alarm when the meter comes into contact with groundwater. Well construction history is known; therefore, it is not necessary to measure the total depth of the wells.

6.3.2 Purging

The water present in a well prior to sampling may not be representative of in-situ groundwater quality and shall be removed prior to sampling. The evacuation procedure shall ensure that all stagnant water is replaced by fresh formation water upon completion of purging. Purging shall be accomplished by removing groundwater from the well at low flow rates using a pump. Depending on the well to be sampled, purging activities will be conducted either by peristaltic or submersible pump (Table 2). Immediately prior to purging, the water level will be measured in the well.

According to the USEPA (1996), the rate at which groundwater is removed from the well during purging ideally be reduced to the minimum capabilities of the pump (0.1-0.4 l/min) to ensure stabilization of indicator parameters. The purge rate should be low enough that substantial drawdown in the well does not occur during purging. A low purge rate will also reduce the possibility of stripping VOCs from the water, and will reduce the likelihood of mobilizing colloids in the subsurface that are immobile under natural flow conditions.

The submersible pump or the peristaltic tubing shall be lowered to the middle of the well screen. During the well purging procedure, water level and indicator field parameters will be collected every three to five minutes to assess the hydraulic effects of purging. Field parameters shall be collected using a flow-through cell for temperature, specific conductance, pH, DO and ORP. A separate sample for turbidity will be collected during each observation interval. At least three readings shall be taken during the purging process. Purging is considered complete and sampling may begin when all the field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three to five minute intervals are within the following limits:

- Turbidity (10% for values greater than 1 NTU),
- Temperature (3%).
- Specific conductance (3%),
- pH (+/- 0.1 unit),
- DO (10%),
- ORP (+/- 10 millivolts)

For low yield wells, the well shall be purged until dry and then allowed to recover sufficiently to provide enough water to be sampled. All purge water will be collected for proper disposal according to NCDENR guidelines. Refer to AMEC SOP FP-D-3, Monitor Well Sampling, in Appendix B.

6.3.3 Well Sampling

Prior to collecting the groundwater sample, the tubing will be disconnected from the flow-through cell, without disrupting the pump. VOC samples will be collected first and directly into pre-preserved sample containers, followed by SVOC samples. If a duplicate sample is to be collected at this location, all bottles designated for a particular analysis for both sample designations will be filled sequentially before bottles from another analysis are filled. The VOC vials will be filled directly from the tubing, until a meniscus forms at the top, and capped. The VOC vial will be inverted and checked for air bubbles to ensure zero headspace. If a bubble appears, the vial will be topped off using a minimal amount of sample to re-establish the meniscus.

6.4 Decontamination Procedures

Protocols for the decontamination of sampling equipment are given in AMEC SOP FP-D-5, Equipment Decontamination, in Appendix B of this SAP. Typical sampling methods utilize dedicated or disposable equipment (e.g., acetate liners for direct-push drilling methods, gloves, bailers, passive diffusion bags for groundwater sampling). Decontamination procedures will be used where non-dedicated equipment is required, e.g., submersible low-flow groundwater sampling pumps, and water level meters. Decontamination will occur after each use of a piece of equipment.

Submersible pumps shall be decontaminated by washing and rinsing the outside surfaces and decontaminating the internal components by initiating the pump motor to process a sequence of decontamination solutions in clean buckets. The decontamination sequence for submersible pumps shall include: 1) detergent (Liquinox) and potable water wash, 2) potable water rinse, and 3) Additional potable water rinse.

7.0 SAMPLE CONTAINERS, PRESERVATION AND STORAGE

Pre-cleaned or new sample containers will be supplied by the laboratory and meet USEPA criteria. Any preservatives required will be added by the laboratory. Immediately after collection, samples will be transferred to properly labeled sample containers and will be properly preserved. Table 2 lists the proper sample container, sample volumes, preservation, and holding times for typical parameters. Samples requiring refrigeration for preservation will be promptly transferred to coolers packed with ice.

7.1 Water Samples

Pre-cleaned or new sample containers will be supplied by the laboratory and meet USEPA criteria. For more information on preservation techniques, refer to AMEC SOP FP-D-3, Monitor Well Sampling, Section 5.3.6.1, in Appendix B. As part of this SAP, the samples will be analyzed for the presence of VOCs using USEPA Method 6200B and 1,4-dioxane using USEPA Method 8260 with SIM.

Low concentration water samples to be analyzed for VOCs will be collected in 40-mL glass vials. 1:1 hydrochloric acid (HCl) will be added to the vial prior to sample collection by the laboratory. The vials will be filled so that there is no headspace. The samples will be chilled to 4°C immediately upon collection. Three vials of each water sample are required for each laboratory.

7.2 IDW Management and Disposal

The type of investigation-derived wastes (IDW) that will be generated during this sampling event is limited to used personal protective equipment (PPE), disposable sampling equipment, purge water and decontamination water. Used PPE and disposal sampling equipment will be double bagged and placed in a municipal refuse dumpster. All liquid IDW will be containerized in a 55-gallon drum, labeled and left on site in a secure location. Labels will identify the contents of the IDW, a contact person and phone number.

8.0 SAMPLE DOCUMENTATION AND SHIPMENT

8.1 Field Notes and Forms

A field book is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the affected activity, the person recording an entry in the logbook, and the beginning and ending dates of the entries. A separate field book will be maintained for each project. Refer to AMEC SOP FP-F-5, Logbooks, Section 5.0, in Appendix B, for additional requirements of field books.

8.2 Labeling, Sample Chain of Custody, Preservation and Shipment

Immediately after collection, samples will be transferred to properly labeled sample containers and will be properly preserved. Samples requiring refrigeration for preservation will be promptly transferred to coolers packed with ice. When possible, samples will be shipped or transported within 24-hours of being collected.

Chain-of-custody procedures will be instituted and followed throughout each investigation. These procedures include field custody, laboratory custody, and evidence files. Chain-of-custody records will be kept starting in the field when sample collection is completed. The chain-of-custody should contain the following information:

- Sample number/location;
- Project name/number, if appropriate;
- Sampler name(s);
- Date and time of sample collection;
- Designation of the sample as a grab or composite;
- Type of sample media;
- Date and signature of the field sample custodian;
- Date and signature of the laboratory sample custodian;
- Sample preservation;
- Types of analysis to be performed; and
- Airbill number (unless hand-delivered to the laboratory).

In the field sampling logs and/or logbook, samplers will note equipment employed during collection. Physical characteristics of the sample, date, time of day, sample location, and any abnormalities noted during sampling will be recorded in the field sampling logs and/or logbook. The field sampler will indicate the sample identification number, date, time, sample media, sample type (i.e., grab), number of containers and the analysis requested on the appropriate chain-of-custody form. If high concentrations are suspected to be present in the samples, a note to that effect should be included on the chain-of-custody form. The original chain-of-custody form will be signed and copied, and the original and one copy will be placed in a sealed Ziploc-type bag in the cooler. A copy of the chain-of-custody will also be faxed or hand-delivered to the laboratory.

Sample labels, which will be sequentially numbered, will be attached to the sample containers. The sample labels will contain the following information:

- Sample number/location;
- Date and time of sample collection; and
- General types of analyses to be performed (optional).

The chain-of-custody documentation and sample labels will be recorded using waterproof, non-erasable ink. The shipping container will be closed and a security seal(s) may be affixed to the latch and/or lid. The seal must be broken to open the cooler and will indicate tampering if the seal is broken before receipt at the laboratory.

If more than one laboratory will be performing analyses, a separate chain-of-custody will be used for each laboratory. The original chain-of-custody form will be signed and copied, and the original and one copy will be placed in the cooler.

The cooler will be shipped via an overnight delivery service or hand delivered to the laboratory. When possible, samples will be shipped to the laboratory within 24-hours of sample collection. When the samples arrive at the laboratory, the laboratory sample custodian will sign the courier's air bill or bill of lading (unless hand-delivered) and will document the cooler temperature on the chain-of-custody, where applicable. If the cooler temperature is greater than 6°C, the AMEC Project Manager should be notified. If the samples were shipped to the laboratory, the courier's air bill number will be written on the chain-of-custody form.

The laboratory will immediately contact the AMEC Project Manager if issues pertaining to sample condition or documentation are detected (e.g., broken, open, or otherwise compromised sample bottles; chain-of-custody information in disagreement with sample labels).

Upon completion of the analyses, the AMEC Project Manager or his/her designee will begin assimilating the field and laboratory notes. In this way, the file for the samples will be generated. The final file for the sample will consist of the following:

- Laboratory data packages, including the appropriate level of QA/QC documentation. The laboratory will maintain summary and raw data from the analysis of environmental and QC samples, chromatograms, mass spectra, calibration data, work sheets, and sample preparation logs.
- Laboratory data packages will include as a minimum the following:
    - Analytical results showing sample number, lab ID, date collected and received, matrix, analytical method(s), project name and number, parameters, units, reporting or method detection limits, dilution factors, date/time sample prepared and analyzed, and any qualifiers;

- QC Data (where appropriate): QC batch number and method, associated lab samples, method blank results, laboratory control sample (LCS) and matrix spike/matrix spike duplicate (MS/MSD) results with spike concentrations, % recovery, % recovery limits, and any qualifiers, date/time analyzed, reporting limits, and units;
- Qualifier list and explanation; and
- 'Sample Condition Upon Receipt' or equivalent form (if relevant).

- Chain-of-custody records.

Upon receipt, the laboratory data package will be checked for completeness to ensure compliance with SAP requirements. Missing information or questions will be addressed with the laboratory project manager so a complete package meeting expectations is produced.

9.0 QUALITY CONTROL

9.1 Field Sampling QA/QC

In order to evaluate data quality, QA/QC samples will be collected during the field investigations. Table 2 lists typical environmental and corresponding QC samples to be collected. Table 4 summarizes typical field sampling quality control checks, frequency of analysis, control limits, and laboratory corrective actions for the analytical method used in this investigation. Field sampling crews will always be under direct supervision of a field manager. Bound log books and appropriate data sheets will be used to document the collection of samples and data so that an individual sample or data set can be traced back to its point of origin, sampler, and type of sampling equipment.

Sampling will be performed according to the methods provided in the SAP. Field QA/QC samples can include blind field duplicates, Matrix Spikes and Matrix Spike Duplicates (MS/MSD), field/equipment blanks, and trip blank samples. Field sampling precision will be evaluated through the relative percent differences (RPD) of the matrix spike and blind field duplicate sample analyses results. In accordance with USEPA Region IV SESD *Field Branches Quality System and Technical Procedures*, the QA/QC samples will be collected each day or with each 20 samples of each medium. Control limits for the blind field duplicate precision have been established at ±50% for water samples. For sample results that are less than or equal to five times the RL or equivalent, the criterion of plus or minus two times the RL will be applied to evaluate field precision.

Decontamination of sampling equipment will be verified through the analysis of field/equipment blanks. The presence of matrix interferences will be evaluated by the analysis of spiked MS/MSD samples. The integrity of environmental media submitted for VOC analysis will be evaluated by the analysis of trip blank samples that accompany each shipment of environmental samples to the laboratory. The trip blank results will be used to determine if contamination of the samples occurred during shipment and/or storage. Proper chain-of-custody protocols, as presented in Section 8.2 of this SAP, will be followed.

9.2 Field Duplicate Samples

Collection of field duplicate samples provides for the evaluation of the laboratory's precision performance by comparing analytical results of two samples from the same location. Field duplicate samples are also collected to evaluate field sample collection precision procedures. Field duplicate samples are duplicate samples collected from one location and sent to the laboratory blind (with two different sample identifications). One field duplicate will be collected for every 20 environmental samples (i.e., minimum frequency of 5%) or one per medium, per container type, per day for less than 10 samples.

9.3 Matrix Spikes and Matrix Spike Duplicates (MS/MSD)

MS/MSD samples are duplicate samples that have spiking solutions added at the laboratory during sample preparation. MS/MSD samples are considered identical to the original sample and require that the sampled material be homogenized in the field and laboratory prior to analyses. Due to the potential loss of VOCs during homogenization, samples collected for VOC analyses will not be homogenized in the field. Since they will not be homogenized, field samplers must make every effort to collect representative samples of the location sampled for VOCs. The percent recovery of the spiked amount indicates the accuracy of the extraction as well as interferences caused by the matrix. Relative percent differences (RPDs) between spike sample recoveries will indicate the precision of the data. One MS/MSD sample set will be collected for every 20 environmental samples submitted to the laboratory (i.e., minimum frequency of 5%) or one MS/MSD for less than 20 samples, for each matrix type.

9.4 Field/Equipment Blanks

Field/equipment blanks are analyzed to assess contamination introduced during field sampling procedures and sample shipment. Field blanks, consisting of samples of the source water used, will be analyzed to assess whether the wash or rinse water contained contaminants that may have been carried over into the site samples. Field blanks are collected at a frequency of one per sampling event per each source of water. A sampling event is considered to be from the time sampling personnel arrive at a site until they leave for more than a week.

Equipment blanks will consist of samples of analyte-free water that are passed through and or over decontaminated sampling equipment. One equipment blank will be collected per sampling event. Field/equipment blanks will not be required if dedicated sampling equipment is utilized. The field/equipment samples will be subject to the same analyses as the environmental samples.

9.5 Trip Blanks

Trip blanks will consist of samples of analyte-free water in the same containers used to collect water or soil samples, which have undergone shipment from the sampling site to the laboratory in coolers with the environmental samples to be analyzed for VOCs. Trip blanks will be analyzed

for VOCs to determine if contamination has taken place during sample handling and/or shipment. One trip blank will accompany each cooler containing water samples to be analyzed for VOCs. Trip blanks will only be analyzed for VOCs.

9.6 Laboratory QA/QC

Laboratory QC analyses serve as a check on the precision and accuracy of analytical methods and instrumentation and potential contamination that may occur during laboratory sample preparation and analyses. Table 2 lists typical environmental and corresponding QC samples to be analyzed. Table 4 summarizes typical laboratory quality control checks, frequency of analysis, control limits, and laboratory corrective actions for the analytical method used in this investigation. A brief description of laboratory QA/QC analyses is contained in the following subsections. A copy of Prism Laboratories, Inc. QAP is included in Appendix A.

9.7 Laboratory Blanks

Several types of blanks will be analyzed by the laboratory to assess method precision and accuracy. Corrective action procedures will be implemented for blank analyses if target compounds are detected at concentrations greater than the RL. The criteria for evaluation of blanks apply to any blank associated with a group of samples. If problems with a blank exist, data must be carefully evaluated to determine whether or not there is an inherent variability in the data for the project, or if the problem is an isolated occurrence not affecting other data.

A method blank is an analyte-free water or soil blank that undergoes the preparation procedures applied to a sample (i.e., extraction, digestion, clean-up). These samples are analyzed to examine whether sample preparation and analysis techniques result in sample contamination. The laboratory will prepare and analyze a method blank with each group of a maximum of 20 samples of similar matrix that are extracted, digested, or analyzed at the same time.

9.8 Laboratory Duplicate Samples and MS/MSD

MS/MSD and laboratory duplicates are analyzed to evaluate the reproducibility, or precision, of the analytical procedures for a given sample. MS/MSD and laboratory duplicate analyses will be performed on environmental samples at a frequency of one per sample media and every 20 samples of similar media. Whenever possible, MS/MSD and laboratory duplicate samples will be prepared and analyzed within the same batch as the environmental samples. MS/MSD samples will be spiked at the laboratory with the target analytes.

Results of duplicate analyses are reported as RPD, which is calculated by dividing the difference in concentration between the duplicate and original sample analyses by the arithmetic mean of their concentration and multiplying the result by 100. One duplicate sample is analyzed for, at most, each 20 samples analyzed of similar matrix. Generally, the MS/MSD data alone are not used to evaluate the precision and accuracy for associated organic samples since data may reflect specific matrix effects only present within one sample. Table 4 list typical precision and accuracy control limits.

9.9 Blank Spikes and Laboratory Control Samples

Blank spikes and laboratory control samples are used to demonstrate that the laboratory process for sample preparation and analysis is in control. Blank spikes and laboratory control samples are analyte-free water spiked with a known amount of analyte and is carried through the entire analytical procedure with the samples. These are used to help confirm matrix effects, which may cause problems with matrix spikes. The term blank spike is used in reference to organic analyses, while the laboratory control sample is used in reference to inorganic analyses; however, they are basically the same. Blank spikes are analyzed at a frequency of one per sample batch or 5% frequency, whichever is more frequent.

9.10 Surrogate Recovery and Internal Standards Performance

Accuracy and matrix biases for individual samples are monitored for organic analyses using surrogate additions. Surrogates are compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard, and are used to evaluate analytical efficiency of the analytical method by measuring recovery. Surrogates are brominated, fluorinated, or isotopically labeled compounds not expected to be detected in environmental media. They are also not typical compounds normally included in the list of analytes detected by a particular analytical method. Surrogates are normally added prior to extraction to portions of samples that will be analyzed for volatile organics, base/neutral-acid extractables, and pesticides/PCBs.

Internal standards, which are compounds not found in environmental samples, will be spiked into samples, blanks, MS/MSDs, and Laboratory Control Samples just prior to analysis, but after sample extraction. Internal standards must meet retention time and performance criteria specified in the analytical method or the sample will be reanalyzed.

9.11 GC/MS Tuning

Tuning and performance criteria are established to verify mass resolution, identification, and to some degree, instrument sensitivity. These criteria are not sample specific; conformance is determined using standard materials. Therefore, these criteria should be met in all circumstances.

9.12 Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to verify that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of analysis, and continuing calibration and performance checks document satisfactory maintenance and adjustment of the instrument on a day-to-day basis. Calibration procedures to be followed are specified, in detail, in the analytical methods. These procedures specify the type of calibration, calibration materials to be used, range of calibration, and frequency of calibration. In addition, typical calibration requirements are listed in the quality control requirements and corrective actions in Table 5.

9.13 Compound Identification and Quantitation

The objective of the quantitative criteria is to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present). The identification criteria can be applied much more easily in detecting false positives than false negatives. Negatives, or non-detected compounds, on the other hand represent an absence of data and are, therefore, much more difficult to assess. The objective for quantitative requirements is to maximize the accuracy of data and sensitivity of the instrument. Unless sample screening indicates the presence of high concentration target analytes or matrix interferences requiring dilution, samples should be analyzed undiluted to maximize sensitivity. Samples must be reanalyzed at the appropriate dilution when concentrations exceed the linear calibration range to maximize accuracy.

In the case of matrix interference, the laboratory should perform, where feasible, sample cleanup as provided by the methods. When matrix interferences are present, samples will be cleaned up during the extraction processes using appropriate methods. The clean-up, extraction, and sample preparation methods should be listed in the data package case narrative.

10.0 FIELD HEALTH AND SAFETY

A health and safety plan (HASP) has been prepared to inform employees of safe work practices, emergency procedures, and possible hazards which may be encountered during field activities. This HASP is consistent with the requirements of the Occupational Safety and Health (OSHA) Standards and Regulations contained in 29 CFR 1910.120.

The HASP covers field work and includes the following information:

- Facility information and contact names;
- Evaluation of the facility;
- Safe work practices;
- Engineering safeguards;
- Education and training;
- Medical surveillance;
- Environmental and personnel monitoring;
- Personal protective equipment;
- Standard operation and safety procedures;
- Facility control and decontamination;
- Emergency and contingency planning; and
- Procedures for documenting and reporting exposures and/or injuries.

All personnel involved in field activities associated with this investigation will be required to read and sign the HASP. Prior to initiation of subcontracted field activities, the AMEC Project Manager or designated representative will brief subcontracted personnel on site conditions, potential hazards and exposures, and emergency procedures. Subcontractors will be requires to sign a document at the site confirming receipt and understanding of the field briefing.

It may be necessary to alter the HASP if new hazards are discovered or if conditions change. It will be the responsibility of the Project Manager to decide when and if a new HASP should be prepared. If a new HASP is prepared, it will include all relevant information including in the previous HASP, as well as the new information. Upon approval, the new HASP will replace the former HASP and must be read and signed as aforementioned. Once the new HASP is in effect, the former HASP will be noted as “obsolete” and archived in the project file. A copy of the applicable HASP is included in Appendix C.

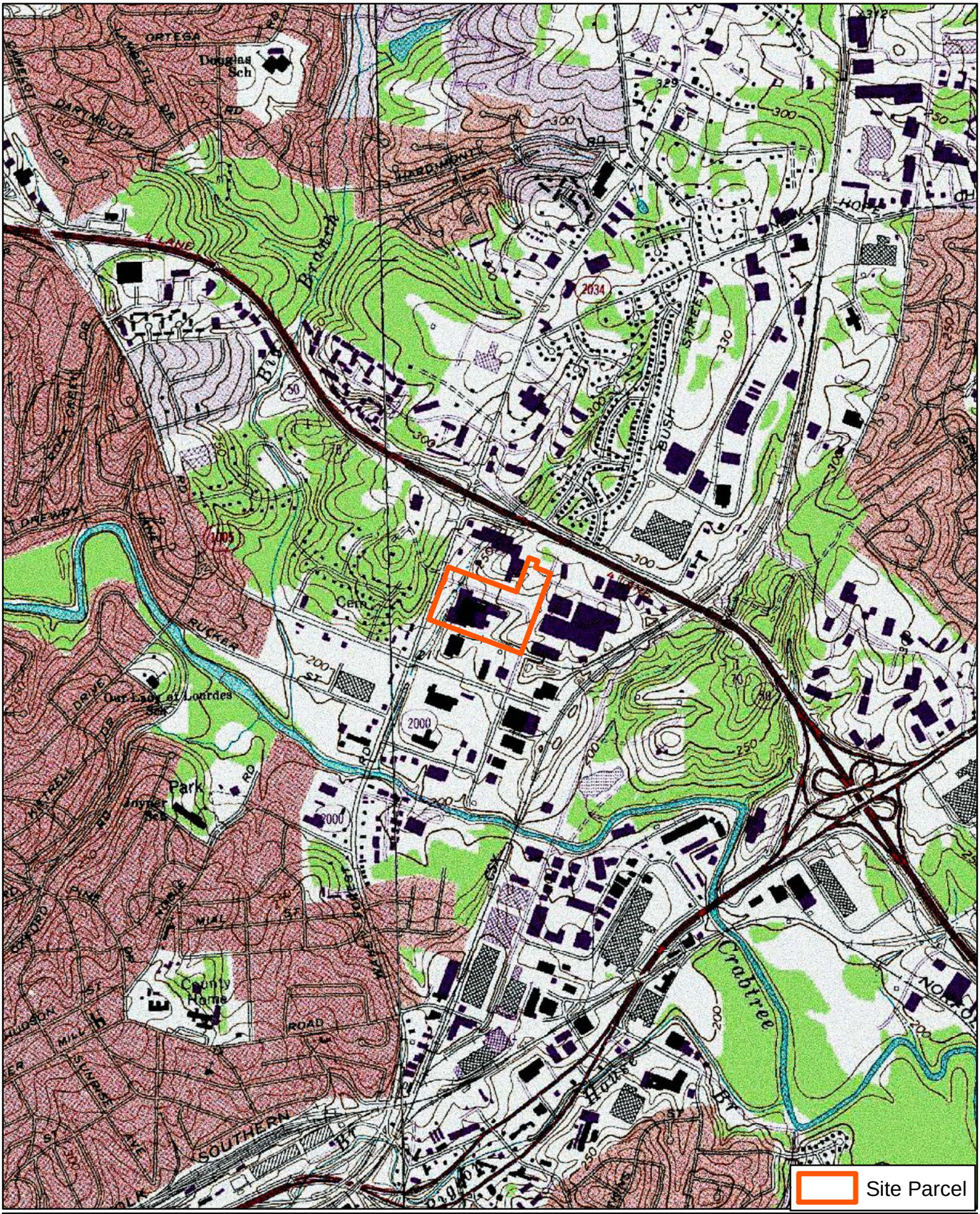
11.0 REFERENCES

AMEC Environment & Infrastructure, *Corrective Measures Study*, October 2010.

USEPA Region IV, SESD *Field Branches Quality System and Technical Procedures,* SESDPLAN-001-R4, January 2012.

USEPA, *Sampling and Analysis Plan Guidance and Template*, Version 2, R9QA/002.1, April 2000.

FIGURES



AMEC Earth & Environmental 4021 Stirrup Creek Drive, Suite 100 Durham, NC 27703	CLIENT: ALCATEL-LUCENT USA, INC RALEIGH, NORTH CAROLINA	amec	FIGURE: 1	TITLE: SITE AREA MAP	
	SITE: FORMER ALCATEL USA FACILITY 2912 WAKE FOREST ROAD RALEIGH, NORTH CAROLINA 27609		DATE: 02/20/2013	DR: CPM / PROJ.: 565280000	CHK: HWT / SCALE: 1" = 1500'

AMEC Environment & Infrastructure 4021 Stirrup Creek Drive, Suite 100 Durham, NC 27703	**CLIENT:** **ALCATEL LUCENT USA, INC.** **RALEIGH, NORTH CAROLINA**	**SITE LOCATION:** **FORMER ALCATEL USA SOURCING FACILITY** 2912 WAKE FOREST ROAD RALEIGH, NORTH CAROLINA 27609	**Figure No.** **2**
amec	**TITLE:** **SITE LAYOUT**	**SCALE:** 1 " = 100 ' / **Date: February 20, 2013** / **PROJECT: 565280000** **DRAWN BY: A. Crain** / **CHECKED BY: H. Thurston**	

P:\1RAL Projects\ProjectFiles\Alcatel-Lucent USA, Inc\565280000- Alcatel Lucent 2010-2011 Raleigh, NC\October 2012 Semi-Annual\GIS drawings

TABLES

AMEC Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, North Carolina 27703
Tel: (919) 381-9900
Fax: (919) 381-9901
www.amec.com

Table 1
Well Construction Details
Alcatel-Lucent USA
Raleigh, North Carolina

Well	Top of Casing Elevation (feet)	Ground Surface Elevation (feet)	Total Well Depth (feet)	Depth to Top of Screen (feet)	Screen Length (feet)	Screened Interval		Well Information		
						Top	Bottom	Well Type	Well Casing Diam.	Surf. Casing Diam.
MW-1s	228.40	229.25	19.00	9.00	10.00	9.00	19.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-2d	225.81	226.14	65.00	55.00	10.00	55.00	65.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-2dr	224.29	224.64	88.00	73.00	15.00	73.00	88.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-2s	225.59	225.99	18.00	8.00	10.00	8.00	18.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-3d	228.48	228.64	70.00	55.00	15.00	55.00	70.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-3s	228.55	228.74	20.50	10.50	10.00	10.50	20.50	Monitoring	2-inch Sch. 40 PVC	N/A
MW-4d	226.44	226.68	67.00	37.00	30.00	37.00	67.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-4dd	226.53	Unknown	142.00	132.00	10.00	132.00	142.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-4s	226.17	226.57	15.00	10.00	5.00	10.00	15.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-5s	228.40	229.25	20.00	10.00	10.00	10.00	20.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-6s	229.16	229.58	20.30	10.30	10.00	10.30	20.30	Monitoring	2-inch Sch. 40 PVC	N/A
MW-7d	229.35	229.53	70.00	50.00	20.00	50.00	70.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-7s	229.27	229.56	19.00	9.00	10.00	9.00	19.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-8s	229.34	229.46	20.00	10.00	10.00	10.00	20.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-9s	243.17	243.42	18.00	8.00	10.00	8.00	18.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-10s	252.71	253.09	24.00	14.00	10.00	14.00	24.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-11s	228.84	229.13	14.00	4.00	10.00	4.00	14.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-12s	228.39	226.82	20.00	10.00	10.00	10.00	20.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-13d	229.42	Unknown	35.00	Unknown	Unknown	Unknown	Unknown	Monitoring	2-inch Sch. 40 PVC	N/A
MW-13s	229.48	229.80	15.00	5.00	10.00	5.00	15.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-14d	227.40	Unknown	56.00	36.00	20.00	36.00	56.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-15d	210.82	Unknown	77.00	62.00	15.00	62.00	77.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-15s	210.47	Unknown	22.80	5.00	18.00	5.00	23.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-16d	231.89	232.22	80.00	Unknown	Unknown	Unknown	Unknown	Monitoring	2-inch Sch. 40 PVC	N/A
MW-1sk	Unknown	Unknown	20.00	10.00	10.00	10.00	20.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-1ik	Unknown	Unknown	42.50	37.50	5.00	37.50	42.50	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-2ik	223.36	226.20	40.90	32.00	10.00	32.00	42.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-2sk	223.47	226.39	20.00	10.00	10.00	10.00	20.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-3dk	225.90	Unknown	33.23	Unknown	Unknown	Unknown	Unknown	Monitoring	2-inch Sch. 40 PVC	N/A
MW-3sk	225.51	225.92	17.00	7.00	10.00	7.00	17.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-4sk	Unknown	227.10	19.00	9.00	10.00	9.00	19.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-5sk	215.28	220.95	24.00	14.00	10.00	14.00	24.00	Monitoring	2-inch Sch. 40 PVC	N/A

Table 1
Well Construction Details
Alcatel-Lucent USA
Raleigh, North Carolina

Well	Top of Casing Elevation (feet)	Ground Surface Elevation (feet)	Total Well Depth (feet)	Depth to Top of Screen (feet)	Screen Length (feet)	Screened Interval		Well Information		
						Top	Bottom	Well Type	Well Casing Diam.	Surf. Casing Diam.
MW-6sk	Unknown	226.93	23.00	13.00	10.00	13.00	23.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-6ik	Unknown	226.94	58.00	53.00	5.00	53.00	58.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-7sk	Unknown	226.99	23.00	13.00	10.00	13.00	23.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-7ik	Unknown	227.01	73.00	58.00	15.00	58.00	73.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-8sk	Unknown	225.37	20.00	10.00	10.00	10.00	20.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-8ik	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Monitoring	2-inch Sch. 40 PVC	N/A
MW-8dk	225.31	225.75	80.00	50.00	30.00	50.00	80.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-9dk	216.95	216.42	70.00	55.00	15.00	55.00	70.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-9sk	217.04	216.34	46.00	6.00	40.00	6.00	46.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-12dk	221.85	221.84	65.00	Unknown	Unknown	Unknown	Unknown	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
RW-1	223.80	227.12	24.00	9.00	9.00	9.00	18.00	Recovery	6-inch Sch. 40 PVC	N/A
RW-2	220.61	225.27	40.00	15.00	25.00	15.00	40.00	Recovery	6-inch Sch. 40 PVC	N/A
RW-2R	Unknown	Unknown	85.00	10.00	75.00	10.00	85.00	Recovery	6-inch Sch. 40 PVC	N/A
RW-3	221.50	Unknown	85.00	10.00	75.00	10.00	85.00	Recovery	6-inch Sch. 40 PVC	N/A
RW-4	221.18	Unknown	85.00	10.00	65.00	10.00	75.00	Recovery	6-inch Sch. 40 PVC	N/A
RW-5	220.83	Unknown	88.00	7.00	65.00	7.00	72.00	Recovery	6-inch Sch. 40 PVC	N/A
RW-6	220.98	Unknown	74.00	13.00	40.00	13.00	53.00	Recovery	6-inch Sch. 40 PVC	N/A
RW-7	220.29	Unknown	85.00	10.00	75.00	10.00	85.00	Recovery	6-inch Sch. 40 PVC	N/A
RW-8	219.18	Unknown	48.00	10.00	38.00	10.00	48.00	Recovery	6-inch Sch. 40 PVC	N/A
RW-9	217.97	Unknown	48.00	13.00	35.00	13.00	48.00	Recovery	6-inch Sch. 40 PVC	N/A
RW-10	215.35	Unknown	52.00	10.00	42.00	10.00	52.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-1	211.74	Unknown	35.00	6.00	29.00	6.00	35.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-2	212.10	Unknown	32.00	7.00	25.00	7.00	32.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-3	212.44	Unknown	33.00	8.00	25.00	8.00	33.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-4	211.64	Unknown	35.00	10.00	25.00	10.00	35.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-5	213.87	Unknown	44.00	9.00	35.00	9.00	44.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-6	214.77	Unknown	45.00	35.00	10.00	35.00	45.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-7	215.90	Unknown	85.00	10.00	75.00	10.00	85.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-8	216.61	Unknown	80.00	10.00	70.00	10.00	80.00	Recovery	6-inch Sch. 40 PVC	N/A

Table 1
Well Construction Details
Alcatel-Lucent USA
Raleigh, North Carolina

Well	Top of Casing Elevation (feet)	Ground Surface Elevation (feet)	Total Well Depth (feet)	Depth to Top of Screen (feet)	Screen Length (feet)	Screened Interval		Well Information		
						Top	Bottom	Well Type	Well Casing Diam.	Surf. Casing Diam.
CRW-9	216.78	Unknown	75.00	7.00	68.00	7.00	75.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-10	216.97	Unknown	83.00	10.00	73.00	10.00	83.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-11	217.12	Unknown	80.00	10.00	70.00	10.00	80.00	Recovery	6-inch Sch. 40 PVC	N/A
CRW-12	217.46	Unknown	80.00	10.00	70.00	10.00	80.00	Recovery	6-inch Sch. 40 PVC	N/A
IW-1	223.87	Unknown	31.00	5.50	25.00	5.50	30.50	Injection	Unknown	Groundwater Injection
IW-2	228.80	Unknown	29.00	4.00	25.00	4.00	29.00	Injection	Unknown	Groundwater Injection
IW-3	224.50	Unknown	30.00	8.00	22.00	8.00	30.00	Injection	Unknown	Groundwater Injection
IW-4	225.28	Unknown	30.00	10.00	20.00	10.00	30.00	Injection	Unknown	Groundwater Injection
IW-5	228.68	Unknown	27.00	7.00	20.00	7.00	27.00	Injection	Unknown	Groundwater Injection
IW-6	225.66	Unknown	28.00	8.00	20.00	8.00	28.00	Injection	Unknown	Groundwater Injection
IW-7	225.11	Unknown	25.00	5.00	20.00	5.00	25.00	Injection	Unknown	Groundwater Injection
IW-8	225.86	Unknown	29.00	4.00	25.00	4.00	29.00	Injection	Unknown	Groundwater Injection
INJ-1b	NM	NM	61.00	Unknown	None	Open Hole 18 to 61		Injection	Unknown	Groundwater Injection
INJ-2b	NM	NM	61.00	Unknown	None	Open Hole 18.1 to 61		Injection	Unknown	Groundwater Injection
INJ-3s	NM	NM	22.00	Unknown	5.00	17.00	22.00	Injection	Unknown	Groundwater Injection
INJ-4s	NM	NM	21.00	Unknown	5.00	16.00	21.00	Injection	Unknown	Groundwater Injection
INJ-5s	NM	NM	25.00	Unknown	5.00	20.00	25.00	Injection	Unknown	Groundwater Injection
MW-17i	229.72	Unknown	30.00	Unknown	10.00	20.00	30.00	PWR	2-inch Sch. 40 PVC	N/A
MW-18i	228.88	229.23	28.00	Unknown	10.00	18.00	28.00	PWR	2-inch Sch. 40 PVC	N/A
MW-19i	228.83	229.15	30.00	Unknown	10.00	20.00	30.00	PWR	2-inch Sch. 40 PVC	N/A
MW-20i	228.95	229.20	31.00	Unknown	10.00	21.00	31.00	PWR	2-inch Sch. 40 PVC	N/A
MW-21i	228.95	229.22	37.00	Unknown	10.00	27.00	37.00	PWR	2-inch Sch. 40 PVC	N/A
MW-22i	229.88	Unknown	35.00	Unknown	10.00	25.00	35.00	PWR	2-inch Sch. 40 PVC	N/A
MW-22s	228.85	229.21	20.00	10.00	10.00	10.00	20.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-23s	227.07	227.42	18.00	8.00	10.00	8.00	18.00	Monitoring	2-inch Sch. 40 PVC	N/A
MW-24d	228.99	229.32	44.00	34.00	10.00	34.00	44.00	Monitoring	2-inch Sch. 40 PVC	6-inch Sch. 40 PVC
MW-24s	229.45	229.74	20.00	10.00	10.00	10.00	20.00	Monitoring	2-inch Sch. 40 PVC	N/A

Notes:
NM = Not Measured
N/A = Not Applicable
Shading indicates well has been abandoned.

Table 2
Monitoring Well Schedule
Alcatel-Lucent USA
Raleigh, North Carolina

Analyses Requested					Contract Laboratory Program Analytical Services	
Chemistry Type					Organics	
Specific Analyses Requested					VOCs (6200)	1,4-dioxane (8260)
Preservatives					HCl	HCl
Analytical Holding Time					Hold <14 days	Hold <14 days
Number of Samples x Number of Sample Containers					No. of Containers	No. of Containers
Sample Name	**Sample Location**	**Sample Depth**	**Order of Sampling**	**Pump Type**	**3 x 40 mL glass vials**	
MW-2dr	MW-2dr	78	1	Submersible	3 x 40 mL glass vials	
MW-2s	MW-2s	13	2	Peristaltic	3 x 40 mL glass vials	
MW-3d	MW-3d	62	9	Submersible	3 x 40 mL glass vials	
MW-4s	MW-4s	13	8	Peristaltic	3 x 40 mL glass vials	
MW-05sk	MW-05sk	19	6	Submersible	3 x 40 mL glass vials	
MW-09dk	MW-09dk	62	7	Submersible	3 x 40 mL glass vials	
MW-09sk	MW-09sk	26	3	Submersible	3 x 40 mL glass vials	
MW-12dk	MW-12dk	60	4	Submersible	3 x 40 mL glass vials	
MW-12s	MW-12s	15	5	Peristaltic	3 x 40 mL glass vials	
MW-18i	MW-18i	23	11	Submersible	3 x 40 mL glass vials	
MW-19i	MW-19i	25	10	Submersible	3 x 40 mL glass vials	
MW-21i	MW-21i	32	14	Submersible	3 x 40 mL glass vials	
MW-22s	MW-22s	15	13	Peristaltic	3 x 40 mL glass vials	
MW-23s	MW-23s	13	16	Peristaltic	3 x 40 mL glass vials	
MW-24s	MW-24s	15	15	Peristaltic	3 x 40 mL glass vials	
MW-24d	MW-24d	39	12	Submersible	3 x 40 mL glass vials	
EQ-1	N/A	N/A	N/A	Submersible	3 x 40 mL glass vials	
DUP-1	TBD	TBD	TBD	TBD	3 x 40 mL glass vials	
DUP-2	TBD	TBD	TBD	TBD	3 x 40 mL glass vials	
Trip-1	N/A	N/A	N/A	N/A	3 x 40 mL glass vials	
Trip-2	N/A	N/A	N/A	N/A	3 x 40 mL glass vials	

Notes:
EQ - Equipment Blank
DUP - Duplicate Sample
TDB - To Be Determined
Trip - Trip Blank
N/A - Not Applicable
HCl - Hydrochloric Acid
mL - milliliter

Table 3
Typical Groundwater Limits and
Standards for Constituents of Concern
Alcatel-Lucent USA
Raleigh, North Carolina

Volatile Organic Analyte	Method	MDL (µg/l)	RL (µg/l)	NC 2L Groundwater Standard (µg/l)
1,1,1,2-Tetrachloroethane	6200B	0.070	0.50	1*
1,1,1-Trichloroethane	6200B	0.075	0.50	200
1,1,2,2-Tetrachloroethane	6200B	0.075	0.50	0.2
1,1,2-Trichloroethane	6200B	0.068	0.50	0.6*
1,1-Dichloroethane	6200B	0.038	0.50	6
1,1-Dichloroethylene	6200B	0.057	0.50	7
1,1-Dichloropropylene	6200B	0.072	0.50	NE
1,2,3-Trichlorobenzene	6200B	0.12	0.50	NE
1,2,3-Trichloropropane	6200B	0.090	0.50	0.005
1,2,4-Trichlorobenzene	6200B	0.15	0.50	70
1,2,4-Trimethylbenzene	6200B	0.038	0.50	400
1,2-Dibromo-3-chloropropane	6200B	0.59	2.0	0.04
1,2-Dibromoethane	6200B	0.041	0.50	NE
1,2-Dichlorobenzene	6200B	0.044	0.50	20
1,2-Dichloroethane	6200B	0.054	0.50	0.4
1,2-Dichloropropane	6200B	0.062	0.50	0.6
1,3,5-Trimethylbenzene	6200B	0.038	0.50	400
1,3-Dichlorobenzene	6200B	0.070	0.50	200
1,3-Dichloropropane	6200B	0.054	0.50	0.4
1,4-Dichlorobenzene	6200B	0.059	0.50	6
2,2-Dichloropropane	6200B	0.27	2.0	NE
2-Chlorotoluene	6200B	0.038	0.50	100
4-Chlorotoluene	6200B	0.053	0.50	24*
4-Isopropyltoluene	6200B	0.059	0.50	25*
Acetone	6200B	1.5	10	6,000
Benzene	6200B	0.054	0.50	1
Bromobenzene	6200B	0.088	0.50	NE
Bromochloromethane	6200B	0.050	0.50	NE
Bromodichloromethane	6200B	0.031	0.50	0.6
Bromoform	6200B	0.10	0.50	4
Bromomethane	6200B	0.24	1.0	10*
Carbon Tetrachloride	6200B	0.065	0.50	0.3
Chlorobenzene	6200B	0.025	0.50	50
Chloroethane	6200B	0.088	0.50	3,000
Chloroform	6200B	0.053	0.50	70
Chloromethane	6200B	0.032	0.50	3
cis-1,2-Dichloroethylene	6200B	0.061	0.50	70
cis-1,3-Dichloropropylene	6200B	0.065	0.50	0.4
Dibromochloromethane	6200B	0.062	0.50	0.4
Dibromomethane	6200B	0.044	0.50	70*

Table 3
Typical Groundwater Limits and
Standards for Constituents of Concern
Alcatel-Lucent USA
Raleigh, North Carolina

Volatile Organic Analyte	Method	MDL (µg/l)	RL (µg/l)	NC 2L Groundwater Standard (µg/l)
Dichlorodifluoromethane	6200B	0.057	1.0	1,000
Ethanol	6200B	42	200	4,000*
Ethylbenzene	6200B	0.054	0.50	600
Hexachlorobutadiene	6200B	0.41	2.0	0.4
Isopropyl Ether	6200B	0.042	0.50	70
Isopropylbenzene (Cumene)	6200B	0.034	0.50	70
m,p-Xylenes	6200B	0.11	1.0	500
Methyl Butyl Ketone (2-Hexanone)	6200B	0.11	1.0	40*
Methyl Ethyl Ketone (2-Butanone)	6200B	0.83	5.0	4,000
Methyl Isobutyl Ketone	6200B	0.048	1.0	100*
Methylene Chloride	6200B	0.073	2.0	5
Methyl-tert-Butyl Ether	6200B	0.056	1.0	20
Naphthalene	6200B	0.094	1.0	6
n-Butylbenzene	6200B	0.059	0.50	70
n-Propylbenzene	6200B	0.059	0.50	70*
o-Xylene	6200B	0.064	0.50	500
sec-Butylbenzene	6200B	0.054	0.50	70
Styrene	6200B	0.034	0.50	70
tert-Amyl Alcohol	6200B	0.72	10	NE
tert-Amyl Methyl Ether	6200B	0.21	10	128*
tert-Butyl Alcohol	6200B	0.52	10	NE
tert-Butylbenzene	6200B	0.11	0.50	NE
tert-Butyl Ethyl Ether	6200B	0.24	10	NE
tert-Butyl Formate	6200B	0.85	10	NE
Tetrachloroethylene	6200B	0.096	0.50	0.7
Toluene	6200B	0.057	0.50	600
trans-1,2-Dichloroethylene	6200B	0.061	0.50	100*
trans-1,3-Dichloropropylene	6200B	0.054	0.50	0.4
Trichloroethylene	6200B	0.044	0.50	3
Trichlorofluoromethane	6200B	0.050	0.50	2,000
Vinyl acetate	6200B	1.3	5.0	88*
Vinyl chloride	6200B	0.068	0.50	0.03
Xylenes, total	6200B	0.17	1.5	500
1,4-Dioxane	8260 (SIM)	1.3	3.0	3

Notes:
MDL - Method Detection Limit
RL - Reporting Limit
µg/l - micrograms per liter
NC 2L Groundwater Standard - Groundwater standards established under 15A NCAC 2L .0202.
*Interim Maximum Allowable Concentrations established under 15A MCAC 2L .0202.

Table 4
Typical Quality Control Requirements and Corrective Actions
Alcatel-Lucent USA
Raleigh, North Carolina

Audit	Frequency	Control Limits	Corrective Action
Holding times	Samples must be extracted and analyzed within holding time.	VOCs: Analyze within 14 days from collection.	1. If holding times are exceeded for initial or any re-analyses required due to QC excursions, notify QAO* immediately since re-sampling may be required. 2. Document corrective action in the case narrative.
MS Tuning	Once every 12 hours, or per lab SOP, prior to initial calibration and calibration verifications.	1. BFB key ions and abundance criteria listed in the method must be met for all 9 ions. 2. Part of the BFB peak will not be background subtracted to meet tune criteria. 3. Documentation of all BFB analyses and evaluation must be included in the data packages.	1. Tune the mass spectrometer. 2. Document corrective action in the case narrative - samples cannot be analyzed until control limit criteria have been met.
Initial Calibration	Prior to sample analysis and when calibration verifications criteria are not met. Initial calibration will contain all target analytes in each standard.	1. Five concentrations bracketing expected concentration range for all compounds of interest; one std must be near the RL. 2. CCC compounds <30% RSD, remaining compounds <50% RSD. 3. SPCC RF as listed in method, non-SPCC > 0.050 RF except for ketones and 2-chloroethyl vinyl ether with RF > 0.010. 4. For compound with %RSD >15, quantitation must be performed using a separate calibration curve and the COD must be >0.99.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action in the case narrative - samples cannot be analyzed until calibration control limit criteria are met. Contact QAO* to discuss problem target analytes before proceeding with analysis.
Calibration Verification	Every 12 hours or per lab SOP, following BFB. The calibration verification will contain all target analytes in each standard at a concentration that is representative of the midpoint of the initial calibration.	1. Within method specified criteria, and percent drift or percent difference (%D) < 20 for CCC compounds, < 50% D for remaining compounds, SPCC RF same as listed in initial calibration. 2. The internal standards areas and retention times must meet the method criteria.	1. Re-analyze. 2. If criteria are still not met, identify and correct problem, recalibrate and notify QAO*. 3. Document corrective action in the case narrative - samples cannot be analyzed until calibration control limit criteria are met.
Preparation Blank Analysis	Every 12 hours, following calibration verification	Common laboratory contaminants (methylene chloride, acetone) less than 3 X RL; anything else less than RL. RLs will be provided along with the preparation blank results.	1. Re-analyze blank. 2. If limits are still exceeded, contact QAO*, clean instrument, recalibrate analytical system, and reanalyze all samples if detected for same compounds as in blank. 3. Document corrective action in the case narrative - samples cannot be analyzed until blank criteria have been met.
Field / Equipment Blank Analysis	Collected one per sampling equipment and after every 20 samples.	Common laboratory contaminants less than 3 X RL; anything else less than RL.	1. Investigate problem, contact QAO*. 2. Document in the case narrative.

Table 4
Typical Quality Control Requirements and Corrective Actions
Alcatel-Lucent USA
Raleigh, North Carolina

Audit	Frequency	Control Limits	Corrective Action
Trip Blank	1 per cooler containing VOC samples.	Common laboratory contaminants less than 3 X RL; anything else less than RL.	1. Investigate problem, contact QAO*. 2. Document in the case narrative.
Laboratory Control Sample Analysis	Each analytical batch. Prepared independently from calibration standards. Spike must contain all target analyte and should be at a concentration, which is in the lower 1/2 of the calibration curve.	Recovery within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used.	1. If recovery failures are above control limits and these compounds are not detected in the associated samples, contact QAO*. 2. If recovery failures are below control limits, reanalyze LCS and examine results of other QC analyses. 3. If recovery is still outside limits, and other QC criteria are met, contact QAO*. 4. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and re-analyze samples since last satisfactory LCS. 5. Document corrective action in the case narrative.
Internal Standards	All samples and blanks (including MS/MSD)	1. Response -50% - +100% of internal standards from continuing calibration of the day. 2. RT must be ± 30 sec. from associated calibration verification standard of that sequence.	1. Re-analyze. 2. If still outside of the limits, report both analyses, and contact the QAO*. 3. Document corrective action in the case narrative. Special Circumstances: If matrix interferences is present (as demonstrated by the lab and documented in the case narrative): 1. Re-analyze (may be at a higher dilution) 2. If internal standard is >10%, report both runs. 3. If internal standard is <10%, report both runs and contact QAO*.
Surrogate Spike	All samples and blanks (including MS/MSD)	Recovery within laboratory control limits.	1. Re-analyze any environmental or QC sample with surrogates that exceed control limits, unless the surrogate recovery is greater than upper control limit, and is within 25% of the upper limit value, and all of the target analytes are not detected in the sample result. 2. If still outside of the limits, report both analyses and contact the QAO*. 3. Document corrective action in the case narrative. Special Circumstances: If matrix interference is present (as demonstrated by the lab and documented in the case narrative): 1. Re-analyze (may be at a higher dilution) 2. If surrogate recovery is >10%, report both runs. 3. If surrogate recovery is <10%, report both runs and contact QAO*.

Table 4
Typical Quality Control Requirements and Corrective Actions
Alcatel-Lucent USA
Raleigh, North Carolina

Audit	Frequency	Control Limits	Corrective Action
Matrix Spike/ Matrix Spike Dup. (MS/MSD) Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	Recovery and RPD within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used. Spike must contain target analytes.	1. Re-analyze if <10%. 2. If re-analysis is still <10%, report both analyses and document in the case narrative. 2. If >10% and LCS criteria are met, document in case narrative; no additional corrective action required. 3. If LCS criteria are exceeded also, examine other QC data for source of problem; i.e., surrogate recoveries for extraction efficiency and calibration data for instrument performance issues, and contact QAO*. Re-extract or re-analyze samples and associated MS/MSD and LCSs as required. 4. Document corrective action in the case narrative
Field Dup. Analysis	Collected 1 per matrix; every 20 samples of similar matrix	50% RPD for waters and 100% RPD for soil. For sample results that are less than or equal to five times the RL, the criterion of plus or minus two times the RL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.
Tentatively Identified Compound	If required, perform for each sample and blank analysis. Non-target compounds will be reported using a Mass Spectral Library search.	Not applicable	Not applicable
Dilutions	1. When target analyte concentration exceeds upper limit of calibration curve. 2. When matrix interference is demonstrated by the lab (e.g., highly viscous samples or a large number of non-target peaks on the chromatogram). 3. A reagent blank will be analyzed if an analyte saturates the detector or if highly concentrated analytes are detected. 4. Laboratory will note in the data deliverables which analytical runs were reported.	1. The reagent blank will meet the method blank criteria.	1. Re-analyze reagent blank until method blank criteria are met. 2. Document corrective action in the case narrative.
pH Determinatio n	Once sample aliquot is taken from the VOC vial, the pH of water samples must be determined.	Record pH and report in the case narrative.	Not applicable
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable	Not applicable

Table 4
Typical Quality Control Requirements and Corrective Actions
Alcatel-Lucent USA
Raleigh, North Carolina

Audit	Frequency	Control Limits	Corrective Action
Laboratory control limits	1. Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable
Percent solids	For soil/sediment samples, the percent solids will be determined and sample results will be corrected for percent solids.	Not applicable	Not applicable
Deliverables	1. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 2. Final spiking concentrations will be presented in summary form.	Not applicable	
Method and QAPP requirements	The laboratory will perform the method as presented in this generic QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable

Notes:
*****indicates that data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods. Excursions from QA/QC criteria will be qualified based on guidance provided in this generic QAPP.
QAO* indicates that communications with the QAO will be documented and included in the data packages.

Table 5
Field Equipment Manufacturer's Calibration Requirements
Alcatel-Lucent USA
Raleigh, North Carolina

Equipment	Calibration Standards	Frequency	Control Limits	Corrective Actions
PID	N/A	Monthly	+/- 5%	Contact Manufacturer
Multiparameter	pH: 4.01, 6.86, 7.01, 9.18, and 10.01 or 1 custom buffer	Prior to Use	+/- 0.02 pH	Contact Manufacturer
	DO: 0 and 100% or 1 custom point		0.00 to 30.00 mg/L: +/- 1.5% of reading or 0.10 mg/L whichever is greater; 30.0 mg/L to 50.0 mg/L: +/- 3% of reading	
	Conductivity: (84 µS/cm, 1413 µS/cm, 5.00 mS/cm, 12.88 mS/cm, 80 mS/cm, and 111.8 mS/cm or custom point		+/- 1% of reading or +/- 1 µS/cm, whichever is greater	
	ORP:		+/- 1.0 mV	
Combo pH & EC	Temperature: automatic	Prior to Use	+/- 0.5 ºC	Contact Manufacturer
	pH: 4.01/7.01/10.01 or 4.01/6.86/9.18		+/- 0.05 pH	
Portable Turbidimeter	<0.1 NTU, 15 NTU, 100 NTU and 750 NTU	Prior to Use	+/- 2% or reading plus 0.02 NTU	Contact Manufacturer

APPENDIX A

PRISM LABORATORIES, INC. QUALITY ASSURANCE PLAN

AMEC Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, North Carolina 27703

Tel: (919) 381-9900
Fax: (919) 381-9901

www.amec.com

QUALITY ASSURANCE PLAN

Document Control No: 043012-06

PRISM LABORATORIES, INC.
449 Springbrook Road
Charlotte, NC 28217
(704)529-6364

Organizational units covered by this plan:

Project Management
Field Services
Sample Receiving
Metals Analysis
Organics Analysis
Wet-Chemistry Analysis
Bacteriological Analysis

Helmuth M.B. Janssen, Lab director / QA Manager	5/2/2012
Steven H. Guptill, Technical Director / Customer Service Manager	5/2/2012
Harold W. Cline, Technical Director / QA Officer	5/2/2012
Paul J. Fitzgerald, Technical Director / QA Officer	5/2/2012
Angela D. Overcash, Vice President of Customer Service	5/2/2012
Robbi A. Jones, President	5/2/2012

No part of this document may be reproduced in any form or by any means without the written permission of
PRISM LABORATORIES, INC., Charlotte, NC 28217

TABLE OF CONTENTS

QA PLAN ELEMENTS

Section	Title	Page	Revision Date
1.0	TITLE PAGE	1 of 1	04/30/2012
2.0	TABLE OF CONTENTS	1 of 7	04/30/2012
3.0	STATEMENT OF POLICY	1 of 1	04/30/2012
4.0	ORGANIZATION AND RESPONSIBLITIES	1 of 20	04/30/2012
4.1	Introduction	1 of 20	
4.2	President	2 of 20	
4.3	Vice President of Analytical Services	3 of 20	
4.4	Vice President of Client Services and New Business Development	4 of 20	
4.5	Laboratory Director (Technical Director)	5 of 20	
4.6	Assistant Laboratory Director (Technical Director)	6 of 20	
4.7	Quality Assurance Manager	7 of 20	
4.8	Quality Assurance Assistant	8 of 20	
4.9	Department Manager (Deputy Technical Director)	9 of 20	
4.10	Group Supervisor/Lead Analyst	10 of 20	
4.11	Sample Receiving Technician	11 of 20	
4.12	Laboratory Analyst	12 of 20	
4.13	Laboraotory Technician	13 of 20	
4.14	Field Services Technician	14 of 20	
4.15	Data entry specialist/data package coordinator	15 of 20	
4.16	Project Manager	16 of 20	
4.17	Deputies to cover Absences	17 of 20	
4.18	Management Team	17 of 20	
4.19	Employee Training	17 of 20	
4.19.1	Orientation	17 of 20	
4.19.2	Basic Laboratory Equipment, Techniques and Procedures	17 of 20	
4.19.3	SOP Training	17 of 20	
4.19.3.1	Initial Demonstration of Capability	18 of 20	
4.19.3.2	On-going Demonstraion of Capability	18 of 20	
4.19.3.3	Ethics and Data Integrity	18 of 20	
4.19.3.3.1	Ethics and Data Integrity Training	18 of 20	
4.19.3.3.2	Employee Training Documentation	19 of 20	
4.19.3.3.3	Monitoring	19 of 20	
4.19.3.3.4	Procedure Documentation	19 of 20	
4.19.4	Documentation	19 of 20	
4.20	Organizational Chart	20 of 20	
5.0	QA TARGETS FOR PRECISION, ACCURACY, METHOD DETECTION LIMITS AND REPORTING LIMITS	1 of 50	04/30/2012
6.0	SAMPLING PROCEDURES	1 of 12	04/12/2011
6.1	Introduction	1 of 12	
6.2	Sampling Capabilities	1 of 12	

TABLE OF CONTENTS

QA PLAN ELEMENTS

Section	Title	Page	Revision Date
	6.3 Field Measurement Capabilities	2 of 12	
	6.4 Sampling Equipment	2 of 12	
	6.5 Sample Containers	5 of 12	
	6.6 Sample Preservation	5 of 12	
	6.7 Documentation	5 of 12	
7.0	SAMPLE CUSTODY AND DOCUMENTATION	1 of 12	04/12/2011
	7.1 Chain-of-Custody	1 of 12	
	7.1.1 Routine Chain-of-Custody	1 of 12	
	7.1.2 Legal Chain-of-Custody	2 of 12	
	7.2 Laboratory Custody Procedures	2 of 12	
	7.2.1 Sample Shipping Container Preparation	3 of 12	
	7.2.2 Sample Receipt	3 of 12	
	7.2.3 Sample Log-In	3 of 12	
	7.2.4 Sample Storage	4 of 12	
	7.2.5 Sample Distribution and Tracking	4 of 12	
	7.2.6 Inter-laboratory Custody	5 of 12	
	7.2.6.1 Sub-samples	5 of 12	
	7.2.7 Sample Extracts and Digestates	5 of 12	
	7.3 Electronic Data Records	5 of 12	
	7.3.1 Computer Security	5 of 12	
	7.3.2 Computer Maintenance	6 of 12	
8.0	ANALYTICAL PROCEDURES	1 of 5	04/30/2012
	8.1 Analytical Methods	1 of 5	
	8.2 Standard Operating Procedures	1 of 5	
	8.3 Glassware Cleaning Procedures	1 of 5	
	8.4 Laboratory Reagent and Standard Storage	1 of 5	
	8.5 Sample Aliquots	2 of 5	
	8.5.1 Aqueous/Liquid Samples	2 of 5	
	8.5.2 Solid Samples	2 of 5	
	8.6 Sample and Waste Disposal	2 of 5	
	8.6.1 Summary	2 of 5	
	8.6.2 Disposal Procedures	2 of 5	
	8.6.2.1 Return to Client	3 of 5	
	8.6.2.2 Internal Sample Disposal – Waters	3 of 5	
	8.6.2.3 Internal Sample Disposal – Solids/Other	3 of 5	
9.0	CALIBRATION PROCEDURES AND FREQUENCY	1 of 13	04/30/2012
	9.1 Laboratory Instrumentation	1 of 13	
	9.2 Standard Receipt and Traceability	1 of 13	
	9.3 Standard Sources and Preparation	1 of 13	
	9.3.1 Standardization of Titrating Solutions	1 of 13	

TABLE OF CONTENTS

QA PLAN ELEMENTS

Section	Title	Page	Revision Date
	9.4 Instrument Performance Parameters	2 of 13	
	9.4.1 GC/MS Instrument Performance Parameters	2 of 13	
	9.4.2 Metals Analysis Instrument Performance Parameters	3 of 13	
	9.4.3 Miscellaneous Equipment Calibration	4 of 13	
	9.4.3.1 Thermometers	4 of 13	
	9.4.3.2 Balances	4 of 13	
	9.4.3.3 Pipettors	4 of 13	
	9.4.3.4 Refrigerators, Incubators and ovens	4 of 13	
	9.4.3.5 Water Bath	4 of 13	
	9.4.3.6 Autoclave	5 of 13	
10.0	PREVENTIVE MAINTENANCE	1 of 3	04/12/2011
	10.1 Routine maintenance	1 of 3	
	10.2 Documentation	1 of 3	
	10.3 Contingency Plans	1 of 3	
11.0	QUALITY CONTROL PROCEDURES	1 of 6	04/12/2011
	11.1 Quality Control checks	1 of 6	
	11.1.1 General	1 of 6	
	11.1.2 Field QC	1 of 6	
	11.1.3 Organic Analyses	2 of 6	
	11.1.4 Microbiology QC	2 of 6	
	11.2 Routine Method used to assess Precision and Accuracy	2 of 6	
	11.2.1 Precision	2 of 6	
	11.2.2 Accuracy	3 of 6	
	11.3 Quality Control Charts	3 of 6	
	11.4 Formulas for Calculating Control Limits	3 of 6	
	11.4.1 Upper/Lower Control Limits	3 of 6	
	11.4.2 Upper/Lower Warning Limits	4 of 6	
	11.5 Spike Concentration Levels	4 of 6	
	11.6 Method detection Limits and Reporting Limits	4 of 6	
	11.6.1 Method detection Limits	4 of 6	
	11.6.2 Reporting Limits	5 of 6	
12.0	DATA REDUCTION, VALIDATION AND REPORTING	1 of 7	04/12/2011
	12.1 Data Reduction	1 of 7	
	12.1.1 Records	1 of 7	
	12.1.2 Metals Analyses	2 of 7	
	12.1.3 Organics analyses	3 of 7	
	12.2 Data Validation	5 of 7	
	12.2.1 Data Integrity	5 of 7	
	12.2.2 Validation of Data – Responsibilities	5 of 7	
	12.2.3 Validation of Data – Laboratory Quality Control Checks	6 of 7	

TABLE OF CONTENTS

QA PLAN ELEMENTS

Section	Title	Page	Revision Date
	12.3 Final Project Review	7 of 7	
	12.4 Data Reporting	7 of 7	
	12.5 Data Storage	7 of 7	
13.0	CORRECTIVE ACTION	1 of 3	04/12/2011
	13.1 Introduction	1 of 5	
	13.1.1 Warning Limits	1 of 5	
	13.1.2 Control Limits	1 of 5	
	13.1.3 Trends Analysis	1 of 5	
	13.2 Initiating Corrective Actions	2 of 5	
	13.3 Specific Corrective Actions	2 of 5	
	13.3.1 Instrument Blanks	3 of 5	
	13.3.2 Calibration Blanks	3 of 5	
	13.3.3 Continuing Calibration Standards	3 of 5	
	13.3.4 Internal Standards	3 of 5	
	13.3.5 Surrogates	3 of 5	
	13.3.6 Method Blanks	4 of 5	
	13.3.7 Initial Calibration Verification Standards (ICV)	4 of 5	
	13.3.8 Digestion/Extraction Matrix Spike (MS/MSD)	4 of 5	
	13.3.9 Duplicates and Duplicate Spikes	4 of 5	
	13.4 Notification of Corrective actions	4 of 5	
14.0	PERFORMANCE AND SYSTEMS AUDITS	1 of 3	04/30/2012
	14.1 Laboratory Systems Audits	1 of 3	
	14.1.1 External Systems Audits	1 of 3	
	14.1.2 Internal Systems Audits	1 of 3	
	14.2 Systems Audits of Field Operations	2 of 3	
	14.3 Performance Audits	2 of 3	
	14.3.1 Internal Performance Audit	2 of 3	
	14.3.2 External Performance Audits	2 of 3	
	14.4 Soliciting Feedback From Clients	2 of 3	
	14.5 Review of Purchased Services	3 of 3	
	14.6 Reporting Internal Audits	3 of 3	

TABLE OF CONTENTS

FIGURES

Figure	Description	Page	Revision Date
4.1	Organizational Chart ……	19 of 19	04/30/2012
7.1	Prism Chain-of-Custody Form ……	6 of 12	04/12/2011
7.2	Prism Chain-of-Custody Form for Pre-Treatment Sampling ……	7 of 12	04/12/2011
7.3	Sample Log-In Logbook ……..	8 of 12	04/12/2011
7.4	Sample Log-In Worksheet ……..	9 of 12	04/12/2011
7.5	Example of Preservation Check Form ……..	10 of 12	04/12/2011
7.6	Prism Container Label ……	11 of 12	04/12/2011
7.7	Example LIMS Sample Bottle Label ……	11 of 12	04/12/2011
7.8	Example Sample Kit Prep/Pick-up Request Form ……..	12 of 12	04/12/2011

TABLE OF CONTENTS

TABLES

Table	Description	Page	Revision Date
5.1	Wet-Chemistry Parameters in Water Matrix …….	2 of 51	04/30/2012
5.2	Wet-Chemistry Parameters in Solid Matrix ……..	5 of 51	04/30/2012
5.3	Metals by ICP/MS Method 200.8 for Surface Water and Wastewater ..……..	6 of 51	04/30/2012
5.4	Metals by ICP/MS Method 3010A/6020A for Ground water ..……...	7 of 51	04/30/2012
5.5	Metals by ICP Method 200.7 for Suface Water and Wastewater …….	8 of 51	04/30/2012
5.6	Metals by ICP Method 3010A/6010C for Ground Water …….	9 of 51	04/30/2012
5.7	Metals by ICP Method 3010A/6010C for TCLP Extracts ……...	10 of 51	04/30/2012
5.8	Metals by ICP Method 3050B/6010C for Solid Matrix …….	11 of 51	04/30/2012
5.9	Metals by CVAA and CVAFS in Water Matrix …….	12 of 51	04/30/2012
5.10	Metals by CVAA in TCLP Matrix …….	12 of 51	04/30/2012
5.11	Metals by CVAA in Solid Matrix …….	12 of 51	04/30/2012
5.12	Purgeable Aromatics in Water Matrix by GC Method EPA 602 …….	13 of 51	04/30/2012
5.13	Volatile Organics in Water Matrix by GC/MS Method SM 6000 B ……...	14 of 51	04/30/2012
5.14	Volatile Organics in Water Matrix by GC/MS Method EPA 624 ……...	17 of 51	04/30/2012
5.15	Volatile Organics in Water Matrix by GC/MS Method SW846-8260B ……..	19 of 51	04/30/2012
5.16	Volatile Organics in Solid Matrix by GC/MS Method SW846-8260B ……...	23 of 51	04/30/2012
5.17	Semi-Volatile Organics in Water Matrix by GC/MS Method EPA 625 ……..……..	26 of 51	04/30/2012
5.18	Semi-Volatile Organics in Water Matrix by GC/MS Method SW846-8270D ……..	29 of 51	04/30/2012
5.19	Semi-Volatile Organics in Solid Matrix by GC/MS Method SW846-8270D ……	34 of 51	04/30/2012
5.20	Organics in Water Matrix by Micro-extraction GC Method EPA 504.1 …….	37 of 51	04/30/2012
5.21	Organics in Water Matrix by Micro-extraction GC Method SW846-8011 …….	37 of 51	04/30/2012
5.22	Organochlorine Pesticides and PCBs in Water Matrix by GC Method EPA 608 ……...	38 of 51	04/30/2012
5.23	Organochlorine Pesticides in Water Matrix by GC Method SW846-8081B …….	39 of 51	04/30/2012
5.24	Organochlorine Pesticides in Solid Matrix by GC Method SW846-8081A ……	40 of 51	04/30/2012
5.25	PCBs in Water Matrix by GC Method SW846-8082A …….	41 of 51	04/30/2012
5.26	PCBs in Solid Matrix by GC Method SW846-8082A ……..	42 of 51	04/30/2012
5.27	PCBs in Oil Matrix by GC Method SW846-8082A ……..	43 of 51	04/30/2012
5.28	PAH in Water Matrix by GC Method EPA 610 …….	44 of 51	04/30/2012
5.29	PAH in Water Matrix by GC Method SW846-8100 …….	45 of 51	04/30/2012
5.30	PAH in Water Matrix by GCMS Method SW846-8270SIM ……..	46 of 51	04/30/2012
5.31	Gasoline Range Organics (GRO) in Water Matrix by GC Method SW846-8015C …….	47 of 51	04/30/2012
5.32	Gasoline Range Organics (GRO) in Solid Matrix by GC Method SW846-8015C …….	47 of 51	04/30/2012
5.33	Gasoline Range Organics (GRO) in Solid Matrix by GC Method SW846-8015C / 5030B	47 of 51	04/30/2012
5.34	Diesel Range Organics (DRO) in Water Matrix by GC Method SW846-3510C/8015C ……	48 of 51	04/30/2012
5.35	Diesel Range Organics (DRO) in Solid Matrix by GC Method SW846-3550B/8015C …….	48 of 51	04/30/2012

TABLE OF CONTENTS

TABLES

Table	Title	Page	Revision Date
5.36	Diesel Range Organics (DRO) in Solid Matrix by GC Method SW846-3545/8015C ……	48 of 51	04/30/2012
5.37	Volatile Petroleum Hydrocarbons (VPH) in Water Matrix by GC Method MADEP-VPH …..	49 of 51	04/30/2012
5.38	Volatile Petroleum Hydrocarbons (VPH) in Solid Matrix by GC Method MADEP-VPH ……	49 of 51	04/30/2012
5.39	Extractable Petroleum Hydrocarbons (EPH) in Water Matrix by GC Method MADEP-EPH	50 of 51	04/30/2012
5.40	Extractable Petroleum Hydrocarbons (EPH) in Solid Matrix by GC Method MADEP-EPH .	50 of 51	04/30/2012
5.41	Sample Preparation Methods ……	51 of 51	04/30/2012
6.1	Sampling Capabilities ……..	1 of 12	04/12/2011
6.2	Field Measurement Capabilities ……	2 of 12	04/12/2011
6.3	Sampling Equipment ……	2 of 12	04/12/2011
6.4	Sample Preservatives ……	6 of 12	04/12/2011
6.5	Sample Requirements for Wet-Chemistry Tests ……	7 of 12	04/12/2011
6.6	Sample Requirements for Metals Tests ……...	9 of 12	04/12/2011
6.7	Sample Requirements for Organics Tests ……...	10 of 12	04/12/2011
8.1	Glassware Cleaning Procedures ……...	4 of 5	04/12/2011
8.2	General Reagent/Standards Storage ……	5 of 5	04/12/2011
9.1	Standardization of Titrating Solutions ……...	2 of 13	04/12/2011
9.2	BFB – 4-Bromofluorobenzene Abundance Criteria ……	2 of 13	04/12/2011
9.3	DFTPP – Abundance Criteria EPA 625……	3 of 13	04/12/2011
9.4	DFTPP – Abundance Criteria SW846-8270D ……	3 of 12	04/12/2011
9.5	Major Laboratory Instrumentation/Equipment ……	6 of 13	04/12/2011
9.6	Standard Sources and Preparation ……...	11 of 13	04/12/2011
9.7	Instrument Calibration Requirements ……...	12 of 13	04/12/2011
10.1	Preventive Maintenance Activities ……	2 of 3	04/12/2011

3.0 STATEMENT OF POLICY

It is the goal of Prism Laboratories, Inc. to meet or exceed the data quality objectives (DQOs) of our clients, state and federal environmental programs, DoD ELAP and the NELAC (National Environmental Laboratory Accreditation Committee) standard and to produce data that is legally defensible and of known quality. This quality assurance plan (QAP) is a description of the procedures that must be followed to determine and control the accuracy and precision of the data generated in the laboratory. The management of Prism Laboratories, Inc. completely supports the policies and procedures described in this QAP and is committed to continually improve the quality the quality system.

Prism Laboratories, Inc. is committed to providing the resources, including facilities, equipment and personnel to ensure the adherence to the Quality Assurance and Quality Control protocols defined in this document.

Project managers are in charge of specific projects and customer groups. The project manager reviews new work to ensure that appropriate facilities and resources exist before accepting the work. Each project manager is responsible for the completeness of final data reports as they relate to assigned projects and customer DQOs. The quality assurance manager is responsible for the monitoring of the quality assurance program and will make recommendations for corrective actions to the president and vice president of analytical services.

Quality is the responsibility of every employee. All personnel will have access to this QAP and subsequent standard operating procedures (SOPs) and will strive to meet the specified requirements in these documents. The quality assurance manager will maintain the training program to ensure that all personnel has the knowledge necessary to meet the requirements of the QAP.

No deviations from the policies and procedures are allowed without the documented approval of the president, vice president of analytical services, and the quality assurance manager. This QAP will be reviewed and revised as necessary at least annually. Major revisions will be forwarded to appropriate copy holders.

PRISM LABORATORIES, INC.

Robbi A. Jones

Robbi A. Jones
President

4.0 ORGANIZATION AND RESPONSIBILITY

4.1 INTRODUCTION

Prism Laboratories, Inc. has been in operation since May 1992. It is a commercial testing laboratory specializing in the analysis of drinking water, groundwater, surface and wastewater, soil as well as solid and hazardous wastes, and air.

Prism Laboratories is classified as a women-owned small business. The two owners (Robbi Jones and Angela Overcash) share equal responsibilities in the day-to-day operations of the laboratory and fulfill the role of President and Vice President of Analytical Services.

The laboratory consists of the following departments:

- Administration
- Marketing
- Project Management
- Field Services
- Sample Receiving
- Metals Analysis
- Organic analysis
- Wet-Chemistry Analysis
- Bacteriological Analysis

4.2 PRESIDENT

The President of Prism Laboratories, Inc. is responsible for the general oversight of the company operations. The President shall:

4.2.1 Assure that there is a Laboratory Director.

4.2.2 Assure that there is a Quality Assurance Manager.

4.2.3 Assure that the Vice Presidents, Laboratory Director and the Quality Assurance Manager clearly understand their functions and responsibilities.

4.2.4 Establish and revise company policy.

4.2.5 Approve the QAP and the Chemical Hygiene Plan (CHP).

Required education and experience:

Education: BS/BA Science
Experience: 10 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.3 VICE PRESIDENT OF ANALYTICAL SERVICES

The Vice President of Analytical Services reports to the President and is responsible for Project Management, data validation and the signing of the final report. The Vice President of Analytical Services shall:

4.3.1 Provide resources to assure that personnel, facilities, equipment and materials are known and available as required to produce data on time according to methods, SOPs, QAP and client Data Quality Objectives (DQOs).

4.3.2 Provide resources to assure that methods, SOPs, QAP and the CHP are approved and followed. Assure that corrective action is taken in response to deviations when necessary.

4.3.3 Provide resources to assure that appropriate and adequate training is provided and that training records are maintained.

4.3.4 Provide resources to assure that laboratory waste is properly disposed.

4.3.5 Assure that the Laboratory Director knows, understands and carries out his/her responsibilities.

4.3.6 Communicate any deviations from policy to the President and assure that required corrective actions are taken.

4.3.7 Review and sign client contracts.

4.3.8 Perform other duties as required or needed.

Required education and experience:

Education: BS/BA Science
Experience: 8 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.4 VICE PRESIDENT OF CLIENT SERVICES AND NEW BUSINESS DEVELOPMENT

The Vice President of Client Services and New Business Development reports to the President and is responsible for the implementation and improvement of Client Services, Facility Management and Market Research. The Vice President of Client Services and New Business Development shall:

4.4.2 Maintain client contact as in-house sales representative, initiate new quotes and ensure proper client contact documentation mechanisms.

4.4.3 Handle client complaints and document complaints on Problem ID Reports. Take corrective action and communicate actions taken to the client.

4.4.4 Ensure consistency of sample container kits. Write SOPs for sample kit preparation, shipment and delivery. Perform training of all personnel responsible for sample kit preparation, shipment and delivery.

4.4.5 Assure that container orders from clients are handled correctly. Verify written orders, perform second line review of completed orders and assign a designee for second line review. Assure that container order forms are archived properly.

4.4.6 Assure the availability of resources for the Field Services Department.

4.4.7 Assure that the laboratory facilities are adequate in size and performance. Assure that maintenance and housekeeping procedures are adequate and followed.

4.4.8 Investigate together with sales representatives the future of the commercial laboratory market. Find new avenues that are beneficial to our laboratory.

4.4.9 Perform other duties as required or needed.

Required education and experience:

Education: BS/BA Science
Experience: 8 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.5 LABORATORY DIRECTOR (TECHNICAL DIRECTOR)

The Laboratory Director reports to the President and is responsible for the day-to-day operations of the laboratory. The Laboratory Director shall:

4.5.2 Assure that personnel, resources, facilities, equipment and materials are known and available as required to produce data on time according to methods, SOPs, QAP and client DQOs.

4.5.3 Assure that methods, SOPs, QAP and the CHP are approved and followed. Assure that corrective action is taken in response to deviations when necessary.

4.5.4 Maintain working knowledge of local, state and federal regulations as they relate to services provided by the laboratory.

4.5.5 Assure that appropriate and adequate training is provided and that training records are maintained.

4.5.6 Assure that raw data is appropriately archived.

4.5.7 Assure that laboratory waste is properly disposed.

4.5.8 Assure that laboratory personnel know, understand and carry out their responsibilities.

4.5.9 Perform other duties as required or needed.

Required education and experience:

Education: BS/BA Science
Experience: 8 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.6 ASSISTANT LABORATORY DIRECTOR (TECHNICAL DIRECTOR)

The Assistant Laboratory Director reports to the Laboratory Director and is responsible for the day-to-day operations of the laboratory. The Assistant Laboratory Director shall:

4.6.1 Determine personnel, resources, facilities, equipment and materials needs in order to produce data on time according to methods, SOPs, QAP and client DQOs.

4.6.2 Keep track of the capacity for the different tests performed in the laboratory. Determine improvements to increase capacity and efficiency without sacrificing quality.

4.6.3 Review training of personnel. Ensure that training is documented and training files are current. Make methods, SOPs, QAP and the CHP available to the departments and ensure document control.

4.6.4 Provide and oversee procedures for data validation and maintain data package formats and train personnel in data package production

4.6.5 Provide technical support and training on instruments, methodologies, SOPs, regulations and the QAP to laboratory staff. Assist in troubleshooting problems.

4.6.6 Review methods, SOPs, QAP and the CHP. Assure that approved procedures are available and followed. Assure that corrective action is taken in response to deviations when necessary.

4.6.7 Plan and assist in the implementation of new methods, instruments and equipment to meet changing regulatory or production requirements. Assure compliance with methods, SOPs, QAP and CHP prior to startup.

4.6.7 Maintain working knowledge of local, state and federal regulations as they relate to services provided by the laboratory.

4.6.8 Write and revise SOPs and methods as necessary according to approved protocols.

4.6.9 Manage special or non-routine projects requiring new or unique methods, SOPs or DQOs

4.6.10 Assure that laboratory waste is properly disposed.

4.6.11 Perform other duties as required or needed.

Required education and experience:

Education: BS/BA Science
Experience: 5 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.7 QUALITY ASSURANCE MANAGER

The Quality Assurance Manager reports to the President and is responsible for the monitoring of the Quality Assurance Program. The Quality Assurance Manager shall:

4.7.1 Assure the inspection of systems and operations for conformance to methods, SOPs, QAP, regulations and client DQOs. Document and report the results of inspections and deviations from methods, SOPs and the QAP to the President along with corrective actions taken.

4.7.2 Coordinate development and revision of the QAP as required.

4.7.3 Coordinate and document certifications by local, state and federal regulatory authorities.

4.7.4 Provide technical support and training to staff on methods, SOPs, regulations and the QAP.

4.7.5 Maintain working knowledge of local, state and federal regulations and quality technology as they relate to services provided by the laboratory and quality control.

4.7.6 Assure that all QAP, method and SOP requirements are met prior to initiation of a new procedure.

4.7.7 Final authority to terminate or alter any incorrect or improper analytical measurement procedure in order to conform to requirements of the QAP.

4.7.8 Assure coordination and documentation of internal and external audits and performance evaluation programs. Assure the coordination of responses to external QA audits or performance evaluations.

4.7.9 Perform other duties as required or needed.

Required education and experience:

Education: BS/BA Science
Experience: 8 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.8 QUALITY ASSURANCE ASSISTANT

The Quality Assurance Assistant reports to the Quality Assurance Manager and is responsible for the completion of routine tasks to be performed by the quality assurance group. The Quality Assurance Assistant shall:

4.8.1 Perform inspections of systems and operations for conformance to methods, SOPs, QAP, regulations and client DQOs. Document and report the results of inspections and deviations to the Quality Assurance Manager along with suggested corrective actions.

4.8.2 Perform follow-up inspections to assure that corrective actions have been taken.

4.8.3 Coordinate and document internal and external performance evaluation studies.

4.8.4 Host and respond to QA audits.

4.8.5 Prepare and distribute laboratory logbooks, forms, methods, SOPs and QAPs and maintain document control documentation.

4.8.6 Maintain documentation on QC charting and precision and accuracy studies.

4.8.7 Assist in the preparation of QC data packages.

4.8.8 Respond to QA questions about final reports and other deliverables.

4.8.9 Perform other duties as required or needed.

Required education and experience:

Education: BS/BA Science
Experience: 4 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.9 DEPARTMENT MANAGER (DEPUTY TECHNICAL DIRECTOR)

The Department Manager reports to the Laboratory Director and is responsible for the day-to-day operations in his/her assigned department. The Department Manager shall:

4.9.1 Schedule personnel, equipment and resources to produce data which complies with methods, SOPs, QAP and customer DQOs and customer due dates.

4.9.2 Insure training of supervisors and analysts on methods, SOPs, QAP and the CHP prior to performing procedures. Ensure that training is documented and training files and training files are current. Maintain methods, SOPs, QAP and the CHP on file and ensure document control.

4.9.3 Assure that instruments and equipment are inspected, cleaned and maintained and as applicable, calibrated and standardized.

4.9.3 Assure that raw data is reviewed for conformance with methods, SOPs, QAP and customer DQOs and that deviations from methods, SOPs and QAP are documented. Provide case narratives and supporting analytical documentation for data packages when necessary.

4.9.4 Assure that raw data is archived.

4.9.5 Inform the Laboratory Director of personnel, instrument or materials problems. Communicate deviations from schedule, methods, SOPs or QAP to the Laboratory Director, Project Managers and Quality Assurance Manager.

4.9.6 Provide technical support and training on instruments, methodologies, regulations and the QAP to department staff. Assist in troubleshooting analytical problems.

4.9.7 Plan and assist in the implementation of new methods, instruments and equipment to meet changing regulatory or production requirements. Assure compliance with methods, SOPs, QAP and CHP prior to startup.

4.9.8 Manage special or non-routine projects requiring new or unique methods, SOPs or DQOs

4.9.9 Write and revise SOPs and methods as necessary according to approved protocols.

4.9.10 Perform other duties as required or needed.

Required education and experience:

Education: BS/BA Science
Experience: 5 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.10 GROUP SUPERVISOR/LEAD ANALYST

The Group Supervisor/Lead Analyst reports to the Department Manager and is responsible for the day-to-day operations in his/her assigned area in the department. The Group Supervisor/Lead Analyst shall:

4.10.1 Schedule personnel, equipment and resources to produce data which complies with methods, SOPs, QAP and customer DQOs and customer due dates.

4.10.2 Perform training of analysts on methods, SOPs, QAP and the CHP prior to performing procedures. Document training and maintain training files. Maintain methods, SOPs, QAP and the CHP on file.

4.10.3 Assure that instruments and equipment are inspected, cleaned and maintained and as applicable, calibrated and standardized.

4.10.4 Review raw data for conformance with methods, SOPs, QAP and customer DQOs. Document all deviations from methods, SOPs and QAP. Provide case narratives and supporting analytical documentation for data packages when necessary. Archive raw data files following data entry.

4.10.5 Inform the Department Manager immediately of any personnel, instrument, equipment or materials problems. Inform the Department Manager, Project Manager and Quality Assurance Manager of any deviations from schedule, SOPs or QAP.

4.10.6 Respond to and undertake corrective action to external and internal audits.

4.10.7 Perform other duties as required or needed.

Required education and experience:

Education: BS/BA Science
Experience: 3 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.11 SAMPLE RECEIVING TECHNICIAN

The Sample Receiving Technician reports to the Sample Receiving Supervisor and is responsible for receiving, storage and shipping of samples. The Sample Receiving Technician shall:

4.11.1 Assure that samples are received, handled, shipped, stored and disposed in conformance with methods, SOPs, QAP, CHP and shipping regulations to meet client due dates and DQOs. Coordinate shipping and receiving with client and Project Manager.

4.11.2 Assure that chain-of-custody of samples is documented, validated and maintained. Document and inform Project Managers immediately of any deviations from any anticipated work volume or schedule, methods, SOPs and QAP.

4.11.3 Obtain training on and read and understand all methods, SOPs and the QAP prior to performing new procedures.

4.11.4 Assure that samples are logged into the LIMS timely and accurately.

4.11.5 Perform other duties as required or as needed.

Required education and experience:

Education: Degree preferred
Experience: 0 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.12 LABORATORY ANALYST

The Laboratory Analyst reports to the Department Manager or to the Group Supervisor/Lead Analyst and is responsible for the analysis of samples and reporting of results. The Laboratory Analyst shall:

4.12.1 Perform sample preparation and analysis according to methods, SOPs and the QAP to meet client due dates and DQOs.

4.12.2 Obtain training on and read and understand all methods, SOPs and the QAP prior to performing new procedures.

4.12.3 Inspect, clean, calibrate, standardize and maintain analysis and measurement equipment, glassware and instrumentation. Document these activities as required by methods, SOPs and the QAP.

4.12.4 Accurately and neatly document all calculations, observations and deviations as required by methods, SOPs and the QAP and forward raw data to the Group Supervisor/Lead Analyst.

4.12.5 Handle laboratory chemicals and samples per custody requirements, SOPs. QAP and the CHP. Properly dispose of laboratory waste. Maintain an organized work area.

4.12.6 Inform the Group Supervisor or Department Manager immediately of any personnel, instrument equipment or material problems or shortages. Inform the Group Supervisor, Department Manager or Project Manager of any deviations from schedule, methods, SOPs or the QAP.

4.12.7 Perform other duties as required or needed.

Required education and experience:

Education: BS/BA Science
Experience: 0 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.13 LABORATORY TECHNICIAN

The Preparations Analyst reports to the Department Manager or to the Group Supervisor/Lead Analyst and is responsible for the preparation of samples. The Preparations Analyst shall:

4.13.1 Perform sample preparation according to methods, SOPs and the QAP to meet client due dates and DQOs.

4.13.2 Obtain training on and read and understand all methods, SOPs and the QAP prior to performing new procedures.

4.13.3 Inspect, clean, calibrate, standardize and maintain glassware and instrumentation. Document these activities as required by methods, SOPs and the QAP.

4.13.4 Accurately and neatly document all calculations, observations and deviations as required by methods, SOPs and the QAP and forward raw data to the Group Supervisor/Lead Analyst.

4.13.5 Handle laboratory chemicals and samples per custody requirements, SOPs. QAP and the CHP. Properly dispose of laboratory waste. Maintain an organized work area.

4.13.6 Inform the Group Supervisor or Department Manager immediately of any personnel, instrument equipment or material problems or shortages. Inform the Group Supervisor, Department Manager or Project Manager of any deviations from schedule, methods, SOPs or the QAP.

4.13.7 Perform other duties as required or needed.

Required education and experience:

Education: Degree preferred
Experience: 0 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.14 FIELD SERVICES TECHNICIAN

The Field ServicesTechnician reports to the Group Supervisor and is responsible for the collection of samples and field measurements. The Field ServicesTechnician shall:

4.14.1 Perform sample collection and field measurements according to methods, SOPs and the QAP to meet client due dates and DQOs.

4.14.2 Obtain training on and read and understand all methods, SOPs and the QAP prior to performing new procedures.

4.14.3 Inspect, clean, calibrate, standardize and maintain sample collection and measurement equipment. Document these activities as required by methods, SOPs and the QAP.

4.14.4 Accurately and neatly document all calculations, observations and deviations as required by methods, SOPs and the QAP and forward raw data to the Group Supervisor.

4.14.5 Handle laboratory chemicals and samples per custody requirements, SOPs. QAP and the CHP. Properly dispose of laboratory waste. Maintain an organized work area.

4.14.6 Inform the Group Supervisor or Department Manager immediately of any personnel, instrument, equipment or material problems or shortages. Inform the Group Supervisor, Department Manager or Project Manager of any deviations from schedule, methods, SOPs or the QAP.

4.14.7 Perform other duties as required or needed.

Required education and experience:

Education: Degree preferred
Experience: 0 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.15 DATA ENTRY SPECIALIST/DATA PACKAGE COORDINATOR

The Data Entry Specialist/Data Package Coordinator reports to the Department Manager and is responsible for the data transfer into the LIMS and the production of QC Data Packages. The Data Entry Specialist/Data Package Coordinator shall:

4.15.1 Accurately and expediently record all required analytical and sample data in LabWorks in conformance with methods, SOPs and QAP.

4.15.2 Obtain training on and read and understand all relevant methods, SOPs and the QAP prior to performing new procedures.

4.15.3 Assemble, copy and distribute to the Project Manager, data packages and data deliverables per client specified request, SOPs and the QAP to meet the clients' due dates.

4.15.4 Coordinate archiving of raw data.

4.15.5 Inform the Supervisor immediately of any personnel or equipment problems. Inform the Supervisor of any deviations from schedule, methods, SOPs or the QAP.

4.15.6 Perform other duties as required or needed.

Required education and experience:

Education: HS
Experience: 0 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.16 PROJECT MANAGER

The Project Manager reports to the Vice President of Analytical Services and provides the interface between the customer and the laboratory. The Project Manager shall:

4.16.1 Screen requests for testing to determine that the laboratory is able to perform the work. Consideration is given to: (1) customer's requirements for DQOs and turn-around time; (2) tests currently performed; (3) required certifications; (4) available resources including equipment, staff and space; (4) workload.

4.16.2 Assure that the customers regulatory requirements, DQOs, schedule and workload volume are known to the laboratory. Maintain contact and document correspondence with customers through all phases of the project.

4.16.3 Prepare quotations, proposals and work plans to match the clients regulatory requirements and DQOs. Assure that the laboratory's methods, pricing and capacity are known to the client. Obtain all appropriate business related documentation.

4.16.4 Maintain a working knowledge of local, state and federal regulations as they relate to services provided by the laboratory.

4.16.5 Review sample submission documentation and appropriate LIMS reports to insure correctness prior to initiation of work. Review data deliverables for completeness and conformance to customer requirements.

4.16.6 Perform other duties as required or needed.

Required education and experience:

Education: BS/BA Science
Experience: 2 years

Other experience, advanced education and/or proven aptitude and performance may count for education or experience. Experience may include laboratory, regulatory or other related environmental or management experience.

4.17 DEPUTIES TO COVER ABSENCES

In the event that a key person is absent, the authority for that position will generally rest with the next in line, most senior staff member in accordance with the organizational chart (See Figure 4.1).

4.18 MANAGEMENT TEAM

Laboratory owners (President and Vice President), Laboratory Director/QA Manager, Customer Service Manager and Sales Manager form the management team. This team meets at least monthly and reviews during the course of a year the following quality system elements:

Matters arising from the last review
Suitability of policies and procedures
Reports from managerial and supervisory personnel
Reports from external audits
Reports from audits by clients
Results of internal audits, including corrective actions implemented
Results of participation in proficiency testing
Results of in-house quality checks
Details of client feedback
Details of any complaints from clients
Personnel training
Adequacy of staff, equipment and facility resources
Future plans (changes in volume and type of work) and projections for new work, new staff, new equipment, etc.

Records of the meetings are kept in the form of meeting minutes which indicate decisions made and action items with completion due dates.

4.19 EMPLOYEE TRAINING

To ensure that personnel is properly trained, each employee is exposed to the procedures described in the current training SOP.

4.19.1 ORIENTATION

New employees first go through an orientation stage where they are indoctrinated in company policies according to the personnel handbook, safety procedures according to the chemical hygiene plan and quality assurance practices during a meeting with the QA department. During this stage the employee learns about the ethical and legal responsibilities and consequences of improper behavior (see 4.19.3.3). The ethics and data integrity training procedure is documented in the Ethic and Data Integrity SOP. The employee is made aware of the responsibilities towards safety in the laboratory and the duties associated with performing analytical tests according to regulatory methods.

4.19.2 BASIC LABORATORY EQUIPMENT, TECHNIQUES AND PROCEDURES

The second stage is training or training verification in routine laboratory activities.

4.19.3 SOP TRAINING

The third stage is training in methods and Standard Operating Procedures (SOPs). This stage has verification and testing steps included to ensure adequate training.

4.19.3.1 INITIAL DEMONSTRATION OF CAPABILITY (IDOC)

Each newly trained employee must perform an Initial Demonstration of Capability (IDOC) by analyzing four replicates of the Laboratory Control Standard (LCS). The acceptance criteria are documented in the corresponding SOP. No sample can be analyzed until an acceptable IDOC is available. A demonstration of capability must be completed each time there is a significant change in instrument type or test method.

Some tests do not lend themselves to spiking (Ignitability by method 1030, Paint Filter Test by 9095 and TCLP method 1311). For these tests, initial demonstration of capability is accomplished in the following manner:

4.19.3.1.1 Demonstration of method and SOP knowledge

The analyst must show method and SOP knowledge by being able to explain the procedure to the department supervisor or his/her designee. If the knowledge is inadequate, the analyst must refrain from analyzing samples until proper knowledge can be demonstrated.

4.19.3.1.2 Practical demonstration of the procedure

If sufficient knowledge exists, the analyst must give a practical demonstration of the procedure to the department supervisor or his/her designee. When the demonstration is successful, the analyst is qualified to perform sample analysis.

4.19.3.2 ON-GOING DEMONSTRATION OF CAPABILITY

An On-going Demonstration of Capability must be performed at least once per year by means of at least one of the following:

Acceptable performance of a blind sample (single blind to the analyst)

Another Demonstration of Capability

At least four consecutive quality control samples with acceptable levels of precision and accuracy

4.19.3.3 ETHICS AND DATA INTEGRITY

4.19.3.3.1 Ethic and Data Integrity Training

Training is performed during employee orientation (see 4.19.1) on the date of hire and on a yearly basis thereafter according to the procedure in the Ethics and Data Integrity SOP.

4.19.3.3.2 Employee Training Documentation

Training is documented by means of an attendance list and a signed "Ethics and Data Integrity Agreement". This information is kept in the employee training file.

4.19.3.3.3 Monitoring

As part of the QA program in the laboratory, procedures will be monitored to detect and prevent ethics and data integrity problems. This is accomplished through in-dept data review (computer data files) and administering of blind performance evaluation samples.

4.19.3.3.4 Procedure Documentation

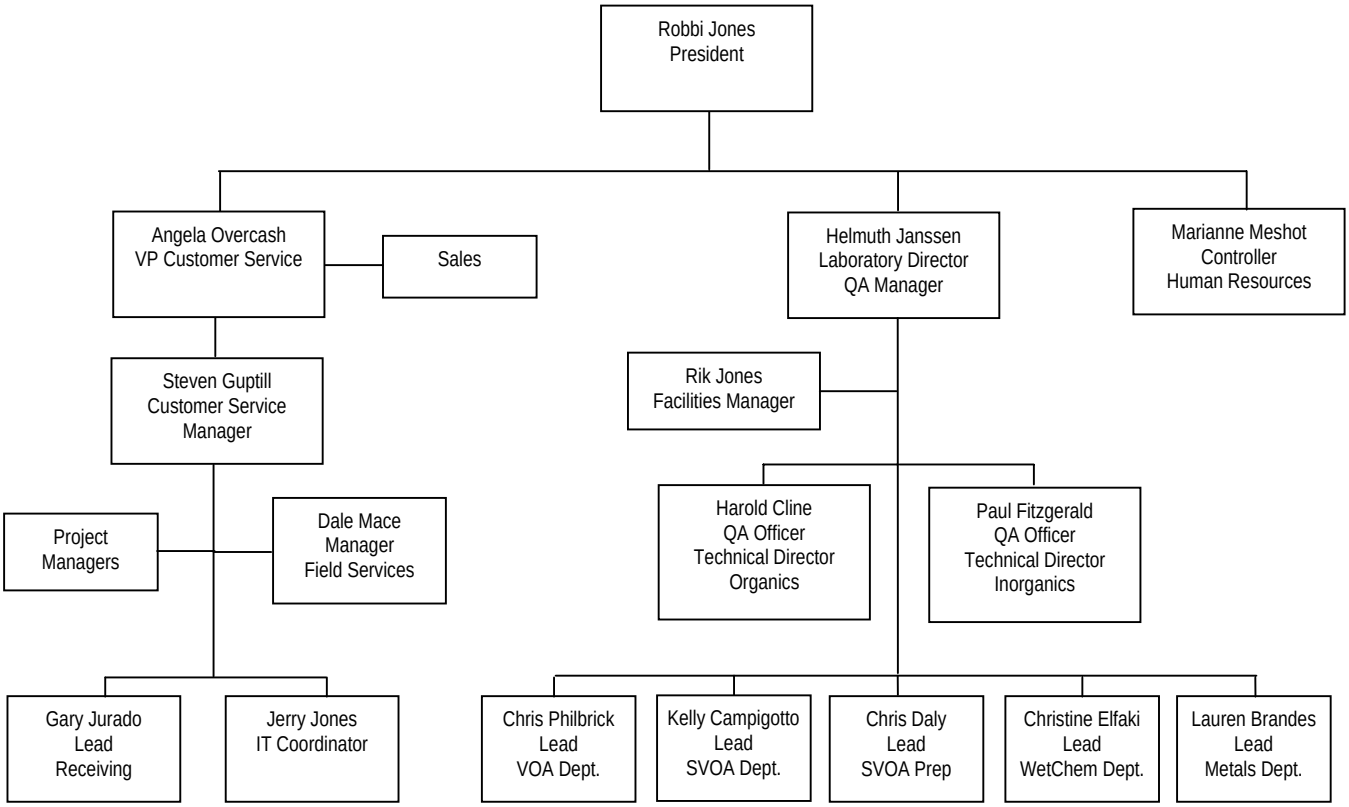
The policies and procedures regarding ethics and data integrity are documented in the "Ethics and Data Integrity Training" SOP.

4.19.4 DOCUMENTATION

All stages of this process are documented on special checklists. The checklists are signed and dated by the trainer and the employee. For analytical methods that are included under the National Environmental Laboratory Accreditation Program (NELAP) certification, a Demonstration of Capability Certification Statement is also included in the documentation.

4.20 ORGANIZATIONAL CHART

Figure 4.1
Organizational Chart



5.0 QA TARGETS FOR PRECISION, ACCURACY, METHOD DETECTION LIMITS AND REPORTING LIMITS

This section provides tables listing precision and accuracy objectives for parameters which Prism Laboratories routinely analyzes in groundwater, surface water, wastewater and solid matrices. The goals for precision and accuracy are reviewed quarterly by the Quality Assurance Manager. This section will be updated at least annually.

The quality assurance target values for precision and accuracy are derived from statistical analyses of in-house quality control data or taken directly from the approved cited methodologies. The calculated acceptance ranges are based on three standard deviations from the mean of a minimum of 30 data points.

When precision and accuracy data are not available because of the newness or infrequency of use of a method, the literature or method values will be used until such time as in-house data can be accumulated sufficient to establish control limits. Where target values are not based on in-house data, the source(s) are provided and the values appropriately annotated.

Sample precision and accuracy data are matrix dependent. Out of control sample results may be reported with comments only after review of the results by the Quality Assurance Manager. A determination must be made that based on the Laboratory Control Sample (LCS or Blank Spike) results, a reanalysis of the out of control sample or best professional judgement that matrix problems prevent performance of the particular method within the established criteria.

Outliers in the accuracy and precision database are determined statistically and not included in the calculation of precision and accuracy objectives. Out of control data is removed from the data set based on a determination by the Quality Assurance Manager.

Method Detection Limit values (MDLs) are also presented. These were derived from statistical analyses of in-house MDL studies, based on the criteria in the 40CFR Part 136, Appendix B (See Section 11.6.1). Where MDLs are not based on in-house data, the source(s) are provided and the values appropriately annotated.

Reporting Limits (RLs) are used for reporting final results. The RL should be at least 3 times the MDL, and is equal or greater than the lowest point used on the calibration curve.

The sample preparation methods for all samples are shown in Table 5.40.

Explanation of acronyms:

MDL = Method Detection Limit (determined according to 40 CFR 136 Appendix B).
RL = Reporting Limit. Value corresponds with the value of the lowest calibration standard.
SM = Standard Methods for the Examination of Water and Wastewater, 18th Edition.
EPA = Methods for the Determination of Organic Substances in Environmental Samples, EPA/600/R-93/100, August 1993
SW846 = Test Methods for Evaluating Solid Waste, 3rd Edition
L = Low Level Concentration, 0-20% of the calibration range.
M = Medium Level Concentration, 20-80% of the calibration range.
H = High Level Concentration, 80-100% of the calibration range.
LCS = Laboratory Control Sample
MS = Matrix Spike
N/A = Not Applicable

Table 5.1
Wet-Chemistry Parameters in Water Matrix

Parameter	Method (Edition/Revision)	MDL (mg/l)	RL (mg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Acidity, Total	SM2310 B (18th)	0.33	5	20	M	90 - 110	80 - 120	M
Alkalinity, Total	SM2320 B (18th)	0.66	5	20	M	90 - 110	80 - 120	M
Biochemical Oxygen Demand								
BOD-5	SM5210 B (18th)	N/A	2	31	M	84 - 114	N/A	M
CBOD-5	SM5210 B (18th)	N/A	2	31	M	81 - 119	N/A	M
Bromide	EPA 300.0 (2.1, 1993)	0.017	0.1	15	M	90 - 110	90 - 110	M
Chemical Oxygen Demand								
COD – Medium Level	SM5220 D (18th) HACH 8000	5.2	50	20	M	90 - 110	80 - 120	M
COD – Low Level	SM5220 D (18th) HACH 8000	2.0	5	20	M	90 - 110	80 - 120	M
Chloride	SW846-9056A EPA 300.0 (2.1, 1993)	0.0051	1	15	M	90 - 110	90 - 110	M
Chromium, Hexavalent	SW846-7196A SM3500-Cr D (18th)	0.0026	0.01	20	M	90 - 110	85 - 115	M
Color (Pt-Co units)	SM2120 B (18th)	N/A	5	20	M	90 - 110	N/A	M
Cyanide, Total (DW only)	SM4500-CN C & SM4500-CN-E (18th)	0.0018	0.005	20	M	90 - 110	90 - 110	M
Cyanide, Total	SM4500-CN C & SM4500-CN-E (18th) SW846-9010C/9014	0.0019	0.005	20	M	85 - 115	80 - 120	M
Cyanide, Amenable to Chlorination,	SM4500-CN G (18th)	0.0019	0.005	20	M	80 - 120	80 - 120	M
Dissolved Oxygen (DO)	SM4500-O G (18th)	N/A	1	20	M	90 - 110	N/A	M
Ferrous Iron	SM3500-Fe D (18th)	0.043	0.2	20	M	90 - 110	80 - 120	M
Fluoride, ISE (Distilled)	SM4500-F C (18th)	0.022	1	20	M	80 - 120	80 - 120	M
Fluoride, ISE (Not distilled)	SM4500-F C (18th)	0.020	0.1	20	M	80 - 120	80 - 120	M
Fluoride	SW846-9056A EPA 300.0 (2.1, 1993)	0.0058	0.1	15	M	90 - 110	90 - 110	M
Hardness								
Calcium Hardness	SM2340 B (18th)	0.094	0.25	20	M	90 - 110	80 - 120	M
Total Hardness	SM2340 C (18th)	0.26	5	20	M	90 - 110	80 - 120	M
Total Hardness	SM2340 B (18th)	0.10	1	20	M	90 - 110	80 - 120	M
Nitrogen								
Ammonia	SM4500-NH3 B&E(18th)	0.094	0.2	20	M	80 - 120	80 - 120	M
Ammonia	SM4500-NH3 H (18th) EPA 350.1 (2.0, 1993)	0.024	0.1	20	M	90 - 110	80 - 120	M
Nitrate	SM4500-NO3 F (18th) EPA 353.2 (2.0, 1993)	0.0025	0.1	20	M	90 - 110	80 - 120	M
Nitrate	EPA 300.0 (2.1, 1993) SW846-9056A	0.0015	0.1	15	M	90 - 110	90 - 110	M

Table 5.1
Wet-Chemistry Parameters in Water Matrix (Continued)

Parameter	Method (Edition/Revision)	MDL (mg/l)	RL (mg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Nitrate+Nitrite	SM4500-NO3 F (18th) EPA 353.2 (2.0, 1993)	0.0025	0.1	20	M	90 - 110	80 - 120	M
Nitrate+Nitrite	EPA 300.0 (2.1, 1993) SW846-9056A	0.0057	0.2	15	M	90 - 110	90 - 110	M
Nitrite	SM4500-N02 B (18th)	0.0005	0.01	20	M	90 - 110	80 - 120	M
Nitrite	SM4500-NO3 F (18th) EPA 353.2 (2.0, 1993)	0.0012	0.1	20	M	90 - 110	80 - 120	M
Nitrite	EPA 300.0 (2.1, 1993) SW846-9056A	0.0040	0.1	15	M	90 - 110	90 - 110	M
Total Kjeldahl Nitrogen	SM4500-N_{ORG} B and SM4500-NH3 E (18th)	0.34	1	20	M	80 - 120	80 - 120	M
Total Kjeldahl Nitrogen	EPA 351.2 (2.0, 1993)	0.11	0.5	20	M	90 - 110	90 - 110	M
Organic Nitrogen	SM4500-N_{ORG} B / SM4500-NH3 E less SM4500-NH3 E (18th)	N/A	0.5	20	M	80 - 120	80 - 120	M
Organic Nitrogen	EPA 351.2 less SM4500-NH3 H (18th)	N/A	0.5	20	M	80 - 120	80 - 120	M
Oil & Grease, Gravimetric-Hexane Extraction (HEM)	EPA 1664A	0.71	5	18*	M	78 - 114*	78 - 114*	M
SGT-HEM	EPA 1664A	0.22	5	34*	M	64 - 132*	64 - 132*	M
pH (pH units)	SM4500-H+ B (18th) SW846-9040	N/A	0.1	N/A	M	99 - 101	99 - 101	M
Phenolics, Total	EPA 420.1 (1978) SW846-9065	0.027	0.05	20	M	80 - 120	80 - 120	M
Phosphorus								
Ortho-Phosphorus	SM4500-P E (18th)	0.0034	0.05	20	M	90 - 110	80 - 120	M
Ortho-Phosphorus (Low-level)	SM4500-P E (18th)	0.0027	0.005	20	M	90 - 110	80 - 120	M
Ortho-Phosphorus	EPA 300.0 (2.1, 1993) SW846-9056	0.046	1	20	M	90 - 110	80 - 120	M
Total Phosphorus	EPA 365.1 (2.0, 1993) SM4500-P F (18th)	0.0088	0.05	20	M	90 - 110	80 - 120	M
Total Phosphorus	SM 4500-P-E (18th)	0.015	0.05	20	M	90 - 110	80 - 120	M
Total Phosphorus (Low-level)	SM 4500-P-E (18th)	0.0029	0.005	20	M	90 - 110	80 - 120	M
Residual Chlorine	SM4500-Cl G (18th)	0.017	0.1	20	M	90 - 110	80 - 120	M
Residual Chlorine (ULR)	SM4500-Cl G (18th)	0.0049	0.010	20	M	75 - 125	75 - 125	M
Silica	EPA 200.7	0.026	1	20	M	90 - 110	80 - 120	M

Table 5.1
Wet Chemistry Parameters in Water Matrix (Continued)

Parameter	Method (Edition/Revision)	MDL (mg/l)	RL (mg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Solids								
Dissolved	SM2540 C (18th)	6.3	50	20	M	90 - 110	N/A	M
Settleable (mL/L)	SM2540 F (18th)	N/A	0.1	20	M	90 - 110	N/A	M
Suspended	SM2540 D (18th)	0.80	5	20	M	90 - 110	N/A	M
Total	SM2540 B (18th)	4.9	20	20	M	90 - 110	N/A	M
Specific Conductance (uMhos/cm)	SM2510 B (18th) EPA 120.1 (1982) SW846-9050	0.15	10	20	M	95 - 105	N/A	M
Sulfate	EPA 300.0 (2.1, 1993) SW846-9056A	0.0096	1	15	M	90 - 110	90 - 110	M
Sulfide	SW846-9034 SM4500-S^{2-} E (18th)	0.30	2	20	M	70 - 130	70 - 130	M
Sulfite	SM4500-SO_3 B (18th)	0.17	2	20	M	90 - 110	80 - 120	M
Surfactants	SM5540 C (18th)	0.014	0.1	20	M	80 - 120	70 - 130	M
Turbidity (NTU)	SM2130 B (18th) EPA 180.1 (2.0, 1993)	0.022	0.4	20	M	90 - 110	N/A	M

* - Oil & Grease by EPA 1664A - Limits from Section 17, Table 1, Method 1664A: N-Hexane Extractable Material and Silica Gel Treated N-Hexane Extractable Material By Extraction and Gravimetry, EPA-821B-94-004b, April 1995.

Table 5.2
Wet-Chemistry Parameters in Solid Matrix

Parameter	Method (Edition/Revision)	MDL (mg/kg)	RL (mg/kg)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Ammonia-Nitrogen	SM4500-NH3 H (18th) EPA 350.1 (2.0, 1993)	1.37	5	20	M	80 - 120	80 - 120	M
Bromide	SW846-9056A	0.098	1	20	M	90 - 110	80 - 120	M
Chloride	SW846-9056A	0.062	10	20	M	90 - 110	80 - 120	M
Chromium, Hexavalent	SW846-7196	0.45	1	20	M	90 - 110	75 - 125	M
Cyanide, Total	SW846-9010C	0.048	0.5	20	M	80 - 120	80 - 120	M
Fluoride	SW846-9056A	0.060	5	20	M	90 - 110	80 - 120	M
Nitrate	SW846-9056A	0.071	1	20	M	90 - 110	80 - 120	M
Nitrate+Nitrite	SW846-9056A	0.41	2	20	M	90 - 110	80 - 120	M
Nitrite	SW846-9056A	0.12	1	20	M	90 - 110	80 - 120	M
Oil & Grease	SW846-9071B	17	40	20	M	80 - 120	80 - 120	M
Ortho-Phosphate	SW846-9056A	0.75	10	20	M	90 - 110	80 - 120	M
pH (pH units)	SW846-9045	N/A	0.1	20	M	N/A	N/A	M
Phosphorus, Total	SM4500-P F (18th)	0.62	2.5	20	M	90 - 110	80 - 120	M
Total Kjeldahl Nitrogen	EPA 351.2 (2.0, 1993)	2.1	25	20	M	90 - 110	90 - 110	M
Solids, Percent Total	SM2540 B (18th)	N/A	1%	20	M	N/A	N/A	M
Sulfate	SW846-9056A	0.17	10	20	M	90 - 110	80 - 120	M
Sulfide, Extractable	SW846-9031	N/A	200	20	M	70 - 130	50 - 150	M
Sulfide, Total	SW846-9034	N/A	10	20	M	80 - 120	80 - 120	M

Table 5.3

Metals by ICP/MS Method 200.8 for Surface Water and Wastewater

Parameter	Method (Edition/Revision)	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Aluminum	EPA 200.8 (5.4, 1994)	10	50	20	M	85 - 115	70 - 130	M
Antimony	EPA 200.8 (5.4, 1994)	0.10	1	20	M	85 - 115	70 - 130	M
Arsenic	EPA 200.8 (5.4, 1994)	0.28	1	20	M	85 - 115	70 - 130	M
Barium	EPA 200.8 (5.4, 1994)	0.85	5	20	M	85 - 115	70 - 130	M
Beryllium	EPA 200.8 (5.4, 1994)	0.28	1	20	M	85 - 115	70 - 130	M
Cadmium	EPA 200.8 (5.4, 1994)	0.16	1	20	M	85 - 115	70 - 130	M
Calcium	EPA 200.8 (5.4, 1994)		50	20	M	85 - 115	70 - 130	M
Chromium	EPA 200.8 (5.4, 1994)	0.13	1	20	M	85 - 115	70 - 130	M
Cobalt	EPA 200.8 (5.4, 1994)	0.064	1	20	M	85 - 115	70 - 130	M
Copper	EPA 200.8 (5.4, 1994)	0.98	5	20	M	85 - 115	70 - 130	M
Iron	EPA 200.8 (5.4, 1994)	3.3	50	20	M	85 - 115	70 - 130	M
Lead	EPA 200.8 (5.4, 1994)	0.14	1	20	M	85 - 115	70 - 130	M
Magnesium	EPA 200.8 (5.4, 1994)	0.62	5	20	M	85 - 115	70 - 130	M
Manganese	EPA 200.8 (5.4, 1994)	0.21	5	20	M	85 - 115	70 - 130	M
Molybdenum	EPA 200.8 (5.4, 1994)	0.12	1	20	M	85 - 115	70 - 130	M
Nickel	EPA 200.8 (5.4, 1994)	0.16	2	20	M	85 - 115	70 - 130	M
Potassium	EPA 200.8 (5.4, 1994)	9.9	100	20	M	85 - 115	70 - 130	M
Selenium	EPA 200.8 (5.4, 1994)	0.22	1	20	M	85 - 115	70 - 130	M
Silver	EPA 200.8 (5.4, 1994)	0.077	1	20	M	85 - 115	70 - 130	M
Sodium	EPA 200.8 (5.4, 1994)	7.6	100	20	M	85 - 115	70 - 130	M
Strontium	EPA 200.8 (5.4, 1994)	0.22	1	20	M	85 - 115	70 - 130	M
Thallium	EPA 200.8 (5.4, 1994)	0.050	1	20	M	85 - 115	70 - 130	M
Tin	EPA 200.8 (5.4, 1994)	0.055	1	20	M	85 - 115	70 - 130	M
Titanium	EPA 200.8 (5.4, 1994)	0.73	2	20	M	85 - 115	70 - 130	M
Vanadium	EPA 200.8 (5.4, 1994)	0.44	5	20	M	85 - 115	70 - 130	M
Zinc	EPA 200.8 (5.4, 1994)	1.9	5	20	M	85 - 115	70 - 130	M

Table 5.4

Metals by ICP/MS Method 3005A/6020A for Ground water

Parameter	Method (Edition/Revision)	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Aluminum	SW846-6020A	9.4	50	20	M	80 - 120	75 - 125	M
Antimony	SW846-6020A	0.36	1	20	M	80 - 120	75 - 125	M
Arsenic	SW846-6020A	0.24	1	20	M	80 - 120	75 - 125	M
Barium	SW846-6020A	0.63	5	20	M	80 - 120	75 - 125	M
Beryllium	SW846-6020A	0.17	1	20	M	80 - 120	75 - 125	M
Cadmium	SW846-6020A	0.52	1	20	M	80 - 120	75 - 125	M
Calcium	SW846-6020A	14	50	20	M	80 - 120	75 - 125	M
Chromium	SW846-6020A	0.26	1	20	M	80 - 120	75 - 125	M
Cobalt	SW846-6020A	0.12	1	20	M	80 - 120	75 - 125	M
Copper	SW846-6020A	0.90	5	20	M	80 - 120	75 - 125	M
Iron	SW846-6020A	3.3	50	20	M	80 - 120	75 - 125	M
Lead	SW846-6020A	0.40	1	20	M	80 - 120	75 - 125	M
Magnesium	SW846-6020A	0.62	5	20	M	80 - 120	75 - 125	M
Manganese	SW846-6020A	0.10	5	20	M	80 - 120	75 - 125	M
Molybdenum	SW846-6020A	0.51	1	20	M	80 - 120	75 - 125	M
Nickel	SW846-6020A	0.74	2	20	M	80 - 120	75 - 125	M
Potassium	SW846-6020A	9.9	100	20	M	80 - 120	75 - 125	M
Selenium	SW846-6020A	0.37	1	20	M	80 - 120	75 - 125	M
Silver	SW846-6020A	0.10	1	20	M	80 - 120	75 - 125	M
Sodium	SW846-6020A	7.6	100	20	M	80 - 120	75 - 125	M
Strontium	SW846-6020A	0.22	1	20	M	80 - 120	75 - 125	M
Thallium	SW846-6020A	0.23	1	20	M	80 - 120	75 - 125	M
Tin	SW846-6020A	0.055	1	20	M	80 - 120	75 - 125	M
Titanium	SW846-6020A	0.66	2	20	M	80 - 120	75 - 125	M
Vanadium	SW846-6020A	0.22	5	20	M	80 - 120	75 - 125	M
Zinc	SW846-6020A	0.94	5	20	M	80 - 120	75 - 125	M

Table 5.5
Metals by ICP Method 200.7 for Surface Water and Wastewater

Parameter	Method (Edition/Revision)	MDL (mg/l)	RL (mg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Aluminum	EPA 200.7 (4.4, 1994)	0.0061	0.1	20	M	85 - 115	70 - 130	M
Antimony	EPA 200.7 (4.4, 1994)	0.0012	0.01	20	M	85 - 115	70 - 130	M
Arsenic	EPA 200.7 (4.4, 1994)	0.0015	0.01	20	M	85 - 115	70 - 130	M
Barium	EPA 200.7 (4.4, 1994)	0.0033	0.01	20	M	85 - 115	70 - 130	M
Beryllium	EPA 200.7 (4.4, 1994)	0.00012	0.002	20	M	85 - 115	70 - 130	M
Boron	EPA 200.7 (4.4, 1994)	0.025	0.5	20	M	85 - 115	70 - 130	M
Cadmium	EPA 200.7 (4.4, 1994)	0.00007	0.001	20	M	85 - 115	70 - 130	M
Calcium	EPA 200.7 (4.4, 1994)	0.015	0.1	20	M	85 - 115	70 - 130	M
Chromium	EPA 200.7 (4.4, 1994)	0.00018	0.005	20	M	85 - 115	70 - 130	M
Cobalt	EPA 200.7 (4.4, 1994)	0.00017	0.005	20	M	85 - 115	70 - 130	M
Copper	EPA 200.7 (4.4, 1994)	0.0018	0.01	20	M	85 - 115	70 - 130	M
Iron	EPA 200.7 (4.4, 1994)	0.013	0.05	20	M	85 - 115	70 - 130	M
Lead	EPA 200.7 (4.4, 1994)	0.00051	0.005	20	M	85 - 115	70 - 130	M
Lithium	EPA 200.7 (4.4, 1994)	0.0037	0.025	20	M	85 - 115	70 - 130	M
Magnesium	EPA 200.7 (4.4, 1994)	0.0012	0.1	20	M	85 - 115	70 - 130	M
Manganese	EPA 200.7 (4.4, 1994)	0.00024	0.01	20	M	85 - 115	70 - 130	M
Molybdenum	EPA 200.7 (4.4, 1994)	0.00050	0.01	20	M	85 - 115	70 - 130	M
Nickel	EPA 200.7 (4.4, 1994)	0.00030	0.01	20	M	85 - 115	70 - 130	M
Potassium	EPA 200.7 (4.4, 1994)	0.047	0.5	20	M	85 - 115	70 - 130	M
Selenium	EPA 200.7 (4.4, 1994)	0.0041	0.02	20	M	85 - 115	70 - 130	M
Silicon	EPA 200.7 (4.4, 1994)	0.0012	0.5	20	M	85 - 115	70 - 130	M
Silver	EPA 200.7 (4.4, 1994)	0.00025	0.005	20	M	85 - 115	70 - 130	M
Sodium	EPA 200.7 (4.4, 1994)	0.0215	0.5	20	M	85 - 115	70 - 130	M
Strontium	EPA 200.7 (4.4, 1994)	0.00026	0.01	20	M	85 - 115	70 - 130	M
Thallium	EPA 200.7 (4.4, 1994)	0.0027	0.01	20	M	85 - 115	70 - 130	M
Tin	EPA 200.7 (4.4, 1994)	0.00065	0.05	20	M	85 - 115	70 - 130	M
Titanium	EPA 200.7 (4.4, 1994)	0.00039	0.01	20	M	85 - 115	70 - 130	M
Vanadium	EPA 200.7 (4.4, 1994)	0.00022	0.005	20	M	85 - 115	70 - 130	M
Zinc	EPA 200.7 (4.4, 1994)	0.0015	0.03	20	M	85 - 115	70 - 130	M

Table 5.6
Metals by ICP Method 3010A/6010C for Ground Water

Parameter	Method (Edition/Revision)	MDL (mg/l)	RL (mg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Aluminum	SW846-6010C	0.0098	0.1	20	M	80 - 120	75 - 125	M
Antimony	SW846-6010C	0.00060	0.01	20	M	80 - 120	75 - 125	M
Arsenic	SW846-6010C	0.0020	0.01	20	M	80 - 120	75 - 125	M
Barium	SW846-6010C	0.0026	0.01	20	M	80 - 120	75 - 125	M
Beryllium	SW846-6010C	0.00015	0.002	20	M	80 - 120	75 - 125	M
Boron	SW846-6010C	0.024	0.5	20	M	80 - 120	75 - 125	M
Cadmium	SW846-6010C	0.000086	0.001	20	M	80 - 120	75 - 125	M
Calcium	SW846-6010C	0.034	0.1	20	M	80 - 120	75 - 125	M
Chromium	SW846-6010C	0.00017	0.005	20	M	80 - 120	75 - 125	M
Cobalt	SW846-6010C	0.00017	0.005	20	M	80 - 120	75 - 125	M
Copper	SW846-6010C	0.00068	0.01	20	M	80 - 120	75 - 125	M
Iron	SW846-6010C	0.0037	0.05	20	M	80 - 120	75 - 125	M
Lead	SW846-6010C	0.00077	0.005	20	M	80 - 120	75 - 125	M
Lithium	SW846-6010C	0.0010	0.025	20	M	80 - 120	75 - 125	M
Magnesium	SW846-6010C	0.00069	0.1	20	M	80 - 120	75 - 125	M
Manganese	SW846-6010C	0.00057	0.01	20	M	80 - 120	75 - 125	M
Molybdenum	SW846-6010C	0.00047	0.01	20	M	80 - 120	75 - 125	M
Nickel	SW846-6010C	0.00035	0.01	20	M	80 - 120	75 - 125	M
Potassium	SW846-6010C	0.022	0.5	20	M	80 - 120	75 - 125	M
Selenium	SW846-6010C	0.0023	0.02	20	M	80 - 120	75 - 125	M
Silicon	SW846-6010C	0.0056	0.5	20	M	80 - 120	75 - 125	M
Silver	SW846-6010C	0.00034	0.005	20	M	80 - 120	75 - 125	M
Sodium	SW846-6010C	0.0056	0.5	20	M	80 - 120	75 - 125	M
Strontium	SW846-6010C	0.000054	0.01	20	M	80 - 120	75 - 125	M
Thallium	SW846-6010C	0.00081	0.01	20	M	80 - 120	75 - 125	M
Tin	SW846-6010C	0.00043	0.05	20	M	80 - 120	75 - 125	M
Titanium	SW846-6010C	0.00010	0.01	20	M	80 - 120	75 - 125	M
Vanadium	SW846-6010C	0.00012	0.005	20	M	80 - 120	75 - 125	M
Zinc	SW846-6010C	0.00083	0.03	20	M	80 - 120	75 - 125	M

Table 5.7
Metals by ICP Method 3010A/6010C for TCLP Extracts

Parameter	Method (Edition/Revision)	MDL (mg/l)	RL (mg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Aluminum	SW846-6010C	0.0088	0.1	20	M	80 - 120	75 - 125	M
Antimony	SW846-6010C	0.00098	0.01	20	M	80 - 120	75 - 125	M
Arsenic	SW846-6010C	0.0014	0.05	20	M	80 - 120	75 - 125	M
Barium	SW846-6010C	0.00094	5	20	M	80 - 120	75 - 125	M
Beryllium	SW846-6010C	0.00025	0.002	20	M	80 - 120	75 - 125	M
Cadmium	SW846-6010C	0.00012	0.025	20	M	80 - 120	75 - 125	M
Chromium	SW846-6010C	0.00053	0.25	20	M	80 - 120	75 - 125	M
Cobalt	SW846-6010C	0.00017	0.005	20	M	80 - 120	75 - 125	M
Copper	SW846-6010C	0.0041	0.01	20	M	80 - 120	75 - 125	M
Iron	SW846-6010C	0.012	0.1	20	M	80 - 120	75 - 125	M
Lead	SW846-6010C	0.00099	0.05	20	M	80 - 120	75 - 125	M
Manganese	SW846-6010C	0.00098	0.01	20	M	80 - 120	75 - 125	M
Molybdenum	SW846-6010C	0.00048	0.01	20	M	80 - 120	75 - 125	M
Nickel	SW846-6010C	0.0017	0.01	20	M	80 - 120	75 - 125	M
Selenium	SW846-6010C	0.0025	0.05	20	M	80 - 120	75 - 125	M
Silver	SW846-6010C	0.00030	0.25	20	M	80 - 120	75 - 125	M
Thallium	SW846-6010C	0.0020	0.01	20	M	80 - 120	75 - 125	M
Tin	SW846-6010C	0.0013	0.05	20	M	80 - 120	75 - 125	M
Titanium	SW846-6010C	0.0040	0.01	20	M	80 - 120	75 - 125	M
Vanadium	SW846-6010C	0.00017	0.005	20	M	80 - 120	75 - 125	M
Zinc	SW846-6010C	0.0032	0.03	20	M	80 - 120	75 - 125	M

Table 5.8
Metals by ICP Method 3050B/6010C for Solid Matrix

Parameter	Method (Edition/Revision)	MDL (mg/kg)	RL (mg/kg)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Aluminum	SW846-6010C	1.0	2.5	20	M	80 - 120	75 - 125	M
Antimony	SW846-6010C	0.036	0.25	20	M	80 - 120	75 - 125	M
Arsenic	SW846-6010C	0.056	0.5	20	M	80 - 120	75 - 125	M
Barium	SW846-6010C	0.074	0.5	20	M	80 - 120	75 - 125	M
Beryllium	SW846-6010C	0.042	0.25	20	M	80 - 120	75 - 125	M
Bismuth	SW846-6010C	0.84	2.5	20	M	80 - 120	75 - 125	M
Boron	SW846-6010C	2.5	25	20	M	80 - 120	75 - 125	M
Cadmium	SW846-6010C	0.026	0.25	20	M	80 - 120	75 - 125	M
Calcium	SW846-6010C	4.0	10	20	M	80 - 120	75 - 125	M
Chromium	SW846-6010C	0.034	0.25	20	M	80 - 120	75 - 125	M
Cobalt	SW846-6010C	0.028	0.25	20	M	80 - 120	75 - 125	M
Copper	SW846-6010C	0.22	0.5	20	M	80 - 120	75 - 125	M
Iron	SW846-6010C	1.7	5	20	M	80 - 120	75 - 125	M
Lead	SW846-6010C	0.062	0.25	20	M	80 - 120	75 - 125	M
Lithium	SW846-6010C	0.19	1.25	20	M	80 - 120	75 - 125	M
Magnesium	SW846-6010C	0.32	2.5	20	M	80 - 120	75 - 125	M
Manganese	SW846-6010C	0.024	0.25	20	M	80 - 120	75 - 125	M
Molybdenum	SW846-6010C	0.037	0.5	20	M	80 - 120	75 - 125	M
Nickel	SW846-6010C	0.31	1	20	M	80 - 120	75 - 125	M
Potassium	SW846-6010C	0.88	12	20	M	80 - 120	75 - 125	M
Selenium	SW846-6010C	0.10	0.5	20	M	80 - 120	75 - 125	M
Silicon	SW846-6010C	0.70	10	20	M	80 - 120	75 - 125	M
Silver	SW846-6010C	0.026	0.25	20	M	80 - 120	75 - 125	M
Sodium	SW846-6010C	1.5	12	20	M	80 - 120	75 - 125	M
Strontium	SW846-6010C	0.029	0.5	20	M	80 - 120	75 - 125	M
Thallium	SW846-6010C	0.096	0.5	20	M	80 - 120	75 - 125	M
Tin	SW846-6010C	0.44	5	20	M	80 - 120	75 - 125	M
Titanium	SW846-6010C	0.049	0.25	20	M	80 - 120	75 - 125	M
Vanadium	SW846-6010C	0.018	0.25	20	M	80 - 120	75 - 125	M
Zinc	SW846-6010C	0.26	2.5	20	M	80 - 120	75 - 125	M

Table 5.9
Metals by CVAA and CVAFS in Water Matrix

Parameter	Method (Edition/Revision)	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Mercury	EPA 245.1 (WW, 3.0, 1994)	0.0070	0.2	20	M	85 - 115	70 - 130	M
Mercury	EPA 245.1 (DW, 3.0, 1994)	0.0070	0.2	10	M	85 - 115	70 - 130	M
Mercury	SW846-7470A	0.0070	0.2	20	M	80 - 120	80 - 120	M
Mercury	EPA 1631E	0.00033	0.001	24	M	79 - 121	71 - 125	M

WW = Wastewater Matrix, DW = Drinking Water Matrix

Table 5.10
Metals by CVAA in TCLP Extracts

Parameter	Method (Edition/Revision)	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
						LCS (%)	MS (%)	
Mercury	SW 846-7470A	0.0070	0.2	20	M	80 - 120	80 - 120	M

Table 5.11
Metals by CVAA in Solid Matrix

Parameter	Method (Edition/Revision)	MDL (µg/kg)	RL (µg/kg)	RPD	Conc. Level	Accuracy Range (%R)		Conc. Level
						LCS %	MS %	
Mercury	SW 846-7471B	2.7	20	20	M	80 - 120	80 - 120	M

Table 5.12
Purgeable Aromatics in Water Matrix by GC Method EPA 602

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range (%R)		Conc. Level
					LCS (%)	MS (%)	
1,2-Dichlorobenzene	0.084	1	10*	M	37 - 150	37 - 150	M
1,3-Dichlorobenzene	0.12	1	10*	M	50 - 141	50 - 141	M
1,4-Dichlorobenzene	0.10	1	10*	M	42 - 143	42 - 143	M
Benzene	0.14	0.5	15*	M	39 - 150	39 - 150	M
Chlorobenzene	0.16	1	27*	M	55 - 135	55 - 135	M
Ethylbenzene	0.16	1	14*	M	32 - 160	32 - 160	M
Isopropyl Ether (IPE)	0.083	5	14*	M	72 - 120*	72 - 120*	M
Methyl tert-Butyl Ether (MTBE)	0.050	2	11*	M	75 - 123*	75 - 123*	M
Naphthalene	0.12	5	15*	M	65 - 128*	65 - 128*	M
Toluene	0.18	1	13*	M	46 - 148	46 - 148	M
m & p- Xylenes	0.33	2	13*	M	77 - 129*	77 - 129*	M
o-Xylene	0.14	1	22*	M	75 - 131*	75 - 131*	M
Total xylenes	0.47	3	22*	M	67 - 131*	68 - 132*	M

Surrogates	Recovery Range (%R)	
1,4-Difluorobenzene	52*	151*

* - Historical Limits.

All other limits based on the method limits.

Table 5.13
Volatile Organics in Water Matrix by GC/MS Method SM6200 B

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range (%R)		Conc. Level
					LCS (%)	MS (%)	
1,1,1,2-Tetrachloroethane	0.070	0.5	20	M	70 - 130	70 - 130	M
1,1,1-Trichloroethane	0.075	0.5	20	M	70 - 130	70 - 130	M
1,1,2,2-Tetrachloroethane	0.075	0.5	20	M	70 - 130	70 - 130	M
1,1,2-Trichloroethane	0.068	0.5	20	M	70 - 130	70 - 130	M
1,1-Dichloroethane	0.038	0.5	20	M	70 - 130	70 - 130	M
1,1-Dichloroethene	0.057	0.5	20	M	70 - 130	70 - 130	M
1,1-Dichloropropene	0.072	0.5	20	M	70 - 130	70 - 130	M
1,2,3-Trichlorobenzene	0.12	0.5	20	M	70 - 130	70 - 130	M
1,2,3-Trichloropropane	0.090	0.5	20	M	70 - 130	70 - 130	M
1,2,4-Trichlorobenzene	0.15	0.5	20	M	70 - 130	70 - 130	M
1,2,4-Trimethylbenzene	0.038	0.5	20	M	70 - 130	70 - 130	M
1,2-Dibromo-3-chloropropane	0.59	2	20	M	70 - 130	70 - 130	M
1,2-Dibromoethane	0.041	0.5	20	M	70 - 130	70 - 130	M
1,2-Dichlorobenzene	0.044	0.5	20	M	70 - 130	70 - 130	M
1,2-Dichloroethane	0.054	0.5	20	M	70 - 130	70 - 130	M
1,2-Dichloropropane	0.062	0.5	20	M	70 - 130	70 - 130	M
1,3,5-Trimethylbenzene	0.038	0.5	20	M	70 - 130	70 - 130	M
1,3-Dichlorobenzene	0.070	0.5	20	M	70 - 130	70 - 130	M
1,3-Dichloropropane	0.054	0.5	20	M	70 - 130	70 - 130	M
1,4-Dichlorobenzene	0.059	0.5	20	M	70 - 130	70 - 130	M
2,2-Dichloropropane	0.27	2	20	M	70 - 130	70 - 130	M
2-Chlorotoluene	0.038	0.5	20	M	70 - 130	70 - 130	M
3,3-Dimethyl-1-butanol	0.52	10	20	M	70 - 130	70 - 130	M
4-Chlorotoluene	0.053	0.5	20	M	70 - 130	70 - 130	M
4-Isopropyltoluene	0.059	0.5	20	M	70 - 130	70 - 130	M
Acetone	1.5	10	20	M	40 - 160	40 - 160	M
Benzene	0.054	0.5	20	M	70 - 130	70 - 130	M
Bromobenzene	0.088	0.5	20	M	70 - 130	70 - 130	M
Bromochloromethane	0.050	0.5	20	M	70 - 130	70 - 130	M
Bromodichloromethane	0.031	0.5	20	M	70 - 130	70 - 130	M
Bromoform	0.10	0.5	20	M	70 - 130	70 - 130	M
Bromomethane	0.24	1	20	M	60 - 140	60 - 140	M
Carbon tetrachloride	0.065	0.5	20	M	70 - 130	70 - 130	M
Chlorobenzene	0.025	0.5	20	M	70 - 130	70 - 130	M

Table 5.13
Volatile Organics in Water Matrix by GC Method SM 6200 B (Continued)

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range (%R)		Conc. Level
					LCS (%)	MS (%)	
Chloroethane	0.088	0.5	20	M	60 - 140	60 - 140	M
Chloroform	0.053	0.5	20	M	70 - 130	70 - 130	M
Chloromethane	0.032	0.5	20	M	60 - 140	60 - 140	M
cis-1,2-Dichloroethylene	0.061	0.5	20	M	70 - 130	70 - 130	M
cis-1,3-Dichloropropene	0.065	0.5	20	M	70 - 130	70 - 130	M
Dibromochloromethane	0.062	0.5	20	M	70 - 130	70 - 130	M
Dibromomethane	0.044	0.5	20	M	70 - 130	70 - 130	M
Dichlorodifluoromethane	0.057	1	20	M	60 - 140	60 - 140	M
Ethanol	42	200	20	M	60 - 140	60 - 140	M
Ethylbenzene	0.054	0.5	20	M	70 - 130	70 - 130	M
Hexachlorobutadiene	0.41	2	20	M	70 - 130	70 - 130	M
Isopropyl ether (IPE)	0.042	0.5	20	M	70 - 130	70 - 130	M
Isopropyl benzene	0.034	0.5	20	M	70 - 130	70 - 130	M
m/p-Xylene	0.11	1	20	M	70 - 130	70 - 130	M
Methyl Butyl Ketone (2-Hexanone)	0.11	0.5	20	M	60 - 140	60 - 140	M
Methyl Ethyl Ketone (2-Butanone)	0.83	20	20	M	60 - 140	60 - 140	M
Methyl Isobutyl Ketone (2-Hexanone)	0.048	0.5	20	M	60 - 140	60 - 140	M
Methylene Chloride	0.073	2	20	M	70 - 130	70 - 130	M
Methyl tert-butyl ether (MTBE)	0.056	1	20	M	70 - 130	70 - 130	M
Naphthalene	0.094	1	20	M	70 - 130	70 - 130	M
n-Butylbenzene	0.059	0.5	20	M	70 - 130	70 - 130	M
n-Propylbenzene	0.059	0.5	20	M	70 - 130	70 - 130	M
o-Xylene	0.064	0.5	20	M	70 - 130	70 - 130	M
sec-Butylbenzene	0.054	0.5	20	M	70 - 130	70 - 130	M
Styrene	0.034	0.5	20	M	70 - 130	70 - 130	M
tert-Amyl Alcohol	0.72	10	20	M	70 - 130	70 - 130	M
tert-Amyl Ethyl Ether	0.30	10	20	M	70 - 130	70 - 130	M
tert-Amyl Methyl Ether	0.21	10	20	M	70 - 130	70 - 130	M
Tert-Butyl Alcohol	0.52	10	20	M	70 - 130	70 - 130	M
tert-Butylbenzene	0.11	0.5	20	M	70 - 130	70 - 130	M
tert-Butyl Ethyl ether	0.25	10	20	M	70 - 130	70 - 130	M
Tert-Butyl Formate	0.85	10	20	M	70 - 130	70 - 130	M
Tetrachloroethene	0.096	0.5	20	M	70 - 130	70 - 130	M
Toluene	0.057	0.5	20	M	70 - 130	70 - 130	M
trans-1,2-Dichloroethene	0.061	0.5	20	M	70 - 130	70 - 130	M

Table 5.13
Volatile Organics in Water Matrix by GC Method SM 6200 B (Continued)

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range (%R)		Conc. Level
					LCS (%)	MS (%)	
trans-1,3-Dichloropropene	0.054	0.5	20	M	70 - 130	70 - 130	M
Trichloroethene	0.044	0.5	20	M	70 - 130	70 - 130	M
Trichlorofluoromethane	0.050	0.5	20	M	60 - 140	60 - 140	M
Vinyl acetate	1.3	5	20	M	60 - 140	60 - 140	M
Vinyl chloride	0.068	0.5	20	M	60 - 140	60 - 140	M
Xylenes, total	0.17	1.5	20	M	70 - 130	70 - 130	M

Surrogates	Recovery Range (%R)	
4-Bromochlorobenzene	70	130
Dibromofluoromethane	70	130
Toluene-d8	70	130

Table 5.14
Volatile Organics in Water Matrix by GC/MS Method EPA 624

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
1,1,1-Trichloroethane	0.12	5	26*	M	52 - 162	52 - 162	M
1,1,2,2-Tetrachloroethene	0.10	5	22*	M	46 - 157	46 - 157	M
1,1,2-Trichloroethane	0.085	5	26*	M	52 - 150	52 - 150	M
1,1-Dichloroethane	0.108	5	26*	M	59 - 155	59 - 155	M
1,1-Dichloroethene	0.094	5	30*	M	10 - 234	10 - 234	M
1,2,4-trimethylbenzene	0.18	5	23*	M	67 - 132	63 - 125	M
1,2-Dichlorobenzene	0.099	5	21*	M	18 - 190	18 - 190	M
1,2-Dichloroethane	0.063	5	24*	M	49 - 155	49 - 155	M
1,2-Dichloropropane	0.12	5	29*	M	10 - 210	10 - 210	M
1,3-Dichlorobenzene	0.11	5	21*	M	59 - 156	59 - 156	M
1,4-Dichlorobenzene	0.11	5	22*	M	18 - 190	18 - 190	M
2-Chloroethyl vinyl ether	0.44	10	44*	M	10 - 305	10 - 305	M
Acetone	2.1	10	23*	M	40 - 166*	40 - 162*	M
Acrolein	0.86	100	36*	M	10 - 196*	10 - 196*	M
Acrylonitrile	0.73	100	29*	M	60 - 134*	60 - 134*	M
Benzene	0.066	5	26*	M	37 - 151	37 - 151	M
Bromodichloromethane	0.082	5	27*	M	35 - 155	35 - 155	M
Bromoform	0.15	5	21*	M	45 - 169	45 - 169	M
Bromomethane	0.19	10	36*	M	10 - 242	10 - 242	M
Butyl acetate	1.3	10	20[s]	M	70 - 130[s]	70 - 130[s]	M
Carbon Tetrachloride	0.088	5	28*	M	70 - 140	70 - 140	M
Chlorobenzene	0.098	5	21*	M	37 - 160	37 - 160	M
Chloroethane	0.26	10	29*	M	14 - 230	14 - 230	M
Chloroform	0.059	5	25*	M	51 - 138	51 - 138	M
Chloromethane	0.17	10	27*	M	10 - 273	10 - 273	M
cis-1,2-Dichloroethene	0.044	1	18*	M	75 - 129*	75 - 129*	M
cis-1,3-Dichloropropene	0.20	5	27*	M	10 - 227	10 - 227	M
Dibromochloromethane	0.087	5	18*	M	53 - 149	53 - 149	M
Epichlorohydrin	0.46	5	20[s]	M	70 - 130[s]	70 - 130[s]	M
Ethylbenzene	0.12	5	23*	M	37 - 162	37 - 162	M
Isopropyl ether (IPE)	0.054	5	36*	M	62 - 136*	62 - 136*	M
m,p-Xylenes	0.26	10	15*	M	80 - 135*	80 - 135*	M

Table 5.14
Volatile Organics in Water Matrix by GC/MS Method EPA 624 (Continued)

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Methyl t-butyl ether (MTBE)	0.12	5	36*	M	56 - 142*	56 - 142*	M
Methylene Chloride	0.069	5	18*	M	10 - 221	10 - 221	M
Methyl ethyl ketone (MEK)	1.1	5	23*	M	71 - 134*	65 - 137*	M
o-Xylene	0.15	5	11*	M	76 - 126*	76 - 126*	M
Tetrachloroethene	0.14	5	23*	M	64 - 148	64 - 148	M
Toluene	0.088	5	27*	M	47 - 150	47 - 150	M
Total xylenes	0.41	5	10*	M	80 - 130*	80 - 130*	M
trans-1,2-Dichloroethene	0.093	5	27*	M	54 - 156	54 - 156	M
trans-1,3-Dichloropropene	0.065	5	26*	M	17 - 183	17 - 183	M
Trichloroethene	0.15	5	22*	M	71 - 157	71 - 157	M
Trichlorofluoromethane	0.018	10	31*	M	17 - 181	17 - 181	M
Vinyl Chloride	0.51	10	28*	M	10 - 251	10 - 251	M

Surrogates	Accuracy Range (%Recovery)	
Dibromofluoromethane	75*	127*
Toluene-d8	74*	122*
Bromofluorobenzene	74*	126*

[s] - Initial Start-up Limits

* - Historical Limits.

All other limits based on the method limits.

Table 5.15
Volatile Organics in Water Matrix by GC/MS Method SW846-8260B

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
1,1,1,2-Tetrachloroethene	0.15	0.5	19	M	79 - 134	78 - 134	M
1,1,1-Trichloroethane	0.063	0.5	18	M	75 - 136	67 - 145	M
1,1,2,2-Tetrachloroethene	0.071	0.5	19	M	62 - 127	68 - 123	M
1,1,2-Trichloro-1,2,2-trifluoroethane	0.11	5	20*	M	70 - 130*	70 - 130*	M
1,1,2-Trichloroethane	0.17	0.5	18	M	70 - 140	75 - 134	M
1,1-Dichloroethane	0.096	0.5	18	M	78 - 130	75 - 134	M
1,1-Dichloroethene	0.078	0.5	20	M	70 - 154	65 - 162	M
1,1-Dichloropropene	0.061	0.5	19	M	71 - 136	68 - 140	M
1,2,3-Trichlorobenzene	0.20	2	31	M	58 - 144	56 - 146	M
1,2,3-Trichloropropane	0.081	1	18	M	71 - 127	73 - 122	M
1,2,4-Trichlorobenzene	0.10	1	20	M	66 - 139	67 - 135	M
1,2,4-Trimethylbenzene	0.048	0.5	18	M	75 - 133	75 - 131	M
1,2-Dibromo-3-chloropropane	0.59	2	25	M	63 - 134	64 - 133	M
1,2-Dibromoethane	0.14	0.5	19	M	77 - 135	80 - 129	M
1,2-Dichlorobenzene	0.076	0.5	16	M	78 - 128	80 - 125	M
1,2-Dichloroethane	0.14	0.5	17	M	68 - 131	69 - 129	M
1,2-Dichloropropane	0.13	0.5	17	M	77 - 130	75 - 131	M
1,3,5-Trimethylbenzene	0.057	0.5	19	M	75 - 130	75 - 131	M
1,3-Dichlorobenzene	0.074	0.5	17	M	77 - 131	79 - 122	M
1,3-Dichloropropane	0.11	0.5	18	M	76 - 125	80 - 125	M
1,4-Dichlorobenzene	0.068	0.5	17	M	75 - 132	76 - 124	M
1,4-Dichlorobutane	0.098	5	20	M	70 - 1301	70 - 130*	M
1,4-Dioxane	13	150	20	M	70 - 130*	70 - 130*	M
2,2-Dichloropropane	0.11	2	19	M	29 - 149	21 - 140	M
2-Chloroethyl vinyl ether	0.22	2	44	M	34 - 144	15 - 181	M
2-Chlorotoluene	0.038	0.5	24	M	74 - 126	75 - 125	M
3,3-dimethyl-1-butanol	0.52	10	20*	M	70 - 130*	70 - 130*	M
4-Chlorotoluene	0.053	0.5	16	M	78 - 129	76 - 130	M
4-Isopropyltoluene	0.065	0.5	19	M	69 - 132	72 - 129	M
Acetone	0.62	5	23	M	40 - 166	40 - 162	M
Acetonitrile	3.0	10	20	M	81 - 127	78 - 129	M

Table 5.15
Volatile Organics in Water Matrix by GC/MS Method SW846-8260B

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Acrolein	1.1	20	20*	M	70 - 130*	70 - 130*	M
Acrylonitrile	0.86	20	20	M	81 - 127	78 - 129	M
Allyl Chloride	0.75	10	20*	M	70 - 130*	70 - 130*	M
Benzene	0.072	0.5	17	M	77 - 128	73 - 131	M
Bromobenzene	0.064	0.5	18	M	78 - 129	80 - 125	M
Bromochloromethane	0.13	0.5	17	M	78 - 135	78 - 135	M
Bromodichloromethane	0.062	0.5	19	M	76 - 138	74 - 138	M
Bromoform	0.27	2	22	M	71 - 135	72 - 130	M
Bromomethane	0.47	1	33	M	41 - 168	41 - 173	M
Carbon Disulfide	1.4	5	27	M	59 - 135	59 - 138	M
Carbon Tetrachloride	0.12	0.5	23	M	72 - 142	66 - 149	M
Chlorobenzene	0.061	0.5	20	M	78 - 119	76 - 119	M
Chloroethane	0.13	0.5	24	M	57 - 142	52 - 153	M
Chloroform	0.089	0.5	19	M	77 - 130	74 - 136	M
Chloromethane	0.11	0.5	20	M	47 - 145	39 - 155	M
Chloroprene	0.86	10	20*	M	70 - 130*	70 - 130*	M
cis-1,2-Dichloroethene	0.076	0.5	17	M	76 - 141	74 - 144	M
cis-1,3-Dichloropropene	0.10	0.5	18	M	65 - 140	64 - 132	M
Cyclohexane	0.16	10	20*	M	70 - 130*	70 - 130*	M
Dibromochloromethane	0.30	0.5	21	M	75 - 134	77 - 131	M
Dibromomethane	0.13	0.5	18	M	76 - 138	76 - 136	M
Dichlorodifluoromethane	0.11	1	22	M	28 - 163	22 - 170	M
Epichlorohydrin	0.46	50	20[s]	M	70 - 130[s]	70 - 130[s]	M
Ethanol	42	200	20*	M	70 - 130*	70 - 130*	M
Ethyl Methacrylate	0.26	10	20*	M	70 - 130*	70 - 130*	M
Ethylbenzene	0.067	0.5	18	M	80 - 127	78 - 130	M
Hexachlorobutadiene	0.36	2	26	M	61 - 134	63 - 132	M
Hexane	3.7	10	20*	M	70 - 130*	70 - 130*	M
Isobutyl alcohol	5	10	20*	M	70 - 130*	70 - 130*	M
Isopropyl ether	0.043	0.5	18	M	60 - 154	62 - 154	M
Isopropylbenzene	0.072	0.5	19	M	70 - 130	72 - 127	M
m,p-Xylenes	0.081	1	19	M	77 - 133	66 - 144	M

Table 5.15
Volatile Organics in Water Matrix by GC/MS Method SW846-8260B

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Methacrylonitrile	0.57	10	20*	M	70 - 130*	70 - 130*	M
Methyl acetate	0.17	10	20*	M	70 - 130*	70 - 130*	M
Methyl butyl ketone	0.19	5	23	M	64 - 137	65 - 130	M
Methyl cyclohexane	0.095	10	20*	M	70 - 130*	70 - 130*	M
Methyl ethyl ketone	0.90	5	23	M	71 - 134	65 - 137	M
Methyl Iodide	0.45	5	20*	M	70 - 130*	70 - 130*	M
Methyl isobutyl ketone	0.12	5	24	M	69 - 134	64 - 137	M
Methyl methacrylate	0.27	10	20*	M	70 - 130*	70 - 130*	M
Methylene Chloride	0.44	1	17	M	73 - 131	71 - 134	M
Methyl-tert-butyl ether	0.070	0.5	19	M	68 - 135	71 - 133	M
Naphthalene	0.098	2	32	M	64 - 136	63 - 134	M
n-Butylbenzene	0.11	1	21	M	68 - 134	69 - 132	M
n-Propylbenzene	0.060	0.5	18	M	72 - 132	75 - 130	M
o-Xylene	0.046	0.5	20	M	78 - 128	75 - 131	M
Pentachloroethane	1.4	10	20*	M	70 - 130*	70 - 130*	M
Propionitrile	2.1	10	20*	M	70 - 130*	70 - 130*	M
sec-Butylbenzene	0.087	0.5	20	M	71 - 131	72 - 130	M
Styrene	0.047	0.5	17	M	78 - 129	77 - 128	M
tert-Amyl Alcohol	0.72	10	20*	M	70 - 130*	70 - 130*	M
tert-Amyl Ethyl ether	0.30	10	20*	M	70 - 130*	70 - 130*	M
tert-Amyl Methyl Ether	0.21	10	20*	M	70 - 130*	70 - 130*	M
tert-Butyl Alcohol	0.74	10	20*	M	70 - 130*	70 - 130*	M
tert-Butylbenzene	0.080	0.5	20	M	70 - 132	72 - 130	M
tert-Butyl Ethyl Ether	0.25	10	20*	M	70 - 130*	70 - 130*	M
tert-Butyl Alcohol	0.52	10	20*	M	70 - 130*	70 - 130*	M
tert-Butyl Formate	0.85	10	20*	M	70 - 130*	70 - 130*	M
Tetrachloroethene	0.069	0.5	20	M	80 - 129	76 - 130	M
Tetrahydrofuran	1.5	10	20*	M	70 - 130*	70 - 130*	M
Toluene	0.042	0.5	18	M	76 - 131	72 - 135	M
trans-1,2-Dichloroethene	0.12	0.5	18	M	76 - 135	73 - 141	M
trans-1,3-Dichloropropene	0.043	0.5	21	M	67 - 140	64 - 137	M

Table 5.15
Volatile Organics in Water Matrix by GC/MS Method SW846-8260B

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Trans-1,4-Dichloro-2-butene	0.51	10	20*	M	70 - 130*	70 - 130*	M
Trichloroethene	0.054	0.5	17	M	77 - 133	72 - 133	M
Trichlorofluoromethane	0.088	0.5	27	M	62 - 148	61 - 152	M
Vinyl acetate	0.10	2	18	M	34 - 167	80 - 154	M
Vinyl Chloride	0.16	0.5	25	M	57 - 141	54 - 146	M

Surrogates	Accuracy Range (%Recovery)	
1,2-Dichloroethane-d4	74	138
4-Bromomfluorobenzene	80	124
Dibromofluoromethane	75	129
Toluene-d8	77	123

* - Initial Start-up Limits

Table 5.16
Volatile Organics in Solid Matrix by GC/MS Method SW846-8260B

Parameter	MDL (µg/kg)	RL (µg/kg)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
1,1,1,2-Tetrachloroethene	0.30	5	15	M	72 - 115	60 - 120	M
1,1,1-Trichloroethane	0.16	5	21	M	67 - 131	52 - 139	M
1,1,2,2-Tetrachloroethene	0.83	5	22	M	56 - 126	39 - 135	M
1,1,2-Trichloro-1,2,2-Trifluoroethane	0.57	10	20*	M	70 - 130*	70 - 130*	M
1,1,2-Trichloroethane	0.42	5	21	M	70 - 133	44 - 140	M
1,1-Dichloroethane	0.42	5	21	M	74 - 127	59 - 137	M
1,1-Dichloroethene	0.30	5	22	M	67 - 149	54 - 162	M
1,1-Dichloropropene	0.53	5	19	M	71 - 130	55 - 137	M
1,2,3-Trichlorobenzene	0.37	10	41	M	68 - 130	34 - 120	M
1,2,3-Trichloropropane	0.75	5	25	M	60 - 137	45 - 139	M
1,2,4-Trichlorobenzene	0.29	10	62	M	66 - 125	35 - 116	M
1,2,4-Trimethylbenzene	0.25	10	24	M	69 - 129	38 - 142	M
1,2-Dibromo-3-chloropropane	1.6	5	25	M	55 - 157	27 - 132	M
1,2-Dibromoethane (EDB)	0.57	5	15	M	70 - 132	49 - 132	M
1,2-Dichlorobenzene	0.23	10	21	M	72 - 123	42 - 130	M
1,2-Dichloroethane	0.81	5	13	M	68 - 128	51 - 131	M
1,2-Dichloropropane	0.32	10	16	M	73 - 130	55 - 138	M
1,3,5-Trimethylbenzene	0.24	10	29	M	69 - 128	44 - 140	M
1,3-Dichlorobenzene	0.07	10	24	M	71 - 120	41 - 129	M
1,3-Dichloropropane	0.54	5	15	M	75 - 124	53 - 129	M
1,4-Dichlorobenzene	0.37	10	21	M	71 - 123	44 - 134	M
1,4-Dichlorobutane	0.50	10	20*	M	70 - 130*	70 - 130*	M
1,4-Dioxane	23	100	20*	M	70 - 130*	70 - 130*	M
2,2-Dichloropropane	0.32	5	20	M	50 - 142	30 - 147	M
2-Chloroethyl vinyl ether	2.8	10	15	M	72 - 126	69 - 124	M
2-Chlorotoluene	0.31	10	29	M	67 - 124	46 - 132	M
4-Chlorotoluene	0.23	10	23	M	71 - 126	44 - 135	M
4-Isopropyltoluene	0.32	15	22	M	68 - 129	32 - 144	M
Acetone	2.7	20	49	M	29 - 198	34 - 143	M
Acrolein	3.0	100	20*	M	70 - 130*	70 - 130*	M
Acrylonitrile	2.5	100	30	M	81 - 107	51 - 105	M

Table 5.16
Volatile Organics in Solid Matrix by GC/MS Method SW846-8260B

Parameter	MDL (µg/kg	RL (µg/kg)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Benzene	0.30	3	20	M	74 - 127	60 - 135	M
Bromobenzene	0.21	5	25	M	73 - 125	45 - 135	M
Bromochloromethane	0.73	5	18	M	72 - 134	55 - 136	M
Bromodichloromethane	0.23	5	17	M	75 - 122	55 - 136	M
Bromoform	0.89	5	35	M	66 - 135	40 - 136	M
Bromomethane	1.4	10	30	M	20 - 180	30 - 137	M
Carbon Disulfide	0.42	10	26	M	61 - 129	49 - 139	M
Carbon Tetrachloride	0.27	5	23	M	64 - 143	48 - 153	M
Chlorobenzene	0.23	5	14	M	74 - 118	57 - 125	M
Chloroethane	3.8	10	47	M	33 - 149	16 - 177	M
Chloroform	0.21	5	18	M	73 - 127	56 - 137	M
Chloromethane	2.5	10	26	M	45 - 143	40 - 145	M
cis-1,2-Dichloroethene	0.40	5	28	M	76 - 134	58 - 140	M
cis-1,3-Dichloropropene	0.25	5	32	M	71 - 125	42 - 135	M
Cyclohexane	1.3	5	20*	M	70 - 130*	70 - 130*	M
Dibromochloromethane	0.34	5	24	M	73 - 122	49 - 127	M
Dibromomethane	0.34	5	15	M	74 - 133	59 - 133	M
Dichlorodifluoromethane	0.54	10	37	M	26 - 146	25 - 151	M
Ethylbenzene	0.32	5	19	M	74 - 128	44 - 144	M
Hexachlorobutadiene	0.64	15	26	M	64 - 125	30 - 126	M
Hexane	0.61	10	20*	M	70 - 130*	70 - 130*	M
Isopropyl ether (IPE)	0.21	5	13	M	59 - 159	51 - 155	M
Isopropylbenzene	0.25	10	27	M	68 - 126	41 - 140	M
m,p-Xylenes	0.64	10	20	M	75 - 124	36 - 148	M
Methyl Acetate	0.50	5	20*	M	70 - 130*	70 - 130*	M
Methyl Butyl Ketone (2-Hexanone)	1.0	50	42	M	61 - 157	30 - 147	M
Methylcyclohexane	0.94	5	20	M	70 - 130*	70 - 130*	M
Methyl ethyl ketone (MEK)	1.8	10	42	M	63 - 149	24 - 160	M
Methyl iodide	0.72	10	20	M	70 - 130*	70 - 130*	M
Methyl Isobutyl Ketone (MIBK)	1.3	10	44	M	57 - 162	25 - 163	M
Methylene Chloride	0.36	10	14	M	74 - 129	53 - 144	M

Table 5.16
Volatile Organics in Solid Matrix by GC/MS Method SW846-8260B

Parameter	MDL (µg/kg)	RL (µg/kg)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Methyl-tert-butyl ether (MTBE)	0.38	5	22	M	70 - 130	49 - 135	M
Naphthalene	0.37	5	44	M	57 - 157	32 - 127	M
n-Butylbenzene	0.22	15	39	M	65 - 135	23 - 148	M
n-Propylbenzene	0.29	10	27	M	67 - 130	35 - 144	M
o-Xylene	0.32	5	17	M	74 - 126	43 - 143	M
sec-Butylbenzene	0.20	15	28	M	66 - 131	34 - 144	M
Styrene	0.22	5	28	M	77 - 121	42 - 132	M
tert-Butylbenzene	0.26	20	29	M	67 - 132	36 - 150	M
Tetrachloroethene	0.35	10	26	M	68 - 130	47 - 142	M
Tetrahydrofuran	2.49	5	20*	M	70 - 130*	70 - 130*	M
Toluene	0.30	5	22	M	71 - 129	57 - 135	M
trans-1,2-Dichloroethene	0.58	5	18	M	73 - 132	58 - 141	M
trans-1,3-Dichloropropene	0.24	5	20	M	68 - 123	41 - 124	M
trans-1,4-Dichloro-2-butene	0.67	10	20*	M	70 - 130*	70 - 130*	M
Trichloroethene	0.46	5	18	M	75 - 133	38 - 164	M
Trichlorofluoromethane	0.41	5	27	M	44 - 146	30 - 157	M
Vinyl acetate	1.4	10	35	M	85 - 161	61 - 154	M
Vinyl Chloride	0.65	10	35	M	48 - 147	40 - 156	M
Xylenes, total	0.94	15	20	M	74 - 126	36 - 148	M

Surrogates	Accuracy Range (%Recovery)	
1,2-Dichloroethane-d4	70	130
4-Bromofluorobenzene	70	130
Dibromofluoromethane	84	123
Toluene-d8	76	129

* - Initial start-up limits

Table 5.17
Semi-Volatile Organics in Water Matrix by GC/MS Method EPA 625

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
1,2,4-Trichlorobenzene	1.8	10	30*	M	44 - 142	44 - 142	M
1,2-Dichlorobenzene	1.8	10	34*	M	32 - 129	32 - 129	M
1,2-Diphenylhydrazine	2.0	10	50[s]	M	40 - 135 [s]	40 - 135 [s]	M
1,3-Dichlorobenzene	1.8	10	36*	M	20 - 124	20 - 124	M
1,4-Dichlorobenzene	1.8	10	35*	M	20 - 124	20 - 124	M
1-Methylnaphthalene	1.7	10	50[s]	M	40 - 135 [s]	40 - 135 [s]	M
2,3-Dichloroaniline[1]	1.9	10	50[s]	M	68 - 134	68 - 134	M
2,4,5-Trichlorophenol	2.9	10	22*	M	66 - 120*	51 - 122*	M
2,4,6-Trichlorophenol	2.0	10	30*	M	37 - 144	37 - 144	M
2,4-Dichlorophenol	1.8	10	31*	M	39 - 135	39 - 135	M
2,4-Dimethylphenol	1.6	10	36*	M	32 - 119	32 - 119	M
2,4-Dinitrophenol	5.8	10	41*	M	10 - 191	10 - 191	M
2,4-Dinitrotoluene	2.6	10	24*	M	39 - 139	39 - 139	M
2,6-Dinitrotoluene	2.2	10	28*	M	50 - 158	50 - 158	M
2-Chloronaphthalene	2.0	10	30*	M	60 - 118	60 - 118	M
2-Chlorophenol	1.8	10	37*	M	23 - 134	23 - 134	M
2-Methylnaphthalene	2.0	10	33*	M	18 - 121	18 - 121	M
2-Methylphenol[1]	1.2	10	36*	M	55 - 126	55 - 126	M
2-Nitroaniline	2.1	10	24*	M	65 - 122*	51 - 139*	M
2-Nitrophenol	1.5	10	33*	M	29 - 182	29 - 182	M
3&4-Methylphenol[2]	0.96	10	30*	M	76 - 107	76 - 107	M
3,3'-Dichlorobenzidine	2.9	10	50[s]	M	10 - 262	10 - 262	M
3-Nitroaniline	2.3	10	24*	M	48 - 109	48 - 109	M
4,6-Dinitro-2-methyl phenol	5.4	10	35*	M	10 - 181	10 - 181	M
4-Bromophenyl-phenyl ether	1.9	10	21*	M	53 - 127	53 - 127	M
4-Chloro-3-Methylphenol	1.7	10	25*	M	22 - 147	22 - 147	M
4-Chloroaniline	2.5	10	38*	M	44 - 163*	10 - 156*	M
4-Chlorophenyl phenyl ether	1.6	10	29*	M	25 - 158	25 - 158	M
4-Nitroaniline	3.2	10	29*	M	63 - 147*	39 - 159*	M
4-Nitrophenol	1.1	10	40*	M	10 - 132	10 - 132	M
Acenaphthene	1.8	10	33*	M	47 - 145	47 - 145	M
Acenaphthylene	1.8	10	33*	M	33 - 145	33 - 145	M

Table 5.17
Semi-Volatile Organics in Water Matrix by GC/MS Method EPA 625 (Continued)

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Acetophenone[1]	4.9	10	50[s]	M	61 - 144	61 - 144	M
alpha-Terpineol[1]	1.6	10	50[s]	M	58 - 156	58 - 156	M
Aniline[2]	2.2	10	35*	M	46 - 134	46 - 134	M
Anthracene	2.6	10	27*	M	27 - 133	27 - 133	M
Azobenzene	2.1	10	34*	M	47 - 109	45 - 113	M
Benzidine	11	50	50[s]	M	15 - 150[s]	15 - 150[s]	M
Benzo (a) anthracene	2.0	10	18*	M	33 - 143	33 - 143	M
Benzo (a) pyrene	2.2	10	21*	M	17 - 163	17 - 163	M
Benzo (b) fluoranthene	1.7	10	34*	M	24 - 159	24 - 159	M
Benzo (g,h,I) perylene	3.3	10	27*	M	10 - 219	10 - 219	M
Benzo (k) fluoranthene	2.3	10	39*	M	11 - 162	11 - 162	M
Benzoic acid	50	100	51*	M	10 - 125*	10 - 125*	M
Benzyl alcohol	1.2	10	37*	M	19 - 77	16 - 107	M
Bis(2-chloroethoxy) methane	2.0	10	30*	M	33 - 184	33 - 184	M
Bis(2-chloroethyl) ether	1.7	10	33*	M	12 - 158	12 - 158	M
Bis(2-chloroisopropyl) ether	1.5	10	34*	M	36 - 166	36 - 166	M
Bis(2-Ethylhexyl) phthalate	3.2	10	21*	M	10 - 158	10 - 158	M
Butyl benzyl phthalate	2.0	10	23*	M	10 - 152	10 - 152	M
Carbazole[1]	2.8	10	50[s]	M	73 - 131	73 - 131	M
Chrysene	2.2	10	22*	M	17 - 168	17 - 168	M
cis-Decahydronaphthalene	1.5	10	50[s]	M	40 - 135[s]	40 - 135[s]	M
Decalin	6.0	20	50[s]	M	40 - 135[s]	45 - 135[s]	M
Dibenzo (a,h) anthracene	3.2	10	28*	M	10 - 227	10 - 227	M
Dibenzofuran	1.9	10	23*	M	39 - 111	39 - 114	M
Diethylphthalate	2.1	10	22*	M	10 - 114	10 - 114	M
Dimethylphthalate	2.9	10	25*	M	10 - 112	10 - 112	M
Di-n-Butyl Phthalate	2.5	10	24*	M	10 - 118	10 - 118	M
Di-n-octyl-phthalate	3.1	10	21*	M	10 - 146	10 - 146	M
Fluoranthene	2.5	10	26*	M	26 - 137	26 - 137	M
Fluorene	1.7	10	30*	M	59 - 121	59 - 121	M
Hexachlorobenzene	2.3	10	29*	M	10 - 152	10 - 152	M
Hexachlorobutadiene	1.8	10	35*	M	24 - 116	24 - 116	M

Table 5.17
Semi-Volatile Organics in Water Matrix by GC/MS Method EPA 625 (Continued)

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Hexachlorocyclopentadiene	2.0	10	36*	M	32 - 117*	26 - 122*	M
Hexachloroethane	1.8	10	37*	M	40 - 113	40 - 113	M
Indeno (1,2,3-c,d) pyrene	2.8	10	34*	M	10 - 171	10 - 171	M
Isophorone	2.0	10	27*	M	21 - 196	21 - 196	M
Naphthalene	1.7	10	35*	M	21 - 133	21 - 133	M
n-Decane[1]	1.4	10	50[s]	M	10 - 200 [s]	10 - 200 [s]	M
Nitrobenzene	1.9	10	34*	M	35 - 180	35 - 180	M
N-Nitrosodimethylamine	1.1	10	45*	M	10 - 119*	10 - 119*	M
N-Nitrosodi-n -propylamine	2.7	10	33*	M	10 - 230	10 - 230	M
N-Nitrosodiphenylamine	1.9	10	26*	M	69 - 152*	57 - 156*	M
n-Octadecane[1]	1.8	10	50[s]	M	65 - 123	65 - 123	M
p-Benzoquinone	1.9	10	50[s]	M	40 - 135 [s]	45 - 135 [s]	M
Pentachlorophenol	2.7	10	36*	M	14 - 176	14 - 176	M
Phenanthrene	2.0	10	23*	M	54 - 120	54 - 120	M
Phenol	0.48	10	43*	M	10 - 112	10 - 112	M
Pyrene	1.4	10	21*	M	52 - 115	52 - 115	M
Pyridine[2]	2.9	10	50[s]	M	33 - 158	33 - 158	M
trans-Decahydronaphthalene	1.9	10	50[s]	M	40 - 135 [s]	40 - 135 [s]	M

Surrogates	Recovery Range (%R)	
2-Fluorophenol	27	74
Phenol-d5	11	52
Nitrobenzene-d5	53	99
2-Fluorobiphenyl	55	96
2,4,6-Tribromophenol	49	109
Terphenyl-d14	42	133

[s] - Initial Start-up Limits

* - Historical Limits.

All other limits based on the method limits.

[1] - Only for the Centralized Waste Treatment and Landfills industries

[2] - Only for the Centralized Waste Treatment industry

NA - Not Available

Table 5.18
Semi-Volatile Organics in Water Matrix by GC/MS Method SW846-8270D

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
1,1-Biphenyl	1.4	10	50[s]	M	35 - 115[s]	35 - 115[s]	M
1,2,4,5-Tetrachlorobenzene	1.8	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
1,2,4-Trichlorobenzene	2.2	10	30	M	45 - 103	44 - 100	M
1,2-Dichlorobenzene	1.8	10	34	M	43 - 100	42 - 99	M
1,2-Diphenylhydrazine	2.0	10	50[s]	M	40 - 135[s]	40 - 135[s]	M
1,3,5-Trinitrobenzene	2.6	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
1,3-Dichlorobenzene	1.8	10	36	M	42 - 98	35 - 101	M
1,3-Dinitrobenzene	1.6	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
1,4-Dichlorobenzene	2.0	10	35	M	42 - 100	43 - 97	M
1,4-Dioxane	2.0	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
1,4-Diphenylenediamine	1.4	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
1,4-Napthaquinone	2.0	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
1-Chloronaphthalene	0.96	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
1-Methylnaphthalene	2.5	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
1-Methylphenanthrene	0.80	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
1-Napthylamine	1.4	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
2,3,4,6-Tetrachlorophenol	1.7	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
2,3-Dichloroanaline	1.1	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
2,4,5-Trichlorophenol	2.0	10	22	M	66 - 120	51 - 122	M
2,4,6-Trichlorophenol	2.3	10	30	M	62 - 121	46 - 117	M
2,4-Dichlorophenol	2.4	10	31	M	58 - 113	42 - 108	M
2,4-Dimethylphenol	2.6	10	36	M	42 - 120	13 - 122	M
2,4-Dinitrophenol	1.6	10	41	M	27 - 129	10 - 166	M
2,4-Dinitrotoluene	1.2	10	24	M	62 - 136	64 - 135	M
2,6-Dichlorophenol	3.2	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
2,6-Dinitrotoluene	1.4	10	28	M	64 - 129	50 - 146	M
2-Acetylaminofluorene	2.2	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
2-Chloronaphthalene	2.3	10	30	M	38 - 141	46 - 114	M
2-Chlorophenol	2.1	10	37	M	49 - 107	36 - 94	M
2-Methylnaphthalene	2.6	10	33	M	55 - 112	36 - 115	M
2-Methylphenol	2.4	10	36	M	40 - 106	27 - 92	M
2-Napthylamine	1.1	10	50[s]	M	45 - 135[s]	45 - 135[s]	M

Table 5.18
Semi-Volatile Organics in Water Matrix by GC/MS Method SW846-8270D (Continued)

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
2-Nitroaniline	1.9	10	24	M	65 - 122	51 - 139	M
2-Nitrophenol	2.5	10	33	M	57 - 115	43 - 108	M
2-Picoline	2.0	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
3&4-Methylphenol	2.4	10	30	M	34 - 101	22 - 84	M
3,3'-Dimethylbenzidine	0.81	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
3,3'-Dichlorobenzidine	0.96	10	34	M	58 - 139	10 - 214	M
3-Methylcholanthrene	1.6	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
3-Nitroaniline	1.3	10	24	M	52 - 155	50 - 145	M
4,6-Dinitro-2-methyl phenol	2.7	10	35	M	49 - 138	25 - 152	M
4-Aminobiphenyl	0.84	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
4-Bromophenyl-phenyl ether	1.8	10	21	M	63 - 135	52 - 128	M
4-Chloro-3-Methylphenol	2.3	10	25	M	33 - 149	44 - 110	M
4-Chloroanailine	2.5	10	38	M	44 - 163	10 - 156	M
4-Chlorophenyl phenyl ether	1.8	10	29	M	63 - 129	55 - 125	M
4-Nitroaniline	0.91	10	29	M	63 - 147	39 - 159	M
4-Nitrophenol	2.6	10	40	M	10 - 77	10 - 105	M
4-Nitroquinoline-1-oxide	1.4	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
5-Nitro-o-toluidine	0.91	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
7,12-Dimethylbenz(a)anthracene	1.2	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
a,a-Dimethylphenthylamine	4.3	20	50[s]	M	45 - 135[s]	45 - 135[s]	M
Acenaphthene	2.1	10	33	M	64 - 118	55 - 117	M
Acenaphthylene	2.2	10	30	M	65 - 119	52 - 121	M
Acetophenone	1.2	10	50[s]	M	57 - 116	57 - 116	M
Aniline	2.2	10	35	M	12 - 197	11 - 124	M
Anthracene	1.2	10	27	M	69 - 134	60 - 136	M
Aramite	1.9	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Atrazine	2.3	10	16	M	47 - 109	45 - 113	M
Azobenzene	1.8	10	34	M	56 - 129	50 - 135	M
Benzaldehyde	1.2	10	50	M	35 - 115	35 - 115	M
Benzidine	9.4	100	50[s]	M	15 - 150[s]	15 - 150[s]	M
Benzo (a) anthracene	0.95	10	18	M	71 - 125	64 - 135	M
Benzo (a) pyrene	1.1	10	21	M	67 - 135	68 - 136	M

Table 5.18
Semi-Volatile Organics in Water Matrix by GC/MS Method SW846-8270D (Continued)

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Benzo (b) fluoranthene	1.4	10	34	M	56 - 145	61 - 149	M
Benzo (g,h,I) perylene	2.1	10	27	M	44 - 149	47 - 151	M
Benzo (k) fluoranthene	1.1	10	39	M	65 - 138	45 - 148	M
Benzyl Alcohol	2.1	10	37	M	34 - 111	30 - 97	M
Bis(2-chloroethoxy) methane	2.2	10	30	M	49 - 126	43 - 119	M
Bis(2-chloroethyl) ether	1.9	10	33	M	47 - 124	36 - 115	M
Bis(2-chloroisopropyl) ether	2.3	10	34	M	42 - 126	36 - 113	M
Bis(2-Ethylhexyl) phthalate	1.8	10	21	M	59 - 139	50 - 168	M
Butyl benzyl phthalate	1.5	10	23	M	67 - 133	52 - 166	M
Caprolactam	1.7	10	50^{s}	M	35 - 115^{s}	35 - 115^{s}	M
Carbazole	1.2	10	50^{s}	M	61 - 154	61 - 154	M
Chlorobenzilate	1.3	10	50^{s}	M	45 - 135^{s}	45 - 135^{s}	M
Chrysene	1.2	10	22	M	72 - 124	62 - 135	M
n-Decane	0.92	10	50^{s}	M	45 - 135^{s}	45 - 135^{s}	M
Diallate	1.0	10	50^{s}	M	45 - 135^{s}	45 - 135^{s}	M
Dibenzo (a,h) anthracene	1.8	10	28	M	49 - 144	45 - 155	M
Dibenzofuran	2.2	10	23	M	68 - 113	58 - 119	M
Diethylphthalate	1.4	10	22	M	70 - 124	55 - 137	M
Dimethoate	1.9	10	50^{s}	M	45 - 135^{s}	45 - 135^{s}	M
Dimethylphthalate	1.6	10	25	M	71 - 117	46 - 135	M
Di-n-Butyl Phthalate	1.8	10	24	M	69 - 128	53 - 141	M
Di-n-octyl-phthalate	1.9	10	21	M	52 - 150	48 - 166	M
Dinoseb	2.0	10	50^{s}	M	45 - 135^{s}	45 - 135^{s}	M
Diphenylamine	1.0	10	50^{s}	M	45 - 135^{s}	45 - 135^{s}	M
Disulfoton	0.96	10	50^{s}	M	45 - 135^{s}	45 - 135^{s}	M
Ethylmethane sulfonate	2.4	10	50^{s}	M	45 - 135^{s}	45 - 135^{s}	M
Famphur	5.1	20	50^{s}	M	45 - 135^{s}	45 - 135^{s}	M
Fluoranthene	0.94	10	26	M	66 - 135	51 - 136	M
Fluorene	1.8	10	30	M	67 - 124	57 - 121	M
Hexachlorobenzene	1.4	10	29	M	62 - 124	55 - 131	M
Hexachlorobutadiene	2.3	10	35	M	42 - 105	39 - 110	M

Table 5.18
Semi-Volatile Organics in Water Matrix by GC/MS Method SW846-8270D (Continued)

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Hexachlorocyclopentadiene	1.8	10	36	M	32 - 117	26 - 122	M
Hexachloroethane	1.9	10	37	M	40 - 99	37 - 98	M
Hexachloropropene	2.9	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Indeno (1,2,3-c,d) pyrene	1.6	10	34	M	40 - 150	14 - 177	M
Isodrin	1.2	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Isophorone	2.4	10	27	M	54 - 125	49 - 113	M
Isosafrole	2.8	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Kepone	5.1	20	50[s]	M	45 - 135[s]	45 - 135[s]	M
Methapyrilene	12	50	50[s]	M	45 - 135[s]	45 - 135[s]	M
Methyl parathion	1.7	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Methylmethane sulfonate	5.0	20	50[s]	M	45 - 135[s]	45 - 135[s]	M
Naphthalene	2.3	10	35	M	54 - 111	38 - 109	M
Nitrobenzene	2.0	10	34	M	51 - 117	34 - 117	M
N-Nitrosodibutylamine	3.1	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
N-Nitrosodiethylamine	2.5	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
N-Nitroso-dimethyl amine	3.2	10	45	M	10 - 119	10 - 119	M
N-Nitrosomethylethylamine	2.3	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
N-Nitrosodi-n-propylamine	2.3	10	33	M	55 - 115	44 - 115	M
N-Nitrosodiphenylamine	1.6	10	26	M	69 - 152	57 - 156	M
N-Nitrosomorpholine	2.9	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
N-Nitrosopiperidine	2.9	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
N-Nitrosopyrrolidine	2.6	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
o,o,o-Triethylphosphorthioate	2.6	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
o-Toluidine	2.2	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Parathion	1.0	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
p-Benzoquinone	1.9	10	50[s]	M	13 - 183	13 - 183	M
p-Dimethylaminoazobenzene	0.92	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
n-Octadecane	1.7	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Pentachlorobenzene	2.8	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Pentachloroethane	2.1	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Pentachloronitrobenzene	1.2	10	50[s]	M	45 - 135[s]	45 - 135[s]	M

Table 5.18
Semi-Volatile Organics in Water Matrix by GC/MS Method SW846-8270D (Continued)

Parameter	MDL (µg/l)	RL (µg/l)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Pentachlorophenol	1.6	10	36	M	23 - 139	17 - 167	M
Phenacetin	1.5	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Phenanthrene	1.2	10	23	M	68 - 128	62 - 131	M
Phenol	2.2	10	43	M	12 - 58	10 - 47	M
Phorate	1.2	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Pronamide	1.0	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Pyrene	1.4	10	31	M	62 - 139	46 - 156	M
Pyridine	3.3	10	31	M	10 - 53	46 - 156	M
Safrole	3.0	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Sulfotepp	1.1	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
a-Terpineol	1.3	10	50[s]	M	45 - 135[s]	45 - 135[s]	M
Thionazin	1.1	10	50[s]	M	45 - 135[s]	45 - 135[s]	M

Surrogates	Recovery Range (%R)	
2-Fluorophenol	27	74
Phenol-d5	11	52
Nitrobenzene-d5	53	99
2-Fluorobiphenyl	55	96
2,4,6-Tribromophenol	49	109
Terphenyl-d14	42	133

[s] - Initial Start-up Limits

Table 5.19
Semi-Volatile Organics in Solid Matrix by GC/MS Method SW846-8270D

Parameter	MDL (µg/kg)	RL (µg/kg)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
1,1-Biphenyl	54	330	50[s]	M	35 - 115[s]	35 - 115[s]	M
1-Chloronaphthalene	52	330	50[s]	M	45 - 135[s]	45 - 135[s]	M
1-Methylhaphthalene	77	330	38	M	35 - 102	26 - 113	M
1-Methylphenanthrene	30	330	50[s]	M	45 - 135[s]	45 - 135[s]	M
1,2,4,5-Tetrachlorobenzene	33	330	50[s]	M	45 - 135[s]	45 - 135[s]	M
1,2,4-Trichlorobenzene	122	330	46	M	54 - 110	25 - 104	M
1,2-Dichlorobenzene	109	330	49	M	53 - 107	22 - 103	M
1,3-Dichlorobenzene	111	330	55	M	52 - 108	18 - 101	M
1,4-Dichlorobenzene	105	330	50	M	52 - 108	14 - 108	M
1,4-Dioxane	65	330	50[s]	M	45 - 135[s]	45 - 135[s]	M
2,3,4,6-Tetrachlorophenol	36	330	50[s]	M	45 - 135[s]	45 - 135[s]	M
2,3-Dichloroanaline	49	330	50[s]	M	45 - 135[s]	45 - 135[s]	M
2,4,5-Trichlorophenol	90	330	35	M	62 - 124	45 - 121	M
2,4,6-Trichlorophenol	110	330	35	M	62 - 120	44 - 115	M
2,4-Dichlorophenol	117	330	45	M	58 - 113	26 - 120	M
2,4-Dimethylphenol	136	330	47	M	59 - 110	33 - 113	M
2,4-Dinitrophenol	8.3	330	39	M	29 - 134	14 - 148	M
2,4-Dinitrotoluene	56	330	28	M	63 - 137	49 - 134	M
2,6-Dinitrotoluene	50	330	31	M	59 - 134	44 - 131	M
2-Chloronaphthalene	115	330	37	M	41 - 147	38 - 112	M
2-Chlorophenol	142	330	51	M	55 - 108	26 - 108	M
2-Methylnaphthalene	122	330	48	M	57 - 116	12 - 128	M
2-Methylphenol	116	330	48	M	56 - 111	26 - 116	M
2-Nitroaniline	58	330	60[s]	M	62 - 125	62 - 125	M
2-Nitrophenol	122	330	44	M	58 - 112	20 - 119	M
3&4-Methylphenol	92	330	45	M	56 - 111	28 - 116	M
3,3'-Dichlorobenzidine	55	330	35	M	51 - 161	10 - 191	M
3-Nitroaniline	99	330	60*	M	65 - 136	65 - 136	M
4,6-Dinitro-2-methyl phenol	36	330	27	M	46 - 148	30 - 148	M
4-Bromophenyl-phenyl ether	74	330	26	M	58 - 137	43 - 126	M
4-Chloro-3-Methylphenol	117	330	35	M	60 - 118	41 - 120	M

Table 5.19
Semi-Volatile Organics in Solid Matrix by GC/MS Method SW846-8270D (Continued)

Parameter	MDL (µg/kg)	RL (µg/kg)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
4-Chloroaniline	114	330	41	M	53 - 144	35 - 115	M
4-Chlorophenyl phenyl ether	97	330	30	M	59 - 131	45 - 123	M
4-Nitroaniline	82	330	60[s]	M	62 - 143	62 - 143	M
4-Nitrophenol	41	330	31	M	48 - 148	33 - 136	M
Acenaphthene	102	330	35	M	62 - 118	46 - 115	M
Acenaphthylene	105	330	35	M	64 - 116	40 - 125	M
Acetaphenone	41	330	50[s]	M	56 - 106	56 - 106	M
Aniline	112	330	60	M	24 - 190	20 - 150	M
Anthracene	65	330	26	M	71 - 132	56 - 127	M
Atrazine	43	330	50	M	35 - 115	35 - 115	M
Azobenzene	76	330	30	M	56 - 125	49 - 123	M
Benzaldehyde	56	330	50[s]	M	35 - 115[s]	35 - 115[s]	M
Benzidine	42	330	50[s]	M	45 - 135[s]	45 - 135[s]	M
Benzo (a) anthracene	68	330	25	M	71 - 129	50 - 134	M
Benzo (a) pyrene	62	330	22	M	74 - 129	59 - 129	M
Benzo (b) fluoranthene	45	330	33	M	63 - 136	46 - 141	M
Benzo (g,h,I) perylene	105	330	26	M	41 - 154	47 - 136	M
Benzo (k) fluoranthene	97	330	38	M	62 - 145	36 - 151	M
Benzoic acid	44	330	60	M	10 - 83	10 - 122	M
Benzyl Alcohol	110	330	43	M	55 - 112	29 - 112	M
Bis(2-chloroethoxy) methane	169	330	46	M	52 - 118	31 - 119	M
Bis(2-chloroethyl) ether	122	330	54	M	50 - 116	23 - 111	M
Bis(2-chloroisopropyl) ether	131	330	50	M	48 - 119	22 - 109	M
Bis(2-Ethylhexyl) phthalate	64	330	26	M	62 - 135	45 - 153	M
Butyl benzyl phthalate	73	330	22	M	62 - 133	43 - 156	M
Caprolactam	94	330	50[s]	M	35 - 115[s]	35 - 115[s]	M
Carbazole	69	330	24	M	71 - 135	49 - 123	M
Chrysene	74	330	32	M	72 - 129	46 - 140	M
n-Decane	50	330	60[s]	M	45 - 135[s]	45 - 135[s]	M
Dibenzo (a,h) anthracene	107	330	25	M	41 - 158	43 - 141	M
Dibenzofuran	93	330	30	M	64 - 115	45 - 121	M
Diethylphthalate	59	330	20	M	73 - 120	53 - 128	M
Dimethylphthalate	62	330	24	M	71 - 115	54 - 123	M

Table 5.19
Semi-Volatile Organics in Solid Matrix by GC/MS Method SW846-8270D (Continued)

Parameter	MDL (µg/kg)	RL (µg/kg)	RPD (%)	Conc. Level	Accuracy Range (%Recovery)		Conc. Level
					LCS (%)	MS (%)	
Di-n-Butyl Phthalate	78	330	33	M	68 - 127	44 - 137	M
Di-n-octyl-phthalate	73	330	25	M	53 - 150	45 - 151	M
Fluoranthene	69	330	35	M	64 - 136	37 - 140	M
Fluorene	77	330	31	M	67 - 120	49 - 119	M
Hexachlorobenzene	55	330	23	M	63 - 124	47 - 128	M
Hexachlorobutadiene	125	330	50	M	55 - 112	24 - 107	M
Hexachlorocyclopentadiene	100	330	50	M	43 - 135	20 - 121	M
Hexachloroethane	110	330	50	M	49 - 113	17 - 102	M
Indeno (1,2,3-c,d) pyrene	87	330	35	M	40 - 160	27 - 156	M
Isophorone	123	330	37	M	55 - 118	22 - 130	M
Naphthalene	128	330	51	M	62 - 111	27 - 111	M
Nitrobenzene	111	330	43	M	50 - 116	23 - 120	M
N-Nitroso-dimethyl amine	83	330	60 [s]	M	20 - 150 [s]	20 - 150 [s]	M
N-Nitrosodi-n-propylamine	113	330	47	M	53 - 113	27 - 120	M
N-Nitrosodiphenylamine	66	330	29	M	76 - 144	46 - 153	M
n-Octadecane	50	330	37	M	39 - 98	26 - 97	M
Pentachlorophenol	27	330	31	M	36 - 145	36 - 155	M
Phenanthrene	58	330	32	M	72 - 123	48 - 137	M
Phenol	122	330	56	M	56 - 108	23 - 115	M
Pyrene	91	330	31	M	51 - 141	43 - 146	M
Pyridine	29	330	60[s]	M	10 - 60	10 - 60	M
a-Terpineol	33	330	60[s]	M	45 - 135[s]	45 - 135[s]	M

Surrogates	Recovery Range (%R)	
2-Fluorophenol	44	117
Phenol-d5	37	127
Nitrobenzene-d5	45	121
2-Fluorobiphenyl	47	130
2,4,6-Tribromophenol	37	131
Terphenyl-d14	38	135

[s] - Initial Start-up Limits
NA - Not Available

Table 5.20
Organics in Water Matrix by Micro-extraction GC Method EPA 504.1

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range (%R)		Conc. Level
					LCS (%)	MS (%)	
Ethylene Dibromide(EDB)	0.0025	0.02	20	M	70 - 130	70 - 130	M
1,2-Dibromo-3-Chloropropane	0.0027	0.02	20	M	70 - 130	70 - 130	M
1,2,3-Trichloropropane	0.0024	0.02	20	M	70 - 130	70 - 130	M

Table 5.21
Organics in Water Matrix by Micro-extraction GC Method SW846-8011

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range (%R)		Conc. Level
					LCS (%)	MS (%)	
Ethylene Dibromide(EDB)	0.0025	0.02	20	M	60 - 140	60 - 140	M
1,2-Dibromo-3-Chloropropane	0.0029	0.02	20	M	60 - 140	60 - 140	M

Table 5.22
Organochlorine Pesticides and PCBs in Water Matrix by GC Method EPA 608

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
α-BHC	0.0049	0.05	31*	M	37 - 134	37 - 134	M
β-BHC	0.011	0.05	29*	M	17 - 147	17 - 147	M
δ-BHC	0.0072	0.05	27*	M	19 - 140	19 - 140	M
γ-BHC (Lindane)	0.0097	0.05	32*	M	32 - 127	32 - 127	M
α-Chlordane	0.010	0.05	40*	M	45 - 119	45 - 119	M
γ-Chlordane	0.012	0.05	34*	M	45 - 119	45 - 119	M
4,4'-DDD	0.020	0.05	29*	M	31 - 141	31 - 141	M
4,4'-DDE	0.017	0.05	38*	M	30 - 145	30 - 145	M
4,4'-DDT	0.033	0.05	30*	M	25 - 160	25 - 160	M
Aldrin	0.012	0.05	35*	M	42 - 122	42 - 122	M
Chlordane (technical)	0.16	0.5	40[s]	M	50 - 150 [s]	50 - 150 [s]	M
Dieldrin	0.0084	0.05	28*	M	36 - 146	36 - 146	M
Endosulfan I	0.0081	0.05	40*	M	45 - 153	45 - 153	M
Endosulfan II	0.019	0.05	32*	M	10 - 202	10 - 202	M
Endosulfan sulfate	0.033	0.05	36*	M	26 - 144	26 - 144	M
Endrin	0.013	0.05	27*	M	30 - 147	30 - 147	M
Endrin aldehyde	0.025	0.05	33*	M	68 - 139*	15 - 165*	M
Endrin ketone	0.018	0.05	29*	M	68 - 150*	29 - 172*	M
Heptachlor	0.017	0.05	36*	M	34 - 111	34 - 111	M
Heptachlor epoxide	0.014	0.05	36*	M	37 - 142	37 - 142	M
Methoxychlor	0.024	0.05	34*	M	70 - 157*	34 - 187*	M
Toxaphene	0.14	0.5	40[s]	M	41 - 126	41 - 126	M
PCB-1016	0.16	0.5	40[s]	M	50 - 114	50 - 114	M
PCB-1221	0.11	1	40[s]	M	15 - 178	15 - 178	M
PCB-1232	0.16	0.5	40[s]	M	10 - 215	10 - 215	M
PCB-1242	0.14	0.5	40[s]	M	39 - 150	39 - 150	M
PCB-1248	0.14	0.5	40[s]	M	38 - 158	38 - 158	M
PCB-1254	0.16	0.5	40[s]	M	29 - 131	29 - 131	M
PCB-1260	0.15	0.5	40[s]	M	10 - 127	10 - 127	M

Surrogates	Recovery Range (%R)	
Tetrachloro-m-xylene (TCMX)	40*	134*
Decachlorobiphenyl (DCB)	13*	186*

[s] - Initial Start-up Limits

* - Historical Limits.

All other limits based on the method limits.

Table 5.23
Organochlorine Pesticides in Water Matrix by GC Method SW846-8081B

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
α-BHC	0.0049	0.05	31	M	63 - 125	52 - 130	M
β-BHC	0.011	0.05	29	M	65 - 137	31 - 166	M
δ-BHC	0.0072	0.05	27	M	65 - 132	20 - 171	M
γ-BHC (Lindane)	0.0097	0.05	32	M	66 - 129	45 - 140	M
α-Chlordane	0.010	0.05	40	M	68 - 126	18 - 147	M
γ-Chlordane	0.012	0.05	34	M	66 - 126	35 - 136	M
4,4'-DDD	0.020	0.05	29	M	66 - 138	17 - 160	M
4,4'-DDE	0.017	0.05	38	M	67 - 127	10 - 158	M
4,4'-DDT	0.033	0.05	30	M	66 - 142	15 - 171	M
Aldrin	0.012	0.05	35	M	62 - 124	24 - 142	M
Chlordane (technical)	0.16	0.5	40[s]	M	50 - 150[s]	50 - 150[s]	M
Dieldrin	0.0084	0.05	28	M	69 - 130	27 - 148	M
Endosulfan I	0.0081	0.05	40	M	71 - 129	40 - 141	M
Endosulfan II	0.019	0.05	32	M	73 - 135	43 - 146	M
Endosulfan sulfate	0.033	0.05	36	M	72 - 137	37 - 153	M
Endrin	0.013	0.05	27	M	69 - 144	35 - 165	M
Endrin aldehyde	0.025	0.05	33	M	68 - 139	15 - 165	M
Endrin ketone	0.018	0.05	29	M	68 - 150	36 - 172	M
Heptachlor	0.017	0.05	36	M	61 - 136	38 - 150	M
Heptachlor epoxide	0.014	0.05	36	M	69 - 131	40 - 141	M
Methoxychlor	0.024	0.05	34	M	70 - 157	37 - 187	M
Toxaphene	0.14	0.5	40[s]	M	50 - 150[s]	50 - 150[s]	M

Surrogates	Recovery Range (%R)	
Tetrachloro-m-xylene (TCMX)	40	134
Decachlorobiphenyl (DCB)	13	186

[s] - Initial Start-up Limits

Table 5.24
Organochlorine Pesticides in Solid Matrix by GC Method SW846-8081B

Parameter	MDL (mg/kg)	RL (mg/kg)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
α-BHC	0.00044	0.002	24	M	72 - 126	62 - 134	M
β-BHC	0.00052	0.002	17	M	79 - 134	67 - 144	M
δ-BHC	0.00027	0.002	18	M	74 - 132	70 - 138	M
γ-BHC (Lindane)	0.00034	0.002	22	M	71 - 129	62 - 137	M
α-Chlordane	0.00044	0.002	25	M	71 - 132	59 - 138	M
γ-Chlordane	0.00039	0.002	27	M	71 - 132	59 - 139	M
4,4-DDD	0.00047	0.002	29	M	72 - 142	57 - 152	M
4,4-DDE	0.00041	0.002	36	M	74 - 129	61 - 143	M
4,4-DDT	0.00063	0.002	38	M	75 - 141	56 - 163	M
Aldrin	0.00054	0.002	29	M	66 - 132	57 - 137	M
Chlordane (technical)	0.0051	0.05	40[s]	M	50 - 150[s]	50 - 150[s]	M
Dieldrin	0.00037	0.002	30	M	72 - 136	60 - 141	M
Endosulfan I	0.00047	0.002	32	M	74 - 134	66 - 137	M
Endosulfan II	0.00047	0.002	20	M	79 - 134	70 - 141	M
Endosulfan sulfate	0.00057	0.002	24	M	73 - 147	65 - 153	M
Endrin	0.00051	0.002	21	M	74 - 147	65 - 164	M
Endrin aldehyde	0.00066	0.002	35	M	73 - 138	63 - 147	M
Endrin ketone	0.00050	0.002	18	M	84 - 135	65 - 152	M
Heptachlor	0.00063	0.002	27	M	72 - 134	63 - 142	M
Heptachlor epoxide	0.00039	0.002	18	M	73 - 132	63 - 136	M
Methoxychlor	0.0011	0.002	30	M	91 - 138	60 - 179	M
Toxaphene	0.0062	0.05	40[s]	M	50 - 150[s]	50 - 150[s]	M

Surrogates	Recovery Range (%R)	
Tetrachloro-m-xylene (TCMX)	40	162
Decachlorbiphenyl (DCB)	26	204

NA = Not Available

[s] Initial start up limits

Table 5.25
PCBs in Water Matrix by GC Method SW846-8082A

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
PCB-1016	0.16	0.5	50	M	50 - 114	50 - 114	M
PCB-1221	0.11	1	50	M	15 - 178	15 - 178	M
PCB-1232	0.16	0.5	50	M	10 - 215	10 - 215	M
PCB-1242	0.14	0.5	50	M	39 - 150	39 - 150	M
PCB-1248	0.14	0.5	50	M	38 - 158	38 - 158	M
PCB-1254	0.16	0.5	50	M	29 - 131	29 - 131	M
PCB-1260	0.15	0.5	50	M	10 - 127	10 - 127	M

Surrogates	Recovery Range (%R)	
Tetrachloro-m-xylene (TCMX)	30	161
Decachlorobiphenyl (DCB)	32	178

[s] -Initial start up limits

Table 5.26
PCBs in Solid Matrix by GC Method SW846-8082A

Parameter	MDL (mg/kg)	RL (mg/kg)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
PCB-1016	0.0093	0.05	28	M	64 - 151	14 - 192	M
PCB-1221	0.040	0.1	40[s]	M	50 - 150[s]	50 - 150[s]	M
PCB-1232	0.013	0.1	40[s]	M	50 - 150[s]	50 - 150[s]	M
PCB-1242	0.013	0.05	40[s]	M	50 - 150[s]	50 - 150[s]	M
PCB-1248	0.010	0.05	40[s]	M	50 - 150[s]	50 - 150[s]	M
PCB-1254	0.012	0.05	40[s]	M	50 - 150[s]	50 - 150[s]	M
PCB-1260	0.0097	0.05	22	M	45 - 166	10 - 192	M

Surrogates	Recovery Range (%R)	
Tetrachloro-m-xylene (TCMX)	36	182
Decachlorobiphenyl (DCB)	34	182

NA = Not Available

[s] -Initial start up limits

Table 5.27
PCBs in Oil Matrix by GC Method SW846-8082A

Parameter	MDL (mg/kg)	RL (mg/kg)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
PCB-1016	NA	1	22	M	50-150[s]	41-141	M
PCB-1221	NA	5	28	M	50-150[s]	15-167	M
PCB-1232	NA	1	29	M	50-150[s]	18-162	M
PCB-1242	NA	1	29	M	50-150[s]	40-111	M
PCB-1248	NA	1	13	M	50-150[s]	38-142	M
PCB-1254	NA	1	22	M	50-150[s]	29-128	M
PCB-1260	NA	1	17	M	50-150[s]	28-127	M

Surrogates	Recovery Range (%R)	
Tetrachloro-m-xylene (TCMX)	72	147
Decachlorobiphenyl (DCB)	65	160

NA = Not Available

[s] -Initial start up limits

Table 5.28
PAH in Water Matrix by GC Method EPA 610

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
2-Methylnaphthalene	0.81	5	34	M	34 - 109*	25 - 105*	M
Acenaphthene	0.82	5	38	M	10 - 124	10 - 124	M
Acenaphthylene	0.74	5	36	M	10 - 139	10 - 139	M
Anthracene	0.55	5	27	M	10 - 126	10 - 126	M
Benzo (a) anthracene	0.35	5	25	M	12 - 135	12 - 135	M
Benzo (a) pyrene	0.32	5	25	M	10 - 128	10 - 128	M
Benzo (b) fluoranthene	0.28	5	25	M	10 - 150	10 - 150	M
Benzo (g,h,I) perylene	0.40	5	26	M	10 - 116	10 - 116	M
Benzo (k) fluoranthene	0.34	5	25	M	10 - 159	10 - 159	M
Chrysene	0.34	5	25	M	10 - 199	10 - 199	M
Dibenzo (a,h) anthracene	0.47	5	24	M	10 - 110	10 - 110	M
Fluoranthene	0.49	5	25	M	14 - 123	14 - 123	M
Fluorene	0.60	5	34	M	10 - 142	10 - 142	M
Indeno (1,2,3-c,d) pyrene	0.34	5	25	M	10 - 116	10 - 116	M
Naphthalene	0.84	5	37	M	10 - 122	10 - 122	M
Phenanthrene	0.50	5	28	M	10 - 155	10 - 155	M
Pyrene	0.47	5	26	M	10 - 140	10 - 140	M

Surrogates	Recovery Range (%R)	
o-Terphenyl	25	150

* - Historical Limits.

All other limits based on the method limits.

Table 5.29
PAH in Water Matrix by GC Method SW846-8100

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
2-Methylnaphthalene	0.81	5	34	M	30 - 104	24 - 118	M
Acenaphthene	0.82	5	38	M	36 - 113	26 - 137	M
Acenaphthylene	0.74	5	36	M	35 - 110	29 - 126	M
Anthracene	0.55	5	27	M	50 - 125	54 - 133	M
Benzo (a) anthracene	0.35	5	25	M	53 - 133	60 - 133	M
Benzo (a) pyrene	0.32	5	25	M	53 - 136	58 - 138	M
Benzo (b) fluoranthene	0.28	5	25	M	52 - 130	60 - 130	M
Benzo (g,h,I) perylene	0.40	5	26	M	58 - 140	62 - 139	M
Benzo (k) fluoranthene	0.34	5	25	M	54 - 132	59 - 133	M
Chrysene	0.34	5	25	M	50 - 136	54 - 140	M
Dibenzo (a,h) anthracene	0.47	5	24	M	54 - 138	58 - 142	M
Fluoranthene	0.49	5	25	M	50 - 132	54 - 141	M
Fluorene	0.60	5	34	M	43 - 117	36 - 137	M
Indeno (1,2,3-c,d) pyrene	0.34	5	25	M	56 - 136	61 - 137	M
Naphthalene	0.84	5	37	M	29 - 100	24 - 116	M
Phenanthrene	0.50	5	28	M	49 - 122	48 - 137	M
Pyrene	0.47	5	26	M	51 - 133	57 - 139	M

Surrogates	Recovery Range (%R)	
o-Terphenyl	34	147

NA = Not Available

[s] -Initial start up limits

Table 5.30
PAH in Water Matrix by GC/MS Method SW846-8270SIM

Parameter	MDL (µg/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
2-Methylnaphthalene	0.43	1	33	M	25 - 106	18 - 121	M
Acenaphthene	0.17	1	20	M	36 - 109	35 - 112	M
Acenaphthylene	0.42	1	24	M	35 - 108	33 - 113	M
Anthracene	0.29	1	30	M	59 - 112	61 - 112	M
Benzo (a) anthracene	0.51	1	26	M	49 - 126	52 - 118	M
Benzo (a) pyrene	0.40	1	25	M	64 - 116	57 - 121	M
Benzo (b) fluoranthene	0.27	1	29	M	55 - 120	55 - 123	M
Benzo (g,h,I) perylene	0.54	1	27	M	44 - 125	35 - 134	M
Benzo (k) fluoranthene	0.40	1	11	M	56 - 120	55 - 119	M
Chrysene	0.97	1	25	M	49 - 124	52 - 117	M
Dibenzo (a,h) anthracene	0.52	1	28	M	45 - 125	38 - 128	M
Fluoranthene	0.36	1	24	M	54 - 118	58 - 115	M
Fluorene	0.22	1	15	M	43 - 114	46 - 113	M
Indeno (1,2,3-c,d) pyrene	0.40	1	29	M	45 - 127	36 - 135	M
Naphthalene	0.57	1	42	M	24 - 100	20 - 108	M
Phenanthrene	0.21	1	29	M	53 - 113	58 - 114	M
Pyrene	0.44	1	15	M	55 - 120	52 - 127	M

Surrogates	Recovery Range (%R)	
Nitrobenzene-d5	13	107
2-Fluorobiphenyl	27	107
Terphenyl-d14	41	136

Table 5.31
Gasoline Range Organics (GRO) in Water Matrix by GC Method SW846-8015C

Parameter	MDL (mg/l)	RL (mg/l)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
GRO - Gasoline Range Organics	0.015	0.2	24	M	60 - 138	69 - 130	M

Surrogates	Recovery Range (%R)	
α,α,α-Trifluorotoluene	57	132

Table 5.32
Gasoline Range Organics (GRO) in Solid Matrix by GC Method SW846-8015C / 5035 MeOH Extraction

Parameter	MDL (mg/kg)	RL (mg/kg)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
GRO - Gasoline Range Organics	1.1	5	23	M	67 - 116	57 - 113	M

Surrogates	Recovery Range (%R)	
α,α,α-Trifluorotoluene	55	129

Table 5.33
Gasoline Range Organics (GRO) in Solid Matrix by GC Method SW846-8015C / 5030B

Parameter	MDL (mg/kg)	RL (mg/kg)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
GRO - Gasoline Range Organics	0.026	0.2	34	M	64 - 124	37 - 126	M

Surrogates	Recovery Range (%R)	
α,α,α-Trifluorotoluene	42	148

Table 5.34
Diesel Range Organics (DRO) in Water Matrix by GC Method SW846-3510C/8015C

Parameter	MDL (mg/l)	RL (mg/l)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
DRO - Diesel Range Organics	0.042	1	22	M	53 - 135	51 - 145	M

Surrogates	Recovery Range (%R)	
o-Terphenyl	50	144

Table 5.35
Diesel Range Organics (DRO) in Solid Matrix by GC Method SW846-3550B/8015C

Parameter	MDL (mg/kg)	RL (mg/kg)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
DRO - Diesel Range Organics	1.0	10	25	M	53 - 118	52 - 119	M

Surrogates	Recovery Range (%R)	
o-Terphenyl	48	130

Table 5.36
Diesel Range Organics (DRO) in Solid Matrix by GC Method SW846-3545A/8015C

Parameter	MDL (mg/kg)	RL (mg/kg)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
DRO - Diesel Range Organics	2.1	7	24	M	55 - 109	50 - 117	M

Surrogates	Recovery Range (%R)	
o-Terphenyl	49	124

Table 5.37
Volatile Petroleum Hydrocarbons (VPH) in Water Matrix by GC Method MADEP-VPH

Parameter	MDL (µ/l)	RL (µg/l)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
C_5-C_8 Aliphatics	3.1	50	50	M	70-130	70-130	M
C_9-C_{12} Aliphatics	9.1	50	50	M	70-130	70-130	M
C_9-C_{10} Aromatics	0.64	50	50	M	70-130	70-130	M

Surrogates	Recovery Range (%R)	
2,5-Dibromotoluene	70	130

Table 5.38
Volatile Petroleum Hydrocarbons (VPH) in Solid Matrix by GC Method MADEP-VPH

Parameter	MDL (mg/kg)	RL (mg/kg)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
C_5-C_8 Aliphatics	0.29	5	50	M	70-130	70-130	M
C_9-C_{12} Aliphatics	0.83	5	50	M	70-130	70-130	M
C_9-C_{10} Aromatics	0.045	5	50	M	70-130	70-130	M

Surrogates	Recovery Range (%R)	
2,5-Dibromotoluene	70	130

Table 5.39
Extractable Petroleum Hydrocarbons (EPH) in Water Matrix by GC Method MADEP-EPH

Parameter	MDL (µ/l)	RL (µ/l)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
C_9-C_{18} Aliphatics	9.5	100	50	M	40-140	40-140	M
C_{19}-C_{36} Aliphatics	24	100	50	M	40-140	40-140	M
C_{11}-C_{22} Aromatics	42	100	50	M	40-140	40-140	M

Surrogates	Recovery Range (%R)	
1-Chloro octadecane	40	140
o-Terphenyl	40	140
2-Fluorobiphenyl	40	140
2-Bromonaphthalene	40	140

Table 5.40
Extractable Petroleum Hydrocarbons (EPH) in Solid Matrix by GC Method MADEP-EPH

Parameter	MDL (mg/kg)	RL (mg/kg)	RPD	Conc. Level	Accuracy Range		Conc. Level
					LCS %	MS %	
C_9-C_{18} Aliphatics	0.85	10	50	M	40-140	40-140	M
C_{19}-C_{36} Aliphatics	0.89	10	50	M	40-140	40-140	M
C_{11}-C_{22} Aromatics	2.2	10	50	M	40-140	40-140	M

Surrogates	Recovery Range (%R)	
1-Chloro octadecane	40	140
o-Terphenyl	40	140
2-Fluorobiphenyl	40	140
2-Bromonaphthalene	40	140

Table 5.41
Sample Preparation Methods

Metals Preparation			
Method	**Component**	**Matrix**	**Preparation For**
3005	Total Recoverable Metals FAA, ICP (* - ICP only)	W	Al, Sb, As*, Ba, Be, B, Ca, Cd, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Si, Ag, Na, Sn, Tl*, V, Zn
SW846 - 3010	Total Metals FAA, ICP (* - ICP only)	W	Al, Sb, As*, Ba, Be, B, Ca, Cd, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Si, Ag, Na, Sn, Tl*, V, Zn
SW846 - 3020	Total Metals by GFAA	W	Sb,As,Be, Cd, Cr, Pb, Mo, Se, Ag,Tl, V
SW846 - 3031	Digestion of Oils FAA, GFAA, ICP	O	Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mo, Ni, Se, Ag, Tl, V, Zn
SW846 - 3040	Dissolution Procedure	O	Sb, Be, Cd, Cr, Cu, Fe, Mn, Ni, V
SW846 - 3050	Acid Digestion of Solids	S	Al, Sb, As, Ba, Be, B, Ca, Cd, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, Tl, Sn, V, Zn
SW846 - 3060	Alkaline Digestion	S	Hexavalent Chromium (SW846-7196)
Inorganic Sample Preparation			
SW 846-9013	Cyanide Distillation for Solids and Oils	S, O	Cyanide, Total (SW845-9010)
SW 846-9030	Distillation for Sulfides	S	Sulfides, Total (SW846-9034)
SW 846-Vol IC, Ch 7, Sec 7.3.3.2, Rev 3 12/96	Hydrogen Cyanide Release	W, S	Hydrogen Cyanide Release
SW 846-Vol IC, Ch 7, Sec 7.3.3.2, Rev 3 12/96	Hydrogen Sulfide Release	W, S	Hydrogen Sulfide Release
Organic Preparation			
SW846 - 3500	Organic Extraction		
SW846 - 3510	Liquid/Liquid Extraction	W	SW846 - 8270, 8081, 8082, 9070
SW846 - 3520	Liquid/Liquid Extraction	W	SW846 - 8270, 8081, 8082
SW846 - 3540	Soxhlet Extraction	S	SW846 - 9071
SW846 - 3545	Pressurized Fluid Extraction	S	SW846 – 8015 DRO
SW846 - 3550	Ultrasonic Extraction	S	SW846 - 8270, 8081, 8082
SW846 - 3580	Waste Dilution	S, O	SW846 - 8270, 8082
SW846 - 5030	Purge and Trap	W, S, O	SW846 – 8021, 8260
Organic Clean-up Procedures			
SW846 - 3600	Clean-up		
SW846 - 3620	Florisil Clean-up	W,S	SW846 - 8082
SW846 - 3630	Silica Gel Clean-up	W,S,O	SW846 - 8100, 8270
SW846 - 3650	Acid-Base/Neutal Partion	W,S,O	SW846 - 8270
SW846 - 3660	Sulfur Clean-up	W,S,O	SW846 - 8082, 8270
TCLP			
1311	TCLP	W,S,O	TCLP Extractions SW846-6010, 8081, 8260, 8270

Matrices: W = Waters
S = Solids, Soils, Sludges
O = Oils, Greases, Petroleums, Waxes

6.0 SAMPLING PROCEDURES

6.1 INTRODUCTION

Prism Laboratories, Inc. utilizes for guidance in sampling procedures the Florida Department of Environmental Protection's "Standard Operating Procedures for Laboratory Operations and Sample Collection Activities" (9/92). The rules and regulations of the state in which sampling occurs will be followed for individual sampling projects. Prism's sampling capabilities and equipment are listed in the following sections.

6.2 SAMPLING CAPABILITIES

Table 6.1
Sampling Capabilities

Parameter Group	Sample Source
Extractable Organics	Drinking water, surface water, groundwater, wastewater, sediments, domestics sludges, hazardous waste (liquid and sludges), soils and air
Volatile Organics	Drinking water, surface water, groundwater, wastewater, sediments, domestics sludges, hazardous waste (liquid and sludges), soils and air
Metals	Drinking water, surface water, groundwater, wastewater, sediments, domestics sludges, hazardous waste (liquid and sludges), soils and air
Inorganic Anions	Drinking water, surface water, groundwater, wastewater, sediments, domestics sludges, hazardous waste (liquid and sludges), soils and air
Organics (BOD, COD, Oil & Grease, Phenol, Surfactants)	Drinking water, surface water, groundwater, wastewater, sediments, domestics sludges, hazardous waste (liquid and sludges), soils and air
Physical Properties	Drinking water, surface water, groundwater, wastewater, sediments, domestics sludges, hazardous waste (liquid and sludges), soils and air
Microbiology	Drinking water, surface water, groundwater, wastewater, sediments, domestics sludges
Cyanide	Drinking water, surface water, groundwater, wastewater, sediments, domestics sludges, hazardous waste (liquid and sludges), soils and air

6.3 FIELD MEASUREMENT CAPABILITIES

Instrument calibrations, field measurement results and observations are documented in the sampler's field log and on Calibration and field Measurement Report Forms (See Figure 6.1 and 6.2).

Table 6.2
Field Measurement Capabilities

Method #	Matrix	Analyte/Component
SM 4500-H^+ B	Water	pH
SM 2550 B	Water	Temperature
SM 2510 B	Water	Specific Conductance
SM 4500-O G	Water	Dissolved Oxygen
SM 2130 B	Water	Turbidity
SM 2580 B	Water	Redox Potential
SM 4500-Cl G	Water	Residual Chlorine

6.4 SAMPLING EQUIPMENT

Table 6.3
Sampling Equipment

Matrix	Equipment	Construction	Use	Parameter Groups
Groundwater	Bailer	SS, Teflon, HDPE	Purging and Sampling	All parameter groups
	Submersible Pump	SS, Teflon	Purging Sampling	All parameter groups All parameter groups, except VOCs
	1.0 μm Filtration Units	N/A	Filtering dissolved parameters	Metals
	0.45 μm Filtration Units	N/A	Filtering dissolved parameters	Demands, Nutrients
Surface water	Sample bottle	Glass Plastic	Grab sampling Grab sampling	All parameter groups Inorganic parameters
	Bailer	SS, Teflon, HDPE	Grab sampling	All parameter groups
	0.45 μm Filtration Units	N/A	Filtering dissolved parameters	All dissolved parameters

Table 6.3
Sampling Equipment (Continued)

Matrix	Equipment	Construction	Use	Parameter Groups
Wastewater	ISCO autosampler	SS, Teflon, Plastic	Grab and composite sampling	Inorganic parameters (with some restrictions on parameters for compositing)
	ISCO autosampler	SS, Teflon, Glass	Grab and composite sampling	All parameter groups, except VOCs (with some restrictions on param. for compositing)
	Sample bottle	Glass Plastic	Grab sampling Grab sampling	All parameter groups Inorganic parameters
	0.45 μm Filtration Units	N/A	Filtering dissolved parameters	All dissolved parameters
Drinking water	Sample bottle	Glass Plastic	Grab sampling Grab sampling	All parameter groups Inorganic parameters
Sediments/ soils	Scoop, spoon	SS	Sampling and compositing	All parameter groups; VOCs may not be taken from composite samples
	Mixing tray	SS	Compositing and homogenizing	All parameter groups; VOCs may not be taken from composite samples
	Hand auger, shovel	SS	Sampling	All parametr groups
	Shelby tube	SS	Sampling	All parametr groups
Sludges and Hazardous waste	Drum Thief	Glass	Sampling	All parametr groups
	Coliwassa tube	Glass	Sampling	All parametr groups
	Sludge judge	Plastic	Sampling	All inorganic parameters
	Sludge sampler	SS	Sampling	All parametr groups
Air	Air pump	Plastic	Sampling	Organics (Volatile and semivolatile)
	Carbon tubes	Charcoal/glass	Sampling	Organics (Volatile and semivolatile)

Field Instruments

Equipment	Model & Mfg.	Use
pH meter	VWR 2000	Determine well stability, Field measurement
Thermometer	VWR 2000	Field measurement
Conductivity meter	Orion 120	Determine well stability, Field measurement
Chlorine meter	DR100, HACH	Residual Chlorine measurement
Turbidity meter	HACH 2100P	Determine well stability
DO meter	YSI 55	Field measurement

Table 6.3
Sampling Equipment (Continued)

Miscellaneous Equipment	
Equipment	**Use**
Cooler with wet ice and insulation	Sample transportation and preservation
Tape measures, water level indicator, mono-filament, latex gloves, safety glasses, protective jacket/smock	Miscellaneous, expendable and protective gear
Documents kit: COC forms, analysis request forms, sampler's log, indelible markers	Documentation
Preservatives Kit: Reagent grade $Na_2S_2O_3$, H_2SO_4, NaOH, HCl and HNO_3 in glass bottles, disposable glass pipettes, narrow range pH meter.	Sample preservation
Decon Kit: Pesticide grade isopropanol in glass or teflon container, lab DI water in HDPE carboy, 1+1 HCl, 1+1 Nitric, plastic wash buckets, Alconox® premixed in HDPE carboy, Liquinox®, cleaning brushes	Decontamination
Waste Kit: Heavy-duty plastic carbage bag, reinforced cardboard box, solvent waste bottle, purge waste containers	Waste disposal, containment and transportation
pH standards: 4.0, 7.0 and 10	pH Calibration
Chlorine standards: 0.1, 1.0, 2.0 mg/l	Chlorine meter calibration check
Conductivity standards:	Conductivity Calibration
Starch Iodine test paper	Check for presence of chlorine
Lead Acetate test paper	Check for presence of sulfide

Acronyms:

N/A	not applicable
SS	stainless steel
HDPE	high density polyethylene
VOC	volatile organic compound
SVOC	semi-volatile organic compound

Submersible pumps may be used for purging or sampling only if no other pumping device is available, since lines (power cords, gas pressure tubing) may not be (practically) constructed of inert materials.

Delivery tubing must be precleaned and precut at the base of operations or laboratory. If the same tubing is used during the sampling event, it must be cleaned and decontaminated between use.

When purging for organics, the entire length of tubing or portion of which comes in contact with the formation water should be constructed of teflon or stainless steel. If other materials (i.e., PVC, HDPE, or polypropylene) are used, the following protocols must be followed:

1) contact with formation waters is minimized by slowly withdrawing the pump from the water column during the last phase of purging, thus removing from the well any water which may have contacted the exterior of the pump and/or tubing;
2) a single well volume must be removed with the sampling device before sampling begins. Tygon™ must never be used for purging when organics are of interest.
   NOTE: THE USE OF NON-INERT (I.E. PVC, HDPE, ETC.) IS NOT RECOMMENDED.

Delivery tubing must be precleaned and precut at the base of operations or laboratory. If the same tubing is used during the sampling event, it must be cleaned and decontaminated between use.

6.5 SAMPLE CONTAINERS

Prism Laboratories provides “certified pre-cleaned” sample containers. The Field Services department will retain the certificate of analysis for bottle cleanliness. All sample containers will be for one-time use only.

Sample containers are prepared as “kits” which make up all the containers needed for a sampling event, including additional containers required for QC sample analysis. Containers are shipped in coolers or in a cardboard box depending on the request of the client. All shipments will contain Chain of Custody forms, labels, shipment inventory and instructions. A Bottle Order form is used to help expedite the kit preparation and to help reduce errors when taking customer requests.

If requested, the shipment is sealed such that any tampering or attempt to open the shipping container and/or the sample containers is evident. All shipments are sealed such that any tampering or attempt to open the shipping container and/or the sample containers is evident.

6.6 SAMPLE PRESERVATION

Proper preservatives are added to the sample containers in the laboratory prior to container shipping. When requested, preservatives may be supplied in separate containers for addition to the sample at the time of collection.

All chemical preservatives must be reagent grade or better. Nitric acid used for preservation of samples for metals determination must be trace metal grade. Lot numbers of all chemicals used are tracked so that any questions relating to the reagent (preservative) used are traceable to the lot of reagent used for preservation. The chemical preservatives used for preserving samples are listed in Table 6.4.

Sample preservation, holding times and container types are listed in Table 6.5 – 6.7 in accordance with federal and state regulations (40CFR Parts 136 and 141, as well as SW846 guidelines).

6.7 DOCUMENTATION

Field documentation consists of Field Logbooks, Calibration and Field Measurement forms, Chain of Custody forms and Sample Labels.

All documentation must be legibly filled out in indelible ink, initialed and dated. Sample labels must contain the information mentioned in Section 7.1.1.

Table 6.4
Sample Preservatives

Aqueous Sample Preservatives				
Reagent	**Concentration**	**Pre-preserved Container Amount**	**Required pH**	**Test Categories**
Ascorbic Acid	Solid	25 mg/40 ml	N/A	SDWA Volatile Organics, THMs
Brominechloride (BrCl)	0.1 N	2.5 ml/500 ml	N/A	Mercury (EPA 1631)
EDTA	2.5%	1 ml/100 ml	N/A	Sulfite
Hydrochloric Acid	1:1	0.2 ml/40 ml	<2	Volatile Organics, TOC
Hydrochloric Acid	1:1	5 ml/liter	<2	MADEP EPH, TN TPH-DRO
Hydrochloric Acid	0.1 M	Adjust in the field	4 to 5	Acrolein, Acrylonitrile
Lead carbonate	Solid	1 g/liter	N/A	Cyanide
Mercuric Chloride	10 mg/ml	1 ml/liter	N/A	SDWA Herbicides, SDWA N&P containing Pesticides
Nitric Acid	Concentrated	3 ml/500 ml	<2	Metals, Hardness
Sodium Hydroxide	10 N	7 ml/liter	>9	Sulfide
Sodium Hydroxide	10 N	7 ml/liter	>12	Cyanide
Sodium Thiosulfate	Solid	100 mg/liter	N/A	Coliforms, Organics, Ammonia
Sodium Arsenite	1%	2 ml/liter	N/A	Cyanide
Sulfuric Acid	Concentrated	5 ml/liter	<2	Phenols, T-Phosphorus, Ammonia, COD, TKN, Nitrate-Nitrite, Oil & Grease
Zinc Acetate	2 N	2 ml/500 ml	N/A	Sulfide
Solid Sample Preservatives				
Reagent	**Concentration**	**Pre-preserved Container Amount**	**Required pH**	**Test Categories**
Methanol	100%	15 ml/ 40ml	NA	MADEP VPH
Sodium Bisulfate	20%	5 ml	NA	Volatile Organics

Table 6.5
Sample Requirements for Wet-Chemistry Tests

Parameter	Container Type [1]		Required Sample Quantity		Preservation [2,3]		Maximum Holding Time [4]	
	Water	Solid	Water	Solid	Water	Solid	Water	Solid
Acidity	P,G	N/A	500 ml	N/A	Cool, ≤6 °C	N/A	14 days	N/A
Alkalinity	P,G	N/A	200 ml	N/A	Cool, ≤6 °C	N/A	14 days	N/A
Ammonia Nitrogen	P,G	4 oz G	1 liter	100 g	Cool, ≤6 °C H_2SO_4 to pH <2	Cool, 4 °C	28 days	28 days
Asbestos	G Amber	4 oz G	2x 1 liter	100 g	Cool, ≤6 °C	Cool, 4 °C	48 hours	N/A
Biochemical Oxygen Demand (BOD)	P,G	N/A	1 liter	N/A	Cool, ≤6 °C	N/A	48 hours	N/A
Bromide	P,G	N/A	100 ml	N/A	Cool, ≤6 °C	N/A	28 days	N/A
Cation Exchange Capacity	N/A	4 oz G	N/A	100 g	N/A	Cool, 4 °C	N/A	14 days
Chemical Oxygen Demand (COD)	P,G	4 oz G	100 ml	100 g	Cool, ≤6 °C H_2SO_4 to pH <2	Cool, 4 °C	28 days	28 days
Chloride	P,G	4 oz G	200 ml	50 g	Cool, ≤6 °C	Cool, 4 °C	28 days	28 days
Chlorine	P,G	N/A	100 ml	N/A	None	N/A	Analyze Immediately	N/A
Chlorophyll A	P,G	N/A	1 liter	N/A	Cool, ≤6 °C, dark	N/A	48 hours	N/A
Coliform Bacteria, Fecal	P,G sterile	N/A	100 ml	N/A	Cool, <10 °C 0.008% $Na_2S_2O_3$ [5]	N/A	6 hours[11]	24 hours
Coliform Bacteria, Total	P,G Sterile	N/A	100 ml	N/A	Cool, <10 °C 0.008% $Na_2S_2O_3$ [5]	N/A	6 hours[11] DW 30 hours	N/A
Color	P,G	N/A	500 ml	N/A	Cool, ≤6 °C	N/A	48 hours	N/A
Conductivity	P,G	N/A	100 ml	N/A	Cool, ≤6 °C	N/A	28 days	N/A
Cyanide, Amenable	P,G	4 oz G	1 liter	100 g	Cool, ≤6 °C NaOH to pH >12 Sodium Arsenite Lead Carbonate	Cool, 4 °C	14 days [6]	14 days
Cyanide, Available	P,G	4 oz G	1 liter	100 g	Cool, ≤6 °C NaOH to pH >12 Sodium Arsenite Lead Carbonate	Cool, 4 °C	14 days [6]	14 days
Cyanide, Total	P,G	4 oz G	1 liter	100 g	Cool, ≤6 °C NaOH to pH >12 Sodium Arsenite Lead Carbonate	Cool, 4 °C	14 days [6]	14 days
Dissolved Oxygen	P,G	N/A	300 ml	N/A	None	N/A	Analyze Immediately	N/A
Ferrous Iron	G	N/A	200 ml	N/A	None	N/A	Analyze Immediately	N/A
Flash point	G	N/A	150 ml	N/A	Cool, ≤6 °C	N/A	N/A	N/A
Fluoride	P	4 oz P	1 liter	100 g	Cool, ≤6 °C	Cool, 4 °C	28 days	28 days
Fomaldehyde	G	4 oz G	1 liter	50 g	Cool, ≤6 °C	Cool, 4 °C	72 hours	72 hours
Hardness	P,G	N/A	200 ml	N/A	HNO_3 to pH <2	N/A	180 days	N/A
Heat of Combustion	N/A	4 oz G	N/A	50 g	N/A	Cool, 4 °C	N/A	N/A
Hexavalent Chromium	P,G	4 oz G	500 ml	100 g	Cool, ≤6 °C (pH=9.3-9.7)	Cool, 4 °C	24 hours (28 days)[12]	30 days to extraction then 7 days
Heterotropic Plate Count	P Sterile	N/A	100 ml	N/A	Cool, <10 °C 0.008% $Na_2S_2O_3$ [5]	N/A	6 hours[11] DW 36 hours	N/A

Table 6.5
Sample Requirements for Wet-Chemistry Tests (Continued)

Parameter	Container Type [1]		Required Sample Quantity		Preservation [2,3]		Maximum Holding Time [4]	
	Water	Solid	Water	Solid	Water	Solid	Water	Solid
Ignitability	N/A	8 oz G	N/A	200 g	N/A	Cool, 4 °C	N/A	A.S.A.P.
Kjeldahl Nitrogen (TKN)	P,G	4 oz G	1 liter	100 g	Cool, ≤6 °C H_2SO_4 to pH <2	Cool, 4 °C	28 days	28 days
Langlier Index	P,G	N/A	1 liter	N/A	Cool, ≤6 °C	N/A	N/A	N/A
Nitrate	P,G	4 oz G	100 ml	50 g	Cool, ≤6 °C	Cool, 4 °C	48 hours	48 hours
Nitrate-Nitrite	P,G	4 oz G	100 ml	50 g	Cool, ≤6 °C H_2SO_4 to pH <2	Cool, 4 °C	28 days	28 days
Nitrite	P,G	4 oz G	100 ml	50 g	Cool, ≤6 °C	Cool, 4 °C	48 hours	48 hours
Oil & Grease	G	N/A	2x 1 liter	N/A	Cool, ≤6 °C H_2SO_4 to pH <2	N/A	28 days	N/A
Organic nitrogen, Total	P,G	4 oz G	1 liter	100 g	Cool, ≤6 °C H_2SO_4 to pH <2	Cool, 4 °C	28 days	28 days
Paint Filter Test	N/A	8 oz G	N/A	500 g	N/A	N/A	N/A	N/A
pH	P,G	4 oz G	50 ml	50 g	N/A	Cool, 4 °C	Analyze Immediately	24 hours
Phenols	P,G	4 oz G	1 liter	100 g	Cool, ≤6 °C H_2SO_4 to pH <2	Cool, 4 °C	28 days	28 days
Phosphorus, Ortho	P,G	4 oz G	500 ml	50 g	Cool, ≤6 °C	Cool, 4 °C	48 hours	48 hours
Phosphorus, Total	P,G	4 oz G	500 ml	50 g	Cool, ≤6 °C H_2SO_4 to pH <2	Cool, 4 °C	28 days	28 days
Residual Chlorine	P,G	N/A	100 ml	N/A	None	N/A	Analyze Immediately	N/A
Reactive Cyanide	N/A	4 oz G	N/A	100 g	N/A	Cool, 4 °C	N/A	14 days
Reactive Sulfide	N/A	4 oz G	N/A	100 g	N/A	Cool, 4 °C	N/A	7 days
Settleable Solids	P,G	N/A	1 liter	N/A	Cool, ≤6 °C	N/A	48 hours	N/A
Silica	P	N/A	200 ml	N/A	Cool, ≤6 °C	N/A	28 days	N/A
Specific Gravity	P,G	4 oz G	100 ml	100 g	Cool, ≤6 °C	Cool, 4 °C	N/A	N/A
Sulfate	P,G	4 oz G	500 ml	100 g	Cool, ≤6 °C	Cool, 4 °C	28 days	28 days
Sulfide, Total	P,G	4 oz G	1 liter	100 g	Cool, ≤6 °C NaOH + Zinc Acetate to pH >9	Cool, 4 °C	7 days	7 days
Sulfite	P,G	N/A	500 ml	N/A	Cool, ≤6 °C EDTA	N/A	Analyze Immediately	N/A
Surfactants	P,G	N/A	1 liter	N/A	Cool, ≤6 °C	N/A	48 hours	N/A
Temperature	P,G	N/A	100 ml	N/A	None	N/A	Analyze Immediately	N/A
Total Dissolved Solids (TDS)	P,G	N/A	200 ml	N/A	Cool, ≤6 °C	N/A	7 days	N/A
Total Halogen	N/A	4 oz G	N/A	10 g	N/A	Cool, 4 °C	N/A	14 days
Total Organic Carbon (TOC)	VOA G Amber	4 oz G	3x 40 ml	100 g	Cool, ≤6 °C HCl to pH <2	Cool, 4 °C	28 days	14 days
Total Organic Halides (TOX)	G Amber	4 oz G	250 ml	100 g	Cool, ≤6 °C H_2SO_4 to pH <2	Cool, 4 °C	28 days	28 days
Total Solids (TS)	P,G	4 oz G	250 ml	50 g	Cool, ≤6 °C	Cool, 4 °C	7 days	7 days
Total Suspended Solids (TSS)	P,G	N/A	1 liter	N/A	Cool, ≤6 °C	N/A	7 days	N/A
Total Volatile Solids (TVS)	P,G	4 oz G	250 ml	50 g	Cool, ≤6 °C	Cool, 4 °C	7 days	7 days

Table 6.5
Sample Requirements for Wet-Chemistry Tests (Continued)

Parameter	Container Type [1]		Required Sample Quantity		Preservation [2,3]		Maximum Holding Time [4]	
	Water	Solid	Water	Solid	Water	Solid	Water	Solid
Turbidity	P,G	N/A	200 ml	N/A	Cool, ≤6 °C	N/A	48 hours	N/A
Toxicity, Acute	P	N/A	1 liter	N/A	Cool, ≤6 °C	N/A	36 hours	N/A
Toxicity, Chronic	P	N/A	1 liter	N/A	Cool, ≤6 °C	N/A	36 hours	N/A
Volatile Acids	P,G	N/A	1 liter	N/A	Cool, ≤6 °C	N/A	28 days	N/A
Volatile Suspended Solids	P,G	N/A	1 liter	N/A	Cool, ≤6 °C	N/A	7 days	N/A

Table 6.6
Sample Requirements for Metals Tests

Parameter	Container Type [1]		Required Sample Quantity		Preservation [2,3]		Maximum Holding Time [4]	
	Water	Solid	Water	Solid	Water	Solid	Water	Solid
Gross Alpha	P	N/A	2x 1 liter	N/A	HNO_3 to pH <2	N/A	180 days	N/A
Gross Beta	P	N/A	2x 1 liter	N/A	HNO_3 to pH <2	N/A	180 days	N/A
Metals except mercury	P,G	4 oz G	500 ml	100 g	HNO_3 to pH <2	N/A	180 days	180 days
Metals, 3030C NC Only	P,G	N/A	500 ml	N/A	HNO_3 to pH <2	N/A	72 hours	N/A
Mercury	P,G	4 oz G	500 ml	10 g	HNO_3 to pH <2	Cool, 4 °C	28 days	28 days
Mercury (Low-level, EPA 1631)	G	N/A	500 ml	N/A	None Excess BrCl	N/A	48 Hours 28 Days	N/A
Organic Lead	P,G	4 oz G	500 ml	30 g	Cool, ≤6 °C	Cool, 4 °C	14 days	14 days
Radium	P,G	N/A	2x 1 liter	N/A	HNO_3 to pH <2	N/A	180 days	N/A
Radium 226	P,G	N/A	2x 1 liter	N/A	HNO_3 to pH <2	N/A	180 days	N/A
Radium 228	P,G	N/A	2x 1 liter	N/A	HNO_3 to pH <2	N/A	180 days	N/A
TCLP-Metals only	P,G		150 g @ 100% Solids >10 kg @ ≥0.5% Solids		None		180 days to TCLP extraction 180 days to analysis, except Hg – 28 days	

Table 6.7
Sample Requirements for Organics Tests

Parameter	Container Type [1]		Required Sample Quantity		Preservation [2,3]		Maximum Holding Time [4]	
	Water	Solid	Water	Solid	Water	Solid	Water	Solid
EPA 502.2 Volatile Organic Compounds in Drinking Water	VOA G	N/A	2x 40 ml	N/A	Cool, ≤6 °C HCl to pH <2 0.008% $Na_2S_2O_3$ [5]	N/A	14 days	N/A
EPA 504.1 EDB & DBCP	VOA G	N/A	3x 40 ml	N/A	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	N/A	14 days	N/A
EPA 507 Nitrogen & Phosphorus Pesticides	G Amber	N/A	2x 1 liter	N/A	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	N/A	14 days to extract, then 30 days	N/A
EPA 515.1 SDWA Herbicides	G Amber	N/A	2x I liter	N/A	Cool, ≤6 °C HCl to pH <2 0.008% $Na_2S_2O_3$ [5]	N/A	14 days to extract, then 28 days	N/A
EPA 524.2 Volatile Organic Compounds in Drinking Water	VOA G	N/A	3x 40 ml	N/A	Cool, ≤6 °C HCl to pH <2 0.008% $Na_2S_2O_3$ [5]	N/A	14 days	N/A
EPA 525.2 Semi-Volatile Organics Compounds in Drinking Water	G Amber	N/A	2x 1 liter	N/A	Cool, ≤6 °C HCl to pH <2 0.004% $Na_2S_2O_3$ [5]	N/A	7 days to extract, then 30 days	N/A
EPA 601 Purgeable Halocarbons	VOA G	N/A	3x 40 ml	N/A	Cool, ≤6 °C HCl to pH <2 0.008% $Na_2S_2O_3$ [5]	N/A	14 days	N/A
EPA 601/602 Halogenated and Aromatic Volatile Organics	VOA G	N/A	3x 40 ml	N/A	Cool, ≤6 °C HCl to pH <2 0.008% $Na_2S_2O_3$ [5]	N/A	14 days	N/A
EPA 602 Purgeable Aromatics	VOA G	N/A	3x 40 ml	N/A	Cool, ≤6 °C HCl to pH <2 0.008% $Na_2S_2O_3$ [5]	N/A	14 days	N/A
EPA 603 Acrolein/Acrylonitrile	VOA G	N/A	3x 40 ml	N/A	Cool, ≤6 °C HCl or NaOH to pH 4-5	N/A	14 days	N/A
EPA 608 Organo Chlorine Pesticides/ PCBs	G Amber	N/A	2x 1 liter	N/A	Cool, ≤6 °C NaOH or H2SO4 to pH 5-9	N/A	7 days to extract, then 40 days	N/A
EPA 610 Polynuclear Aromatic Hydrocarbons	G Amber	N/A	2x 1 liter	N/A	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	N/A	7 days to extract, then 40 days	N/A
EPA 613 2,3,7,8-TCDD (Dioxin)	G Amber	N/A	2x 1 liter	N/A	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	N/A	7 days to extract, then 40 days	N/A
EPA 624 Volatile Priority Pollutants	VOA G	N/A	3x 40 ml	N/A	Cool, ≤6 °C HCl to pH <2 0.008% $Na_2S_2O_3$ [5]	N/A	14 days	N/A
EPA 625 Semi-Volatile Priority Pollutants	G Amber	N/A	2x 1 liter	N/A	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	N/A	7 days to extract, then 40 days	N/A
EPA 6230D Halogenated and Aromatic Volatile Organics	VOA G	N/A	3x 40 ml	N/A	Cool, ≤6 °C HCl to pH <2 0.008% $Na_2S_2O_3$ [5]	N/A	14 days	N/A
SW846-8011 EDB and DBCP	VOA G	N/A	3 x 40 ml	N/A	Cool, ≤6 °C HCl to pH <2	N/A	14 days	N/A
SW846-8021 Halogenated and Aromatic Volatile Organics	VOA G	VOA G + stirr bar	3x 40 ml	2x 5g	Cool, ≤6 °C HCl to pH <2 0.008% $Na_2S_2O_3$ [5]	Cool, ≤6 °C 5 ml 20% $NaHSO_4$ [7]	14 days	14 days[7]
		Encore		2x 5 g		Cool, 4 °C		48 hours[8]
		4 oz G		100 g		Cool, 4 °C		48 hours[9]

Table 6.7
Sample Requirements for Organics Tests (Continued)

Parameter	Container Type [1]		Required Sample Quantity		Preservation [2,3]		Maximum Holding Time [4]	
	Water	Solid	Water	Solid	Water	Solid	Water	Solid
SW846-8081 Organochlorine Pesticides	G Amber	8 oz G	2x 1 liter	200 g	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	Cool, ≤6 °C	7 days to extract, then 40 days	14 days to extract, then 40 days
SW846-8082 PCBs	G Amber	8 oz G	2x 1 liter	200 g	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	Cool, ≤6 °C	28 days to extract, then 40 days	28 days to extract, then 40 days
SW846-8100 Polynuclear Aromatic Hydrocarbons (PAH)	G Amber	8 oz G	2x 1 liter	200 g	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	Cool, ≤6 °C	7 days to extract, then 40 days	14 days to extract, then 40 days
SW846-8141 Organophosphorus Pesticides	G Amber	8 oz G	2x 1 liter	200 g	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	Cool, ≤6 °C	7 days to extract, then 40 days	14 days to extract, then 40 days
SW846-8151 Herbicides	G Amber	8 oz G	2x 1 liter	200 g	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	Cool, ≤6 °C	7 days to extract, then 40 days	14 days to extract, then 40 days
SW846-8260 Volatile Organics	VOA G	VOA G + stirr bar	3x 40 ml	2x 5g	Cool, ≤6 °C HCl to pH <2 0.008% $Na_2S_2O_3$ [5]	Cool, ≤6 °C 5 ml 20% $NaHSO_4$ [7]	14 days	14 days [7]
		Encore		2x 5 g		Cool, ≤6 °C		48 hours [8]
		4 oz G		100 g		Cool, ≤6 °C		48 hours [9]
SW846-8270 Semi-Volatile Organics	G Amber	8 oz G	2x 1 liter	200 g	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	Cool, ≤6 °C	7 days to extract, then 40 days	14 days to extract, then 40 days
SW846-8280 Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans	G Amber	8 oz G	4x 1 liter	200 g	Cool, ≤6 °C 0.008% $Na_2S_2O_3$ [5]	Cool, ≤6 °C	7 days to extract, then 40 days	14 days to extract, then 40 days
SW846-9070 Oil & Grease	G	N/A	2x 1 liter	N/A	Cool, ≤6 °C HCl to pH <2	N/A	28 days	N/A
SW846-9071 Oil & Grease	N/A	8 oz G	N/A	200 g	N/A	Cool, ≤6 °C	N/A	28 days
SW846-1311 TCLP All Parameters	G		500 g @ 100% Solids 20 kg @ ≥0.5% Solids		None		See individual analyte groups	
SW846-1311 TCLP Non-Volatile Organics	G		350 g @ 100% Solids 15 kg @ ≥0.5% Solids		None		14 days to TCLP extraction, 7 days to preparative extraction, 40 days to analysis	
SW846-1311 TCLP Volatile Organics	G		150 g @ 100% Solids 1200 g @ ≥0.5% Solids		None		14 days to TCLP extraction, 14 days to analysis	
Ethanol	VOA G	4 oz G	3x 40 ml	100 g	Cool, ≤6 °C	Cool, ≤6 °C	14 days	14 days
Ethylene glycol	VOA G	4 oz G	3x 40 ml	100 g	Cool, ≤6 °C	Cool, ≤6 °C	14 days	14 days
Methane	VOA G	N/A	3 x 40 ml	N/A	Cool, ≤6 °C	N/A	14 days	N/A
Methanol	VOA G	4 oz G	3x 40 ml	100 g	Cool, ≤6 °C	Cool, ≤6 °C	14 days	14 days
Diesel Range Organics (DRO)	G Amber	8 oz G	2x 1 liter	200 g	Cool, ≤6 °C	Cool, ≤6 °C	7 days to extract, then 40 days	14 days to extract then 40 days
Gasoline Range Organics (GRO)	VOA G	4 oz G	3x 40 ml	100 g	Cool, ≤6 °C HCl to pH <2	Cool, ≤6 °C	14 days	14 days
MADEP EPH	G Amber	4 oz G	2x 1 liter	100 g	Cool, ≤6 °C 5 ml 1:1 HCl	Cool, ≤6 °C	14 days to extract, then 40 days	14 days to extract, then 40 days

Table 6.7
Sample Requirements for Organics Tests (Continued)

Parameter	Container Type [1]		Required Sample Quantity		Preservation [2,3]		Maximum Holding Time [4]	
	Water	Solid	Water	Solid	Water	Solid	Water	Solid
MADEP VPH	VOA G	VOA G	3x 40 ml	2x 40 ml	Cool, ≤6 °C HCl to pH <2	Cool, ≤6 °C 15ml Methanol[10]	14 days	28 days
MADEP VPH	N/A	Encore	N/A	2x 25 g Encore Device	N/A	Cool, ≤6 °C	N/A	48 hours to methanol preservation, then 28 days

1 Polyethylene (P) or Glass (G). All organics containers will have teflon-lined caps.

2 Sample preservation should be performed immediately upon sample collection.

3 When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium Hydroxide (NaOH) in water solutions at concentrations of 0.08% by weight or less (pH about 12.30 or less).

4 Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time, and has received a variance from the Regional Administrator under § 136.3(e). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See § 136.3(e) for details.

5 Should only be used in the presence of residual chlorine. Method 502.2 allows the use of ascorbic acid (25 mg/40 ml).

6 Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine is sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH ≥12.

7 When samples effervesce, use organic free reagent water. Holding time: 48 hours or 14 days if samples frozen within 48 hours.

8 48 hours until preservation with 20% $NaHSO_4$ (for low-level analysis) or with methanol (for high level analysis). After preservation 14 days from the collection time.

9 48 hours until analysis or methanol preservation. After preservation, 14 days from collection time.

10 MADEP VPH 1ml methanol / 1 g of sample. Amount is based on 15 g of sample.

11 The maximum transport time to the laboratory is 6 hours. Samples should be processed within 2 hours of receipt at the laboratory.

12 To achieve the 28 day holding time, use the ammonium sulfate buffer solution specified in EPA method 218.6.

7.0 SAMPLE CUSTODY AND DOCUMENTATION

It is the responsibility of Prism Laboratories to ensure the integrity of samples collected or received by the laboratory. To help ensure sample integrity a system of procedures and documentation is used to track the persons who have custody of the sample.

Sample custody is maintained if a sample is found to be in any of the following states:

It is in a sampler's or transferee's physical possession

It is in a sampler's or transferee's view, after being in his/her physical possession

It has been secured by the sampler or transferee to prevent tampering

It has been placed in a secure area, with access limited to certain individuals

7.1 CHAIN-OF-CUSTODY

The chain-of-custody system incorporates certain procedures, such as the signing for and securing of sample containers as they arrive into the laboratory. Prism Laboratories provides two basic levels of chain-of-custody: Routine Chain-of-Custody and Legal Chain-of-Custody. The laboratory operates under routine chain-of-custody protocols, as discussed below. If legal chain-of-custody procedures are required for a project, Prism Laboratories will provide this service; however, arrangements must be made with the laboratory prior to sampling kit preparation and sampling.

7.1.1 ROUTINE CHAIN-OF-CUSTODY

For the majority of environmental sampling plans, routine chain-of-custody, as defined in this section, should be adequate for the tracking and assessment of sample custody and disposition from the initial sampling through the reporting of analytical results. The primary instrument used by Prism for documenting a sample's custody is the chain-of-custody form, or COC. A special COC form is used for samples collected for municipal pre-treatment programs.

Routine chain-of-custody procedures generally begin at the time of sample collection. The person(s) collecting the sample(s) must insure that all samples are uniquely identified and labeled. The label must contain at a minimum: sample identification, site description, date and time of collection, chemical preservatives, collector's initials, sample type and special remarks concerning the sample. The labels must be water resistant and filled out with indelible ink.

Once sampling has been completed, the sampling crew should complete the COC form. The form must be signed by the person relinquishing the samples and kept with the samples in the sample shipping container when shipped to the laboratory.

Upon receipt by the laboratory, the content of the shipping container is inspected for thermal and chemical preservation, damage and contamination. After the received samples are compared to the COC, problems are documented and the form is signed (as being received by the laboratory). If the samples are delivered by sampling personnel from a company other than Prism, a copy of the COC is given to the person delivering the samples as a record for receipt of the samples by the lab.

Once the requested analyses are completed, the final sample report is prepared, and sent to the client with another copy of the COC.

Other documents used to track a sample's custody are the sample bottle label with laboratory ID code, the sample log-in logbook and worksheet, the analytical and instrument logbooks, and any raw data printouts. All of these documents are used to document the chain-of-custody under routine laboratory operation.

Examples of chain-of-custody documentation are presented at the end of this section as follows:

Figure 7.1 - Prism Chain-of-Custody Form
Figure 7.2 - Prism Chain-of-Custody Form for pre-treatment sampling
Figure 7.3 - Sample Log-In Logbook
Figure 7.4 - Sample Log-In Worksheet
Figure 7.5 - Example of Preservation Check Form
Figure 7.6 - Prism Container Label

7.1.2 LEGAL CHAIN-OF-CUSTODY

Legal chain-of-custody, as defined here, is a system of procedures and documentation utilized to record and track the possession of a sample, in order to provide legally defensible evidence in a court-of-law. All individuals physically possessing the sample must as such by recording the date and time of possession and sign the chain-of-custody. The primary concern in legal custody issues is the matter of identifying opportunities for which the raw sample may be tampered with or altered. The key difference between routine and legal sample chain-of-custody is the requirement that all individuals must document possession for legal chain-of-custody, including every employee in the laboratory. It can be argued that a sample, which is physically located at the laboratory facility, is secured and maintained by capable hands, and that opportunities for tampering with it (presumably by individuals outside of the facility), would be held to an extreme minimum. Tampering by individuals within the company, for all practical purposes, may be possible under either chain-of-custody protocol. For these reasons, routine chain-of-custody procedures, as practiced by Prism Laboratories, should be sufficient for standard sample tracking and quality assurance purposes.

7.2 LABORATORY CUSTODY PROCEDURES

Several key individuals are responsible for the integrity and security of clients' samples. Following are some of these individuals, who play vital roles in helping assure that samples are properly identified, analyzed, and maintained:

Sample Custodian - This individual is the primary person responsible for the receipt, log-in, and storage of samples. This person also may identify problems incurred during the sampling, preservation, and shipment of samples. Subsequently, the sample custodian may notify the client or alert other laboratory personnel as to these problems.

Project Managers - These individuals check to ensure that every project is logged in to the Laboratory Information Management System (LIMS) correctly. Any problems encountered are discussed with the appropriate personnel, and the project manager or the sample custodian correct the information in the LIMS.

Department Supervisors - are responsible for helping with the implementation and oversight of chain-of-custody procedures within their individual departments.

Laboratory Analysts and Technicians - Each analyst and technician is responsible for maintaining sample integrity during the course of the sample's route through the laboratory system. Each analyst and technician is instructed in the techniques necessary for proper sample handling and storage.

Quality Assurance Manager - This individual is responsible for defining, documenting, implementing, and auditing the procedures used by the laboratory in order to maintain proper chain-of-custody.

Laboratory Director - This individual is ultimately responsible for the implementation and oversight of the entire laboratory system, helping assure that the proper procedures are in place and effectively monitored, in order to maintain sample and data integrity.

7.2.1 SAMPLE SHIPPING CONTAINER PREPARATION

When a client requests sample bottles from the laboratory, the employee taking the request is instructed to identify and record the necessary information for sample shipping container preparation. The information can be recorded on a Sample Kit Prep/Pick-up Request form (see Figure 7.8). This form is then sent to the shipping container preparation area, where the kit is prepared accordingly. The sample containers are assembled, along with a blank chain-of-custody form, and the entire kit is prepared for shipment or customer pick-up. In most cases, bottles are pre-preserved by our facility, during the kit preparation procedure. In the event that preservation may need to be performed in the field (for example, when sampling chlorinated supplies), a preservatives kit is supplied, along with instructions for proper sample collection and preservation.

7.2.2 SAMPLE RECEIPT

The samples are unpacked and after inspection of the shipment, the chain-of-custody form is signed by the person receiving the samples for the. A log-in worksheet is completed, where integrity information and special instructions are recorded. If discrepancies are observed, the samples are stored, and appropriate laboratory personnel (i.e., project manager, supervisors, QA manager, laboratory director) are notified. The laboratory then notifies the client as to the discrepancies and awaits the client's instructions. Further action is entirely at the discretion of the client and will be noted on the final data report.

7.2.3 SAMPLE LOG-IN

If samples are intact and no apparent discrepancies are noted, the samples are then logged into the Laboratory Information Management System (LIMS) as a Work Order. A Work Order is defined as the set of samples received in a single, distinct group, which generally coincides with a single project for a single client (which is usually further identified by separate COCs). The status of the Work Order at this time is “Received”.

At the time of computer entry, a record is also maintained in the login logbook, in order to maintain appropriate tracking documentation, in the event that the computer system goes down. Once the samples have been logged into the LIMS, the sample custodian makes a copy of the COC and prints labels (See Figure 7.7) to be affixed to the appropriate sample containers. At this time rush samples and samples with short holding times are brought to the appropriate department for analysis.

The original COC and the log-in worksheet are sent to the project manager. The project manager reviews the information in the LIMS and makes corrections if needed and adds test comments/analysis instructions and prints a Sample Receipt Confirmation Report. After review

of this report, the project manager updates the status of the Work Order to “Available”.

The Sample Receipt Conformation Report, COC, and Sample Log-In Worksheet are attached to each other and kept in a project folder, which is maintained for each individual Work Order.

7.2.4 SAMPLE STORAGE

All samples are stored at 0.1-6 °C. unless the method or project requires different storage conditions. All non-volatile water samples are stored in a 12’x20’ walk-in cooler. Water samples for volatile analyses are stored in two separate coolers while soil samples are also stored in a separate refrigerator unit. All samples are stored in sample number order.

When needed a specific area is designated for legal chain-of-custody samples, for which limited access is available.

Extracts and digested samples are stored in the individual departments and have to be treated as individual samples

7.2.5 SAMPLE DISTRIBUTION AND TRACKING

Worklists are generated in each department of the laboratory. These worklists indicate which analyses are required for the individual samples, as well as other pertinent information, such as sample receipt date and login group number. The analyst uses the backlogs to schedule daily activities and prioritize short-hold time and rush analyses.

To help track a group of samples that arrive at the laboratory together, the LIMS assigns a Work Order number. The Work Order number is a 7-digit number (e.g., 0040455) where the first digit represents the year and the second and third digits are preserved for the month. The last four digits form a sequential number.

The LIMS assigns a unique, sequential identification to each sample. The numbering scheme is a code of the Work Order Number followed by a 2-digit number. Sample labels will show this number followed by an uppercase letter for each container received for a sample (Example: 0040455-01A, 0040455-01 B if two containers are received for this sample).

The assignment of a Work Order helps track the entire group of samples through the laboratory together. Most of the computer-generated forms, are created by using this link, including the final sample report, The LIMS also offers other tracking features, such as cross-reference searching of virtually all the data recorded in the LIMS, such as date received, date sampled, analysis requested, and client name.

The analyst checks the results, once an analysis is completed. Then the results are entered or electronically downloaded into the data entry portion of the LIMS. From the data entry step, the sample results are forwarded to the data validation portion of the LIMS. All LIMS-recorded results for a QC batch are checked against the raw data and the QC results validated by the supervisor or designee. Once this review of the data is concluded, the results are forwarded to the report generation where final review and approval takes place.

7.2.6 INTERLABORATORY CUSTODY

All samples sent to other laboratories are sent with inter-laboratory chain-of-custody forms. Sample information supplied by our client is transferred to this interlab COC with the exception of client name, address, project, or sample site ID. In place of this confidential information, we supply our Login Sample Number to the subcontract laboratory. At no time will confidential client information be supplied to anyone other than a designated representative of that client.

7.2.6.1 SUB-SAMPLES

When sub-samples are taken from an original sample, they must be identified by the original LIMS Sample ID.

7.2.7 SAMPLE EXTRACTS AND DIGESTATES

Sample extracts and digestates must be uniquely identified. The identification should include the LIMS sample ID, test ID, date or batch ID and a unique suffix when more than one extract or digestate is prepared from the same sample.

7.3 ELECTRONIC DATA RECORDS

Various areas of the laboratory generate electronic data, including the sample login and analytical instrumentation areas. Sample login data and analytical results data are entered manually into the LIMS.

7.3.1 COMPUTER SECURITY

Each employee has two unique security passwords to obtain access to the computer network and to the LIMS. Different security levels determine which options in LIMS can be accessed:

Level 1 - Review only, no access to data entry and/or modification
Personnel not involved in data entry and validation

Level 2 - Access to data entry and review of results, no access to modification
Technical personnel

Level 3 - Access to data entry, review and results modification
Supervisors, Lead Analysts, Project Managers

Level 4 - Access to data entry, review, result modification and analysis code modification
Technical Director, Quality Assurance Manager

Level 5 - Administrator privilege
President, Network Administrator

Backups are generated daily. To guard against fire, theft or malicious activities the backups are kept on separate servers in separate buildings.

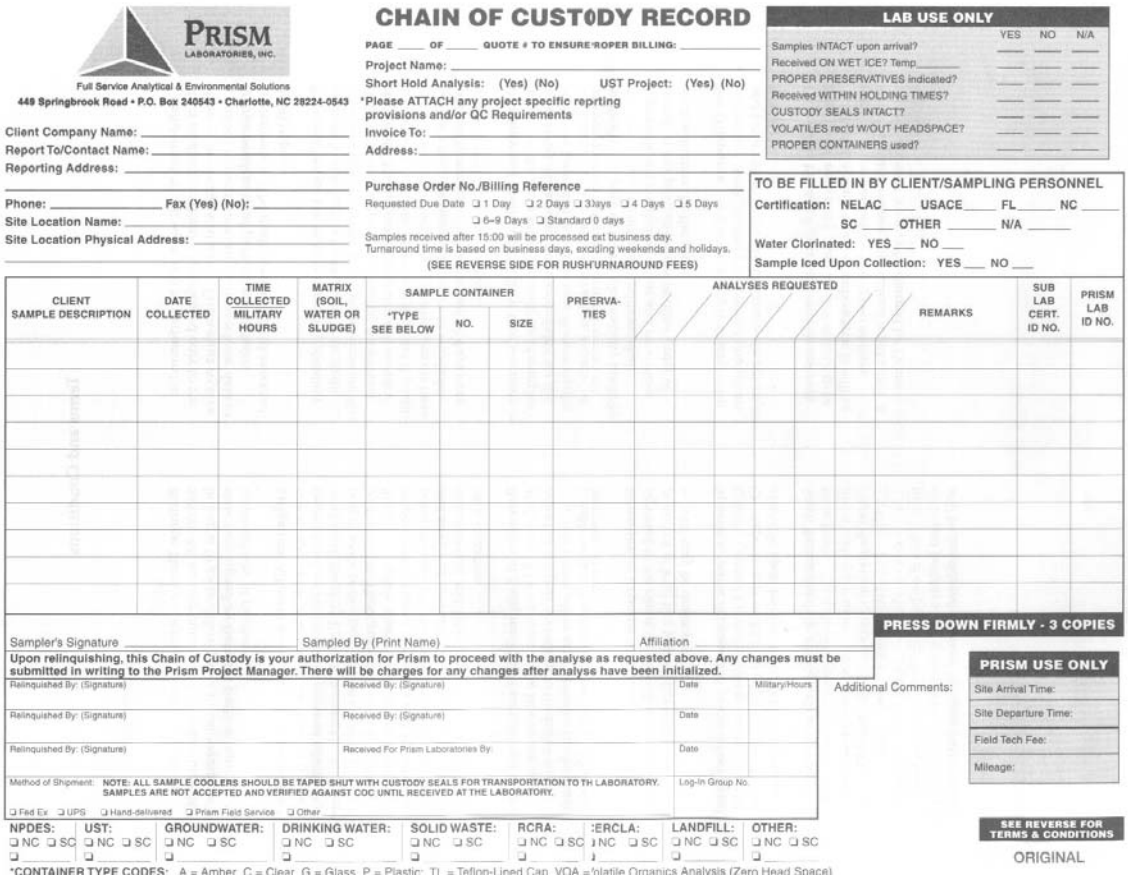
7.3.2 COMPUTER MAINTENANCE

The most vital records for each area are also printed to hardcopy. All GC and GC/MS electronic data are archived on CD-ROM. LIMS backups occur daily. The network administrator monitors the daily backups for completion and accuracy and a log is kept to document the backup activities. Backups are checked for proper restore integrity.

Occasionally, the LIMS is archived to reduce the number of active records in the system (in order to increase system performance).

Archived CD-ROMs are stored in a locked, fireproof filing cabinet for a minimum of five years.

Figure 7.1
Prism Chain-of-Custody Form



PRISM LABORATORIES, INC.
Full Service Analytical & Environmental Solutions
449 Springbrook Road • P.O. Box 240543 • Charlotte, NC 28224-0543

CHAIN OF CUSTODY RECORD

PAGE ____ OF ____ QUOTE # TO ENSURE PROPER BILLING: _____
Project Name: _____
Short Hold Analysis: (Yes) (No) UST Project: (Yes) (No)
*Please ATTACH any project specific reprting provisions and/or QC Requirements
Invoice To: _____
Address: _____

LAB USE ONLY

	YES	NO	N/A
Samples INTACT upon arrival?			
Received ON WET ICE? Temp_____			
PROPER PRESERVATIVES indicated?			
Received WITHIN HOLDING TIMES?			
CUSTODY SEALS INTACT?			
VOLATILES rec'd W/OUT HEADSPACE?			
PROPER CONTAINERS used?			

Client Company Name: _____
Report To/Contact Name: _____
Reporting Address: _____
Phone: _____ Fax (Yes) (No): _____
Site Location Name: _____
Site Location Physical Address: _____

Purchase Order No./Billing Reference _____
Requested Due Date ❑ 1 Day ❑ 2 Days ❑ 3 Days ❑ 4 Days ❑ 5 Days ❑ 6–9 Days ❑ Standard 0 days
Samples received after 15:00 will be processed ext business day.
Turnaround time is based on business days, exclding weekends and holidays.
(SEE REVERSE SIDE FOR RUSH TURNAROUND FEES)

TO BE FILLED IN BY CLIENT/SAMPLING PERSONNEL
Certification: NELAC ____ USACE ____ FL ____ NC ____ SC ____ OTHER ____ N/A ____
Water Clorinated: YES ___ NO ___
Sample Iced Upon Collection: YES ___ NO ___

CLIENT SAMPLE DESCRIPTION	DATE COLLECTED	TIME COLLECTED MILITARY HOURS	MATRIX (SOIL, WATER OR SLUDGE)	SAMPLE CONTAINER *TYPE SEE BELOW	NO.	SIZE	PRESERVA-TIES	ANALYSES REQUESTED	REMARKS	SUB LAB CERT. ID NO.	PRISM LAB ID NO.

PRESS DOWN FIRMLY - 3 COPIES

Sampler's Signature _____ Sampled By (Print Name) _____ Affiliation _____

Upon relinquishing, this Chain of Custody is your authorization for Prism to proceed with the analyse as requested above. Any changes must be submitted in writing to the Prism Project Manager. There will be charges for any changes after analysis have been initialized.

Relinquished By: (Signature)	Received By: (Signature)	Date	Military/Hours
Relinquished By: (Signature)	Received By: (Signature)	Date	
Relinquished By: (Signature)	Received For Prism Laboratories By:	Date	

Method of Shipment: NOTE: ALL SAMPLE COOLERS SHOULD BE TAPED SHUT WITH CUSTODY SEALS FOR TRANSPORTATION TO TH LABORATORY. SAMPLES ARE NOT ACCEPTED AND VERIFIED AGAINST COC UNTIL RECEIVED AT THE LABORATORY.
❑ Fed Ex ❑ UPS ❑ Hand-delivered ❑ Prism Field Service ❑ Other _____
Log-In Group No.

Additional Comments:

PRISM USE ONLY
Site Arrival Time:
Site Departure Time:
Field Tech Fee:
Mileage:

NPDES:	UST:	GROUNDWATER:	DRINKING WATER:	SOLID WASTE:	RCRA:	:ERCLA:	LANDFILL:	OTHER:
❑ NC ❑ SC	❑ NC ❑ SC	❑ NC ❑ SC	❑ NC ❑ SC	❑ NC ❑ SC	❑ NC ❑ SC	❑ NC ❑ SC	❑ NC ❑ SC	❑ NC ❑ SC
❑ _____	❑ _____	❑ _____	❑ _____	❑ _____	❑ _____	❑ _____	❑ _____	❑ _____

*CONTAINER TYPE CODES: A = Amber C = Clear G = Glass P = Plastic TL = Teflon-Lined Cap VOA = Volatile Organics Analysis (Zero Head Space)

SEE REVERSE FOR TERMS & CONDITIONS

ORIGINAL

Figure 7.2
Prism Chain-of-Custody Form for pre-treatment sampling

PRISM LABORATORIES, INC.
Full Service Analytical & Environmental Solutions

WASTEWATER CHAIN OF CUSTODY RECORD

449 Springbrook Road ▲ Charlotte, NC 28217
P.O. Box 240543 ▲ Charlotte, NC 28224-0543
Phone: 704/529-6364 ▲ Fax: 704/525-0409

PAGE ____ OF ____ QUOTE # _____

Client _____
Physical Address _____
Phone _____ Fax _____
P.O.#/Billing Reference _____
Project Name _____

PRESS DOWN FIRMLY - 3 COPIES

REPORT TO: Name _____
Address _____
BILL TO: Name _____
Address _____
Requested Due Date _____
(SEE REVERSE SIDE FOR RUSH TURNAROUND FEES)

LAB USE ONLY

	YES	NO	N/A
Samples INTACT upon arrival?			
Received ON WET ICE? Temp _____			
PROPER PRESERVATIVES indicated?			
Received WITHIN HOLDING TIMES?			
CUSTODY SEALS INTACT?			
VOLATILES rec'd W/OUT HEADSPACE?			
PROPER CONTAINERS used?			

State Certification
Requested NC ____ SC ____ Other ____ NA ____
Water Chlorinated Yes ____ No ____ NA ____
Sample Iced Upon Collection Yes ____ No ____
CMUD _____ NPDES _____ OTHER _____

CLIENT SAMPLE I.D.	SAMPLE TYPE		CONTAINER TYPE AND SIZE (ML)			PRESERVATIVES USED						ANALYSES TO BE PERFORMED ON THE SAMPLES															SUB LAB CERT. ID NO.	PRISM LAB ID NO.
	Comp	Grab	Plastic	Glass	Other	None	Iced	HCl	NaOH	HN03	H_2SO_4	pH	BOD	TSS	Cd	Cr	Cu	Pb	Ni	Ag	Zn	O&G	CN-	NH3 as N				

Sampler's Signature _____ Sampled By (Print Name) _____ Affiliation _____

Relinquished By: (Signature)	Received By: (Signature)	Date	Military/Hours
Relinquished By: (Signature)	Received By: (Signature)	Date	
Relinquished By: (Signature)	Received For Prism Laboratories By:	Date	
Method of Shipment:		Log-In Group No.	

Additional Comments:
Pipe # _____

Composite Type: FLOW TIME HAND (circle one)
Start Date & Time for Composite Sampler: ____/____/____ _____ Hrs
Stop Date & Time for Composite Sample: ____/____/____ _____ Hrs
Date & Time Composite Sample Collected: ____/____/____ _____ Hrs
Total Hours Composite Collected Over: _____ Hours. End Flow: _____ Gal / Cu Feet (circle one)
Start Flow: _____
Total: _____

Date & Time Grab(s) Taken: ____/____/____ _____ Hrs.
Field pH Meter Calibrated: Yes ____ No ____
Field pH Result: _____ Analyst's Initials: _____
Field Temp. Result: _____ Analyst's Initials: _____
Sampler Interrupted: Yes ____ No ____ If Yes, Why? _____

SEE REVERSE FOR TERMS & CONDITIONS

ORIGINAL

Figure 7.3
Sample Log-In Logbook

SAMPLE RECEIVING MASTER LOG

GROUP #	CUSTOMER NAME	PRISM ID #	CLIENT PROJ. NAME	DATE REC'D	INIT.	INV. DATE	INV. #	STATE	COMMENT

PRISM LABORATORIES, INC.
LOGBOOK #: Q162

PAGE 1 OF 100

Figure 7.4
Sample Log-In Worksheet

Prism Laboratories, Inc.

Date Report Mailed:	_____
Initial:	_____
Date Revised Report Mailed:	_____
Initial:	_____

Sample ID: _____
Login No. : _____
Method of Shipment: UPS:_____
Fed Ex:_____
Hand-delivered:_____
Prism:_____

1. Temperature of samples _____
   a. Number of coolers rec'd _____
   b. Number of containers rec'd _____
   c. Number of unused containers rec'd & type _____
   (Make note on Incident Form for PM)

2. Were custody seals on outside of cooler intact?	Y	N	N/A
3. Were custody seals on samples intact?	Y	N	N/A
4. Packing material used? Bubble Wrap Peanuts Foam Other: _____			
5. COC in cooler?	Y	N	N/A
6. COC properly filled out?	Y	N	N/A
7. Samples rec'd on wet ice?	Y	N	N/A
8. All containers intact?	Y	N	N/A
9. Matrix? Soil Water Sludge Product Other _____			
10. Volatiles rec'd?	Y	N	N/A
a. Volatiles without headspace?	Y	N	N/A
11. Were all labels complete?	Y	N	N/A
12. Were correct bottles used for samples?	Y	N	N/A
13. Sufficient amount of sample sent in each bottle?	Y	N	N/A
14. Samples check for short holds?	Y	N	N/A
a. Short holds taken to analyst(s)? (see back)	Y	N	N/A
15. Ph checked? (see back)	Y	N	N/A
a. Any pH problems? (if yes, see Incident Report)	Y	N	N/A

Initials _____
Date: _____

*** Any problems should be documented on Incident Report Form.(See Back)**

Figure 7.5
Example of Preservation Check Form

pH CHECK

METALS(<2) _____
NH3(<2) _____
COD(<2) _____
TPHOS.(<2) _____
CN(>12) _____
SULFIDE(>12) _____
EPH(<2) _____
PHENOLICS(<2) _____
TKN(<2) _____
NO3/NO2(<2) _____
PESTICIDES (5-9) _____

SHORT HOLDS

CLIENT ID	TEST	ANALYST	DATE	TIME	INIT.

INCIDENT REPORTING FORM

1. SUBMITTEE **Date/Time**_____ **Initials**_____

Sample ID(s):_____

Parameter/Test:_____

Description of Problem:_____
_____
_____
_____
_____

2. PROJECT MANAGER **Date Received**_____ **Initials**_____

Client:_____ **Date Notified:**_____

Comments:_____
_____
_____

___New Sample Obtained
___Data Qualified in Comments
___Compliance Sample(State ____) - NOTE: Copy for QA Dept.
___Non-Compliance Sample
___Notified Dept. Manager of Problem

F:Common\Forms\Loginwk.xls (sheet2) Created:5/25 KJW Modified: 10/18/05 PAG

Figure 7.6
Prism Container Label

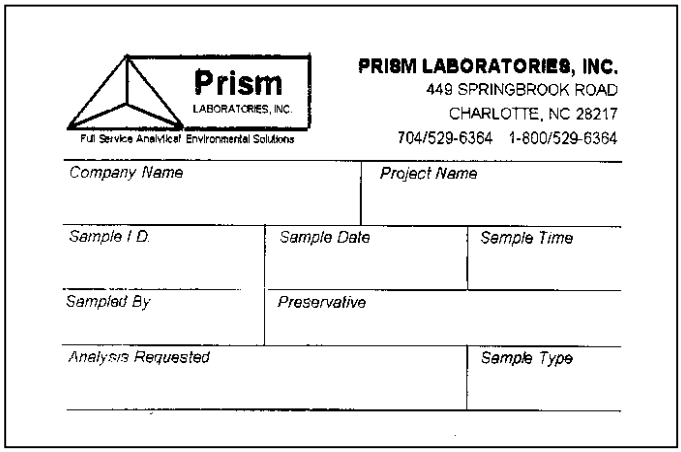


Figure 7.7
Example LIMS Sample Bottle Label

Prism ID: **1010224-01-A**
Collection Date: **01/14/11 11:00**
Sample ID: **WS174 MTLS1**
Prism Laboratories, Inc
Other

Figure 7.8
Example Sample Kit Prep/Pick-up Request Form

PRISM LABORATORIES, INC.
Full Service Analytical & Environmental Solutions

SAMPLE KIT REQUEST

449 Springbrook Rd.
Charlotte, NC 28217
(704)529-6364
(800)529-6364
Fax: (704)525-0409

PRESS DOWN FIRMLY • 4 COPIES

DATE/TIME:		INITIALS:	

CLIENT:		CERTIFICATIONS: ☐ NC ☐ SC ☐ TN	
COMPANY:		☐ NELAC ☐ ACOE ☐ OTHER:	
DELIV. ADDRESS:		TRIP BLANKS?	☐ YES ☐ NO
PHONE #:		LABEL CONTAINERS?	☐ YES ☐ NO
PROJECT ID:		EST. SUBMITTAL DATE:	

MATRIX	QTY	TEST(S)

SHORT HOLDING TIMES DISCUSSED WITH THE CLIENT? ☐ YES ☐ NO

QTY	✔ TEST	✔ MATRIX	✔ CONTAINERS
	☐ 8260	☐ WATER	☐ 3x 40 mL VOA (1:1 HCl)
		☐ SOLID	☐ 2x VOA BISULFATE
			☐ 1x VOA METHANOL
			☐ 2 OZ. G %SOLIDS
		☐ SOLID	☐ 3x 5 g. ENCORE
			☐ 2 OZ. G %SOLIDS
	☐ 8270	☐ WATER	☐ 2x 1L AMBER G.
		☐ SOLID	☐ 1x 8 OZ. G.
	☐ EPH	☐ SOLID	☐ 1x 4 OZ. G. (AMBER)
		☐ WATER	☐ 2x 1L AMBER G. (HCl)
	☐ VPH	☐ SOLID	☐ 2x VOA METHANOL
			☐ 1x 2 OZ. G. %SOLIDS
		☐ WATER	☐ 3x 40 mL VOA (1:1 HCl)
	☐ 624	☐ WATER	☐ 3x 40mL VOA (1:1 HCl)
	☐ 625	☐ WATER	☐ 2x 1L AMBER G.
	☐ METALS	☐ SOLID	☐ 1x 4OZ. G.
		☐ WATER	☐ 1x 500mL P (HNO3)
		☐ WATER	☐ 1x 500mL P. (UNPRES.)
	☐ 601/602	☐ WATER	☐ 3x 40mL VOA (1:1 HCl)
	☐ 504	☐ WATER	☐ 3x 40mL VOA (UNPRES.)
	☐ TOC	☐ SOLID	☐ 1x 4OZ. G.
		☐ WATER	☐ 3x 40mL VOA (HCl)
	☐ CN	☐ SOLID	☐ 1x 4OZ. G.
		☐ WATER	☐ 1x 1L P. (NaOH)
	☐ O&G	☐ SOLID	☐ 1x 8OZ. G.
		☐ WATER	☐ 2x 1L. G. (HCl)

QTY	✔ TEST	✔ MATRIX	✔ CONTAINERS
	☐ BOD/TSS	☐ WATER	☐ 1x 1L P (UNPRES.)
	☐ AMMONIA	☐ WATER	☐ 1x 500mL (H2SO4)
		☐ SOLID	☐ 1x 4 OZ. G
	☐ T.PHOS.	☐ WATER	☐ 1x 500ml P. (H2SO4)
		☐ SOLID	☐ 1x 4OZ. G
	☐ FECAL	☐ WATER	☐ 1x 100mL (na2s203)
		☐ WATER	☐ 1X 4oz. g
	☐ CHLORIDE	☐ WATER	☐ 1x 500mL (UNPRES.)
		☐ SOLID	☐ 1x 4OZ. G
	☐ FLUORIDE	☐ WATER	☐ 1x 500mL (UNPRES.)
		☐ SOLID	☐ 1x 4OZ. G
	☐ COLILERT	☐ WATER	☐ 1x 100mL (Na2S2O3)
	☐ TKN	☐ WATER	☐ 1x 1L (H2SO4)
		☐ SOLID	☐ 1x 4OZ. G
	☐ CONDUCT.	☐ WATER	☐ 1x 250mL (unpres.)
	☐ NITRATE	☐ WATER	☐ 1x 500mL (UNPRES.)
		☐ SOLID	☐ 1x 4OZ. G
	☐ NITRITE	☐ WATER	☐ 1x 500mL (UNPRES.)
		☐ SOLID	☐ 1x 4OZ. G
	☐ GR	☐ WATER	☐ 3x 40mL (HCl)
		☐ SOLID	☐ 1x 4OZ. G
	☐ DR	☐ WATER	☐ 2x 1L (UNPRES.)
	☐	☐ SOLID	☐ 1x 8OZ G
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐

INCLUDE IN KIT:	KIT DELIVERY:	CLIENT DELIVERY DATE:	SPECIAL INSTRUCTIONS:
☐ COCs	☐ DELIVER BY:		
☐ COOLER(S)	☐ CLIENT PICK UP ON:		
☐ LABELS	☐ SHIP TO CLIENT VIA:		
☐ FED EX FORMS	☐ NEXT DAY AM		
☐ OTHER:	☐ NEXT DAY PM		
	☐ GROUND		

KIT PREPARED BY:		CHECKED BY:		DATE/TIME:	
KIT DELIVERED BY:		DATE/TIME:			

DISTRIBUTION
Login: Original + copy **Client:** Include w/kit **PM:** Copy

8.0 ANALYTICAL PROCEDURES

8.1 ANALYTICAL METHODS

Prism Laboratories uses EPA approved analytical methods appropriate for the regulatory program, sample type and data quality objectives. The analytical method used is documented in logbooks or on data system hardcopy and is reported with the analytical results in the final report. The analytical methods and their analyte lists are given in the tables in Section 5.0. If a method or a parameter is not listed in the tables, a method validation package must be prepared, including method detection limit (MDL) studies, before any analyses are reported for that method and/or parameter.

8.2 STANDARD OPERATING PROCEDURES

In order to obtain reliable results and consistency during the execution of procedures, Prism Laboratories requires adherence to methods and standard operating procedures (SOPs). A standard operating procedure is a document that provides precise directions for performing a procedure (i.e., analysis method, calibration procedure, administrative action). SOPs are usually written for routine and repetitive tasks.

SOPs are developed according to a standard procedure. SOPs must be approved by management and the distribution is controlled to assure that only current versions of SOPs are used. Each SOP has an effective date. Replaced versions are archived to maintain documentation of methods used in the past. In order to deviate from a SOP, a written approval must be obtained from the quality assurance manager.

8.3 GLASSWARE CLEANING PROCEDURES

The general procedures that will be used to clean laboratory glassware are listed in Table 8.1 by the associated analysis. The key describing each procedure immediately follows the table.

8.4 LABORATORY REAGENT AND STANDARD STORAGE

Purchased reagents and standards must meet the quality criteria specified in methods and SOPs.

All reagents and standards are delivered to the appropriate department where they will be stored appropriately (See Table 8.2 Reagent and Standard Storage).

Standards are stored according to the conditions in the method and/or SOP. Standards must not be stored in the same storage unit as used for samples or reagents.

The reagents and standards are dated upon receipt, labeled with an expiration date, and logged into a standard/reagent logbook. All standards and reagents are assigned a unique number, which is listed on the container as well as in the logbook. The information contained in the standard/reagents logbook includes manufacturer/ vendor, lot number, purity/concentration, date of receipt, and an expiration date. When opened, the containers are initialed and dated by the analyst.

A logbook is used to document reagent and standard preparation. The logbook documents reagent IDs of stock solutions or neat chemicals, preparation method, preparation date, expiration date and the preparer’s initials. Each prepared reagent and standard receives a unique ID code which is documented in the logbook. The label of the reagent or standard container receives the unique ID code and the expiration date.

All standard material must be checked with standard material from a different source or lot number. The acceptance criteria are specified in the individual method SOPs.
Reagent blanks are used to determine the quality of the reagent material.

8.5 SAMPLE ALIQUOTS

When only part of a sample is taken for analysis, the following procedures are applied to assure that a representative sub-sample is obtained:

8.5.1 AQUEOUS/LIQUID SAMPLES

The sample must be mixed thoroughly to assure that the sample is homogeneous. Care must be taken with samples that are to be analyzed for volatile constituents. In order to prevent loss of these constituents, these samples must not be shaken vigorously but the container should be inverted three times before a sub-sample is taken.

Since suspended solids in the sample can settle rather quickly, the sub-sample must be taken immediately after the mixing procedure.

8.5.2 SOLID SAMPLES

The sample must be mixed thoroughly to assure that the sample is homogeneous. Care must be taken with samples that are to be analyzed for volatile constituents. For soil samples, foreign matter such as leafs, sticks and rocks must not be included in the sub-sample.

Aliquots of solid samples for TCLP analysis must include the same relative amounts of different materials as the original sample.

8.6 SAMPLE AND WASTE DISPOSAL

The following protocols are observed when disposing waste from the laboratory:

8.6.1 SUMMARY

Prism Laboratories has the policy to comply with all regulations concerning proper disposal and safe handling of laboratory samples, chemicals and wastes. The disposal of wastes must be documented and when completed the requirements of laboratory in-house hazardous and non-hazardous waste management per EPA guidelines. This includes furnishing materials, safety equipment, and expertise necessary for the classification and manifesting for the removal of waste from the facility.

8.6.2 DISPOSAL PROCEDURES

Generally samples are held in the proper storage areas for at least 30 days after the sampling date. Thereafter they are taken from the appropriate storage area and stored in the warehouse until disposal. Upon request the samples may be kept in storage for an extended amount of time. Samples associated with USACE projects must be kept for at least 60 days after sampling. Samples may be disposed of in two ways: Internal disposal or return to client.

8.6.2.1 RETURN TO CLIENT

If the disposal cost of a sample is prohibitive, it may be agreed with the client to return the sample. Samples will also be returned if it is requested by the client.

8.6.2.2 INTERNAL SAMPLE DISPOSAL – WATERS

When water samples are ready for disposal, they are reviewed for the method of disposal. The method of disposal is determined by examining information about the samples such as client description and analytical results. All waters that are non-hazardous can be poured down the drain. If a water sample has any contaminants which would preclude disposal to a POTW (e.g. Dioxins, PCBs) it is segregated and handled as a solid/other type of sample (See Section 8.4.2.2). These samples are stored until a contracted company removes the waste according to the waste type.

8.6.2.3 INTERNAL SAMPLE DISPOSAL – SOLIDS/OTHER

When samples or laboratory waste are ready for disposal, the type of waste is determined by examining available information (client description, analytical results). The samples are categorized in different waste streams:

Waste stream 1:	Methylene chloride waste from organic extractions
Waste stream 2:	Pyridine waste from cyanide extractions
Waste stream 3:	Non-halogenated waste from organic prep containing acetone and hexane.
Waste stream 4:	TKN liquid waste, containing mercury.
Waste stream 5:	Spent COD vials containing acid and mercury.
Waste stream 6:	Autosampler vials containing solvents such as methylene chloride, carbon disulfide, hexane, acetone
Waste stream 7:	Chloroform waste from MBAS analysis
Waste stream 8:	Soil/Methanol, soil samples containing organic solvents, fuels and oils (no PCBs).
Waste stream 9:	Non-hazardous bacteria plates

The waste is kept in special disposal storage areas until the contractor removes the waste. Waste that does not fall into these categories is separated and lab packed and removed by a contractor.

Table 8.1
Glassware Cleaning Procedures

Analysis	Cleaning Procedure
Extractable organics	15, 1-4, 7, (6 or 8 optional if 19 used), 17, 19 ***or*** 15, 1-4, 16, 17, 19 ***or*** 15, 1-3, 18, 3, 4, 17, 19
Purgeable organics	1-4, (7 optional), 13 ***or*** 1-4, (5 optional), (8 optional), 13
Trace metals	1-4, 12, 4
Nutrients	1-4, 11, 4
Minerals, COD, BOD, cyanide, and phenols	1-4
Solid residues	1-4, 14
Petroleum hydrocarbons, Oil & Grease	1-5, (9 optional if 19 used), 19
1. Remove all labels using sponge or acetone.	
2. Wash with hot tap water and a brush to scrub inside of glassware, stopcocks, and other small pieces, if possible using a suitable laboratory grade detergent.	
• Organics	Liquinox, Alconox or equivalents
• Inorganic Anions	Liquinox or equivalent
• Inorganic Cations	Liquinox, Acationox, Micro or equivalents
3. Rinse thoroughly with hot tap water.	
4. Rinse thoroughly with deionized water.	
5. Rinse thoroughly with pesticide grade Acetone.	
6. Rinse thoroughly with pesticide grade Methylene Chloride.	
7. Rinse thoroughly with pesticide grade Methanol.	
8. Rinse thoroughly with pesticide grade Hexane.	
9. Rinse thoroughly with freon.	
10. Rinse with HPLC grade Acetonitrile and Methanol (if used).	
11. Rinse or soak with 1:1 HCl (Hydrochloric acid).	
12. Rinse or soak with 10% HNO3 (Nitric acid).	
13. Bake at 105C for 3-4 hours.*	
14. Bake at 180C for 3-4 hours (prior to use as per method).	
15. After use, rinse with last solvent used.	
16. Drain, then heat in muffle furnace for 15-30 minutes.	
17. Store inverted or capped with suitable material or suitable container stopper.	
18. Soak in oxidizing agent (chromic acid or equivalent); preferably hot (40-50C).	
19. Last step (prior to use) should be a rinse with the solvent used in analysis.	
*Class A Volumetric glassware will not be baked.	

TABLE 8.2
General Reagent/Standards Storage

Chemical	Method of Storage
Methylene Chloride Trichlorofluoromethane	Stored in original containers at room temperature in solvent storage cabinet (Non-Flammable Storage)
Acetone Diethyl Ether Hexane	Flammable Storage
Silica Gel Sodium Sulfate	Stored in original containers at room temperature in cabinet designated for standards and reagent storage
Sodium hydroxide	Stored in original containers in base storage area away from acid storage
Acetic acid Nitric acid Sulfuric acid Hydrochloric acid Perchloric acid Phosphoric acid	Stored in original containers in acid storage cabinet away from base storage
Reagents (dry)	Stored in original containers at room temperature in cabinet designated for standards and reagent storage
Reagents (wet)	Refrigerator, 0.1 to 4.4 °C. (If required)
Standards – VOA Standards – SVOA Standards – Wet Chemistry Standards - Metals	Freezer (-20 to -10 °C.) Separate freezer for volatiles and semi-volatiles. Refrigerated 0.1 – 4.4 °C. Refrigerated 0.1 – 4.4 °C. (If required) Stored at room temperature in standard storage area

9.0 CALIBRATION PROCEDURES AND FREQUENCY

9.1 LABORATORY INSTRUMENTATION

Before analysis of samples can begin, the instrument used for the analysis must be calibrated and/or their calibration verified to ensure that the instrumentation operates within the limits required by methods and SOPs.

A list of laboratory equipment, including instrumentation that requires calibration, can be found in Table 9.5. Field equipment is detailed in Section 6.0 of this plan.

9.2 STANDARD RECEIPT AND TRACEABILITY

Standards are received by the appropriate department supervisor and are initialed and dated at the time of receipt. All manufacturers' paperwork associated with each standard is filed in each area's Certificates of Analysis binder. A standard/Reagents logbook is used to document manufacturer, lot number, purity/concentration, received date and expiration date. All standards, when opened are initialed and dated by the analyst.

Whenever standards are prepared or diluted, they are logged into a Standards Prep logbook unique to each department. All standards are assigned a unique number, which is listed on the container as well as in the logbook. Information contained in the Standards Prep logbook include manufacturer, lot number, initial concentration, date made, analyst, solvent used, initial and final volumes, information about the composition of the standard, and expiration date.

All standard containers are labeled with a unique identifier, concentration, expiration date, preparation date (when applicable), and initials.

The expiration date is checked when standards are taken from storage for use. If the material is expired the standard will not be used and is labeled “Not in use” and removed for disposal.

All procedures associated with making the standard are recorded. Standards which are diluted from previously diluted, in-house standards are recorded as unique standards in the standards logbook.

The standard identification number is used in all documentation to trace the standard during use in the laboratory.

Only standard sources approved by the QA department may be used. Standards will be traceable to NIST when possible.

Standards are stored according to the conditions in the method and/or SOP. Standards must not be stored in the same storage unit as used for samples.

9.3 STANDARD SOURCES AND PREPARATION

Stock solutions are prepared for the purpose of making working standards. Reagents or standards must not be pipetted directly from the reagent or standard container. Minimal amounts are used from an interim holding container. Unused solutions must not be poured back in the original container. Dilutions must be made using reagent grade or pesticide grade solvents. Proper storage conditions must be observed.

See Table 9.6 for standard sources and preparation.

9.3.1 STANDARDIZATION OF TITRATING SOLUTIONS

The laboratory uses purchased pre-standardized reagents when possible for all those solutions and methods requiring standardization. For solutions that require standardization, Table 9.1 shows the source of the primary standards used to standardize, and the frequency of standardization. Standardization must be documented in the appropriate logbook.

Table 9.1
Standardization of Titrating Solutions

Solution	Source of Primary Standard	Frequency
EDTA (0.2N)	$CaCO_3$ NIST	Daily
NaOH (0.02N)	$KHC_8H_4O_4$ NIST	Each new solution
H_2SO_4 (o.1N)	Na_2CO_3 ACS Grade	Each new solution
H_2SO_4 (0.02N)	Na_2CO_3 ACS Grade	Each new solution
$Na_2S_2O_3$ (0.75N)	$KH(IO_3)_2$ ACS Grade	Daily
$NA_2S_2O_3$ (0.0375N)	$KH(IO_3)_2$ ACS Grade	Daily
$Hg(NO_3)_2$ (0.141N)	NaCl NIST	Daily
$Hg(NO_3)_2$ (0.0141N)	NaCl NIST	Daily
KCN (0.0192N)	$AgNO_3$ ACS Grade	Monthly
KI (0.0225N)	$NA_2S_2O_3$ ACS Grade	Daily
I_2	$NA_2S_2O_3$ ACS Grade	Daily

9.4 INSTRUMENT PERFORMANCE PARAMETERS

Performance parameters are checked at the beginning of each analytical run to determine acceptable instrument performance. The operating conditions are documented in a logbook or on hardcopy from the data system and kept with the analytical run file.

The Instrument calibration frequencies and criteria are listed in Table 9.6

9.4.1 GC/MS INSTRUMENT PERFORMANCE PARAMETERS

Each system used for the analysis of volatile compounds must be tuned to meet the abundance criteria listed below for BFB (See Table 9.2). These requirements must be met every 12 hours for method SW846-8260 and every 24 hours for method EPA 624.

Table 9.2
BFB – 4-Bromofluorobenzene Abundance Criteria

Mass	Ion Abundance Criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	base peak, 100% relative abundance
96	5 to 9% of mass 95
173	less than 2% of mass 174
174	greater than 50% of mass 95
175	5 to 9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5 to 9% of mass 176

Each system used for the analysis of semi-volatile compounds must be tuned to meet the abundance criteria listed below for DFTPP (See Table 9.3). These requirements must be met every 12 hours for method SW846-8270 and every 24 hours for method EPA 625

Table 9.3
DFTPP – Abundance Criteria for EPA 625

Mass	Ion Abundance Criteria
50	30 to 60% of mass 198
68	less than 2% of mass 69
70	less than 2% of mass 69
127	40 to 60% of mass 198
197	less than 1% of mass 198
198	Base peak, 100% relative abundance
199	5 to 9% of mass 198
275	10 to 30% of mass 198
365	greater than 1% of mass 198
441	Present but less than mass 443
442	greater than 40% of mass 198
443	17 to 23% of mass 442

Table 9.4
DFTPP – Abundance Criteria for SW846-8270D

Mass	Ion Abundance Criteria
51	10 to 80% of Base Peak
68	less than 2% of mass 69
70	less than 2% of mass 69
127	10 to 80% of Base Peak
197	less than 2% of mass 198
198	Base peak, or greater than 50% of mass 442
199	5 to 9% of mass 198
275	10 to 60% of Base Peak
365	greater than 1% of mass 198
441	Present but less than 24% of mass 442
442	Base Peak, or > 50% of mass 198
443	15 to 24% of mass 442

9.4.2 METALS ANALYSIS INSTRUMENT PERFORMANCE PARAMETERS

Performance parameters are checked at the beginning of each analytical run. The operating conditions are documented in a logbook and on special forms which are attached with the analytical run data.

The following minimum criteria must be met before proceeding with the analytical run, unless approval is obtained from the appropriate supervisor:

9.4.2.1 ICP

Mn emission count should be above 200,000

Mn BEC (Background Equivalent Concentration) should be >-0.02

9.4.3 MISCELLANEOUS EQUIPMENT CALIBRATION

9.4.3.1 THERMOMETERS

All thermometers in use are labeled and calibration verified with a NIST traceable thermometer. The calibration verification is performed once per year and is documented on a thermometer record for each thermometer.

9.4.3.2 BALANCES

All balances are checked each day of use with two certified weights bracketing the weight-range used. Balances are under a maintenance contract service at least once per year.

9.4.3.3 PIPETTORS

All pipettors are verified quarterly. The calibration verification is documented on calibration verification record sheets.

9.4.3.4 REFRIGERATORS, INCUBATORS AND OVENS

Refrigerators, incubators and ovens are checked for proper temperature at least once on the day of use. The temperature is documented on log sheets near the instrument or analysis logbook.

The temperature of incubator units used for drinking water analyses is recorded twice per day (for days in use) for the top and bottom shelves with readings separated by at least four hours.

9.4.3.5 WATER BATH

Temperature is recorded when equipment is in use in a logbook or log sheet.

The temperature of water baths used for drinking water analyses is recorded twice per day (for days in use) with readings separated by at least four hours.

9.4.3.6 AUTOCLAVE

Records are kept to record date, contents, sterilization time, temperature, total cycle time and analyst's initials for each cycle.

Once per month the timer mechanism is verified.

9.4.3.7 VOLUMETRIC LABWARE

Volumetric glassware used in the laboratory is Class A.

Non-Class A volumetric labware is checked by lot before use or upon evidence of deterioration. Acceptance criteria: Bias: Mean within $\pm$ 3% of nominal volume; Precision: RSD $\leq$ 3% of stated volume (based on 10 replicate mesurements).

Table 9.5
Major Laboratory Instrumentation/Equipment

#	ID	Manufacturer	Model	Serial Number	Use
GC/MS Instrumentation					
1	SMS-D	Hewlett-Packard	5890 II GC / 5972 MSD	3030G12015 / 11227	8270, 625
1	SMS-E	Hewlett-Packard	5890 II GC / 5972 MSD	2643A11242 / 3118A02670	8270, 625, TCLP
1	SMS-F	Agilent	6890N GC / 5975 B MSD	CN621A4365/US372A2754	8270, 625 Backup
1	VMS-A	Hewlett-Packard Encon / Archon	6890 GC / 5973 MSD Enchon / Archon	US00025437 / US03950313 502063006 / 13888	8260, 624, 6210D
1	VMS-B	Hewlett-Packard Encon / Varian	5890 II GC / 5972 MSD Encon / Archon	0209SAL1031 / 209SAL1030 504063006 / 12805	8260, 624, TCLP
1	VMS-C	Hewlett-Packard EST / Varian	5890 II GC / 5972 MSD Enchon / Archon	C128183 / 2919A00274 171111301 / 13617	8260, 624, TCLP
1	VMS-D	Hewlett-Packard EST / Varian	5890 II GC / 5972 MSD Enchon / 8100	3121A35908 / 3114A02142 468112905 / 15291	8260, 624
1	VMS-E	Agilent Encon / Centurion	6890 GC / 5973 MSD Enchon EV / Centurion	US00022389 / US63810370 EV110051408 / CENT1140108	8260, 6200D
1	VMS-F	Agilent Encon / Centurion	6890 GC / 5973 MSD EV/ Enchon / Centurion	US00041610 / US10480475 EV168041309 / 170111201 E / CENTS106062309	8260, 6200D
GC Instrumentation					
1	SGC-B	Hewlett-Packard	5890 A GC / FID	2750A18933	610, 8100, EPH Backup
1	SGC-D	Hewlett-Packard	5890 II PLUS / Dual FID	3336A57017	DRO
1	SGC-E	Hewlett-Packard	5890 II / Dual ECD	3121A3560	608,8081, 8082 Backup, 504 Backup, 8011 Backup
1	SGC-F	Hewlett-Packard	5890 II / Dual ECD	3033A33452	504, 8011, 8082, 608, 8081 Backup
1	SGC-G	Agilent	6890GC / Dual FID	CN621A4380	EPH
1	VGC-A	Hewlett-Packard Tekmar / Varian	5890 II / PID/FID 2000 / Archon	3029A25981 92261001 / 12805	VPH
1	VGC-B	Agilent Encon / EST	6890N GC / PID / FID Encon / Archon	CN92174365 335010804E / 13610	VPH
1	VGC-D	Agilent Teledyne Tekmar	6890 / HT3	US00001758 / BETA004	RSK-175
1	VGC-F	Hewlett-Packard EST / Varian	5890 II FID PID/ELCD Enchon / Archon	3203S3990B 336012904 / 13451	601, 602, 6230D
Headspace Analyzer					
1	VGC-X	Hewlett-Packard Teledyne Tekmar	5890 II FID HT3	9449 BETA004	Screening/ Product analysis

Table 9.5
Major Laboratory Instrumentation/Equipment (Continued)

#	ID	Manufacturer	Model	Serial Number	Use
Chromatography Data Stations					
10		EZ Chrom	EZ Chrom Elite		With GC
10		Hewlett-Packard	Chemstation		With GC and GC/MS
Gel Permeation Chromatograph					
1	GPC-A	O.I. Corp	Autoprep 1000	A125330296	Extraction Cleanup
Accelerated Solvent Extraction					
1	ASE-A	Dionex	ASE-200	0020376	3545
Inductively-Coupled Plasma w/ Autosampler					
1	ICP-MS	Thermo Elemental Cetac	X5 ASX-510	X0214 090236ASX	Metals
1	ICP	Perkin-Elmer Perkin-Elmer	Optima 5300DV AS90	077N5031401 9072	Metals
Mercury Analyzer w/ Autosampler					
1 1 1	FIMS CVAFS	Perkin-Elmer Perkin-Elmer Leeman Labs	Fims 100 S10 Hydra AF Gold^{+}	101S8051201 102S8062420 010-00077-1	Mercury Mercury
Ion Chromatograph					
1 1	IC	Dionex Dionex	Model 300 AS 40	99020307 99020052	Anions
Wet Chemistry Automation					
1 1 1	AA3 AA3 AA3	Bran-Luebbe Bran-Luebbe Bran-Luebbe	AA3-Chem. Module MT16 AA3 Colorimeter 169 AA3 Compact Sampler	951378 54502704 9538005 54468356 96248	Ammonia, TKN, Nitrate, Nitrite, Phosphorus
Solid Phase Extraction					
1 1	SPE	Horizon Horizon Horizon	Model 3000 XL Controller: SPE-DEX 3000 Speedvap	04-1187 04-1252 04-2025	Oil and Grease, 1664
pH/Specific Ion Meters					
1	pH-1903	VWR	SB70P	001903	pH Wet-Chem
1	pH-6542	VWR	SB20	00006542	pH BOD
1	pH-2649	VWR	SB20	00002649	pH Metals
1		Accumet	Model 25A	L0005814	Fluoride
1		Orion	EA920	RS74A	Fluoride
1	pH-1114	VWR	SP21	00001114	Field pH
1	pH-1321	VWR	SP20	00001321	Field pH
1	pH-1464	VWR	SP70P	001464	Field pH
1	pH-2004	VWR	SP70P	002004	Field pH
1	pH-3008	VWR	SP70P	003008	Field pH
1	pH-1879	VWR	SP70P	CO1879	Field pH

Table 9.5
Major Laboratory Instrumentation/Equipment (Continued)

#	ID	Manufacturer	Model	Serial Number	Use
Specific Ion Probes					
1		Orion	Fluoride 94-09		Fluoride
3		Orion	DO 97-08		Dissolved Oxygen
Turbidity Meter					
1		HACH	2100P	970400013798	Turbidity
Spectrophotometers (UV/VIS)					
1	UV/VIS-1	Sequoia Turner	390	0001191 TN	P, NO_3/NO_2, COD
1	UV/VIS-3	Thermo Electron Corp.	AQUAMATE	AQA114520	COD, CN
1		HACH	DR 2400	020900000508	Residual Chlorine
1		HACH	Pocket Colorimeter	990600134271	Residual Chlorine
Conductivity Meters					
1		VWR	21800-012	51077445	Conductivity
Dissolved Oxygen Meters					
1		YSI	5100	04L1469AJ	BOD
Block Digestor					
1		Seal Analytical	BD 50s	4648A11425 / 4648A11428	TKN
4		Environmental Express	36 Place Hot Blocks		Metals Digestion
2		HACH HACH	45600 45600	890800455 970800016437	COD
Dessicators					
2		Fisher Scientific	Dessicator		Solids
1		Sanplatec Corp.	Dry Keeper		Oil & grease
1		Boekel	Dessicator		Oil & Grease
Autoclave					
1		Market Forge	Modra STM-E	117872	Coliform, Phosphorus
Incubators					
4		Various	BOD Incubator		BOD
3		Various	Bacteria Incubator		Fecal and Total Coliform
Colony Counter					
1		Reichert-Jung	Quebec Darkfield colony Counter	1142-1	Fecal and Total Coliform
Water Baths					
1		Fisher Scientific	Water Bath Incubator	304764	Fecal Coliform
1		Precision Scientific	Water Bath Incubator	699010242	Fecal Coliform
1		Blue M	Magic Whirl		Fecal Coliform/Not in use
1		Blue M	C1060		Oil & Grease
1		Precision Scientific	280 Series 2862	201287-85	Fecal Coliform
1		Precision Scientific	180 Series	698041092	BOD, spore Ampules

Table 9.5
Major Laboratory Instrumentation/Equipment (Continued)

#	ID	Manufacturer	Model	Serial Number	Use
Ovens					
1		Binder	ED53		TDS
1		Binder	ED115		TSS
1		Fisher Scientific	Isotemp 106G		Glassware
1		ASP	Drying Oven DX-38		TDS
1		Fisher Scientific	Isotemp Oven Model 630F		TSS
1		DESPATCH	Constant Temperature Oven	104602	%Solids
1		Blue M	Stable Therm Gravity Oven		Glassware
1		Fisher Scientic	Model 14 Muffle Furnace	30300003	VSS
Digestion/Distillation Units					
1		Environmental Express	Micro Block-R		Phenols
1		Lab-Crest	Midi Distillation Unit		Cyanide
1		Labconco	RapidSill II	242061	Not in service
1		Labconco	6 Place Distillation Unit	0001 07761T	Ammonia
Shaker Unit					
2		Glascol	3D Shaker		Aqueous extractions
TCLP Tumblers					
1		Environmental Express	12-Place Unit		TCLP 1311
1		As. Design and Mfg. Co.	4-Place Unit		TCLP 1311
Zero-Headspace Extractors					
3		Environmental Express	ZHE		TCLP 1311
TCLP Pressure Filter Units					
2		Millipore			TCLP 1311
Ultrasonic Extractors (Cell Disrupters)					
1		Branson	Sonifier 450		Soil extractions
1		Misonex Inc.	XL		Soil extractions
1		Fisher Scientific	Sonic Dismembrator 550		Soil extractions
Concentrator					
3		Zymark	TurboVap II		Extract concentration
Analytical Balances					
1	BAL #2	Sartorius	CP 224S	14504159	Wet Chem
1	BAL #10	Denver Instruments		B043564	Wet Chem
Top Loading Balances					
1	BAL #1	Precisa	500C	66244	Soil VOC, GRO, VPH
1	BAL #3	OHAUS	Scout Pro SP402	7126190729	Wet Chem
1	BAL #4	OHAUS	Scout Pro SP402	712630901	Metals Prep
1	BAL #5	Mettler	PE 6000	D39650	Metals Prep
1	BAL #6	OHAUS	Scout Pro SP402	7130070215	Organic Prep
1	BAL #7	Sartorius	Handy	39020044	Micro

Table 9.5
Major Laboratory Instrumentation/Equipment (Continued)

#	ID	Manufacturer	Model	Serial Number	Use
Top Loading Balances					
1	BAL #8	OHAUS	Scout Pro SP402	7125400212	Metals
1	BAL #9	Denver Instruments	XL-3K	110001026	Soil VOC, GRO, VPH
1	BAL #11	OHAUS	Scout Pro SP402	7122171785	ZHE
Refrigeration Units					
1		Walk-In Cooler	30’ x 15’		Soil samples
1		Walk-In Cooler	10’ x 10’		Metals samples
1		Walk-In Cooler	14” x 20”		Main sample cooler
1		Tennetics	Deli-Style Cooler, 6’		VOC samples
5		Refrigerators	Various		Standards, reagents
Laboratory Pure Water					
3		Dracor	DI Water System		All Analyses
Ice Maker (Commercial Grade)					
1		Cornelius	1000 Series		Field services
Central Vacuum System					
1		Welch DuroSeal	1420 Vacuum Pump		Vacuum system
Flammables Cabinet					
1		Sheldon Mfg.	1045 TD (45 Gallons)		Flammable storage
1		Eagle Mfg.	BEI-47 (45 Gallons)		Flammable storage
1		A&A Prod. Inc.	A145 (45 Gallons)		Flammable storage
1		Justrite Mfg.	25600 (60 Gallons)		Flammable storage
Fumehoods					
7		Various			Various analyses
Safety Shower Stations					
3		Various			Safety
Eye Wash Stations					
4		Various			Safety

Table 9.6
Standard Sources and Preparation

Instrument Group	Standard Source	Concentration Received	Source Storage	Preparation from Source	Stock Storage	Preparation Frequency
GC/MS – VOA						
Methods 624, 8260	Ultra or equivalent	2000 ppm	Frozen	1:10 dilution in methanol	Frozen	Monthly
Appendix IX	Accustandard or equivalent	2000 ppm	Frozen	1:10 dilution in methanol	Frozen	As needed
GC/MS - SVOA						
Methods 625, 8270	NSI or equivalent	200 ppm	Cool 4°C.	As is	Cool 4°C.	Monthly
Appendix IX	Accustandard or equivalent	200 ppm	Cool 4°C.	As is	Cool 4°C.	As needed
GC/PID/ELCD	Ultra or equivalent	2000 ppm	Frozen	1:20 dilution in methanol	Frozen	Monthly, gaseous stds, weekly
ICP – Cal Stds.	CPI multi element or equivalent	100-1000 ppm	Room temp.	1:100 or as required	Room temp. 5% HNO_3	As needed or every two weeks
ICP – ICV	HPS multi element or equivalent	100-1000 ppm	Room temp.	1:50 or as required	Room temp. 5% HNO_3	Weekly or as needed
CVAA – Cal Stds	Inorganic Ventures or equivalent	1000 ppm	Room temp.	1:100, 1:10	Room temp. 5% HNO_3	Monthly
CVAA – ICV	HPS or equivalent	1000 ppm	Room temp.	1:100, 1:10	Room temp. 5% HNO_3	Monthly
ICP/MS	HPS multi element or equivalent	10-100 ppm	Room temp.	1:100 or as required	Room temp. 5% HNO_3	As needed or every two weeks
GFAA – ICV	HPS multi element or equivalent	100-1000 ppm	Room temp.	1:50 or as required	Room temp. 5% HNO_3	As needed

Table 9.7
Instrument Calibration Requirements

Instrument	Method Reference	# Stds Initial Calibration	Criteria Initial Calibration	Frequency for Calibration	Frequency of ICV	Criteria for ICV	Frequency of CCV	Criteria for CCV
GC/MS VOA	SW846-8260	5	%RSD≤15% for each cmpd or Corr. Coef. ≥0.995 %RSD≤30% for CCCs RF of SPCCs (1)	As needed	Every calibration	%diff≤20% for CCCs RF of SPCCs(1)	Every 12 hr.	%diff≤20% for CCCs RF of SPCCs(1)
GC/MS VOA	EPA 624	5	%RSD≤35% for each cmpd. Or use curve	As needed	Every calibration	Table 5 of EPA 624	Every 24 hr.	Table 5 of EPA 624
GC/MS SVOA	SW846-8270	5	%RSD≤15% for each cmpd or Corr. Coef. ≥0.995 %RSD≤30% for CCCs RF of SPCCs ≥ 0.050	As needed	Every calibration	%diff≤20% for CCCs RF of SPCCs ≥ 0.050	Every 12 hr.	%diff≤20% for CCCs RF of SPCCs ≥ 0.050
GC/MS SVOA	EPA 625	5	%RSD≤35% for each cmpd. Or use curve	As needed	Every calibration	80-120% R	Every 24 hr.	80-120% R
GC/FID	SW846-8015	5	%RSD≤20% for each cmpd or Corr. Coef. ≥0.990	As needed	Every calibration	85-115% R	Every 12 hr.	85-115% R
GC/FID	SW8468100	5	%RSD≤20% for each cmpd or Corr. Coef. ≥0.990	As needed	Every calibration	85-115% R	Every 12 hr.	85-115% R
GC/PID/ELCD	EPA 601/602	3	%RSD≤10% for each cmpd. Or use curve	As needed	Every calibration and per batch of 20	Table 2 in the method	Every 24 hr.	Table 2 in the method
GC/PID/ELCD	SW846-8021	5	%RSD≤20% for each cmpd or Corr. Coef. ≥0.990	As needed	Every calibration	85-115% R	At the beginning and end of each 12 hr. shift	85-115% R
GC/ECD	SW846-8081 SW846-8082	5	%RSD≤20% for each cmpd or Corr. Coef. ≥0.990	As needed	Every calibration and per batch of 20	85-115% R	At the beginning of each 12 hr. shift and after 20 samples or less.	85-115% R

Table 9.7
Instrument Calibration Requirements (Continued)

Instrument	Method Reference	# Stds Initial Calibration	Criteria Initial Calibration	Frequency for Calibration	Frequency of ICV	Criteria for ICV	Frequency of CCV	Criteria for CCV
GC/ECD	SW846-8011	5	%RSD≤10% for each cmpd. or Corr. Coef. ≥0.990	As needed	Every calibration and at least weekly	85-115% R	At the beginning of each 12 hr. shift and after 20 samples or less.	85-115% R
GC/ECD	EPA 608	3	%RSD≤10% for each cmpd. Or use curve	As needed	Every calibration and per batch of 20	85-115% R	Every 24 hr.	85-115% R
ICP/MS		5	Corr. Coef. ≥0.998	Daily	Every calibration	90-110% R	Every 10 samples	90-110% R
ICP		5	Corr. Coef. ≥0.995	Daily	Every calibration	95-105% R	Every 10 samples	90-110% R
IC	EPA 300.0	5	Corr. Coef. ≥0.995	As needed	Every calibration	90-110% R	Every 10 samples	90-110% R
pH meter		3	±0.1 Std Units	Daily	Every calibration	±0.1 Std Units	Every 10 samples	±0.1 Std Units

(1) SW846-8260 SPCCs:

Chloromethane	0.10
1,1-dichloroethane	0.10
Bromoform	0.10
Chlorobenzene	0.30
1,1,2,2-Tetrachloroethane	0.30

10.0 PREVENTATIVE MAINTENANCE

10.1 ROUTINE MAINTENANCE

See Table 10.1 for routine maintenance activities.

10.2 DOCUMENTATION

All instruments have a maintenance logbook. Any routine and non-routine repairs are recorded in the log.

Service contracts are in effect for GC, GC/MS and ICP instrumentation and laboratory balances. Back-up instrumentation and equipment are available for most analyses with limited holding times.

10.3 CONTINGENCY PLANS

In the event of major equipment failure, the following options are available:

Use alternative (back-up) instrument

Request a service call

Subcontract to another certified laboratory

Invalidate/reschedule the sampling event

At no time will holding times be compromised due to equipment failure. Relationships with other certified laboratories have been established and shall be used as needed.

Table 10.1
Preventive Maintenance Activities

Instrument	Activity	Frequency
GCs and GC/MSs	check septum	daily
	check gases	daily
	change gases	as needed
	change in-line filters	as needed
	clip cap. Columns	as needed
	ELCD reservoir	fill daily
	polish PID lamp	quarterly
	change Ion Exchange resin	annually/as needed
	replace Ni tube (ELCD)	as needed
	clean detectors	quarterly
	let tip cleaning	bimonthly
	bake-off columns/traps	as needed
	replace- pump oil	semi-annually
	check autosampler syringe and tubing	daily
Atomic Absorption spectrophotometers	check gases	daily
	check DI reservoir	daily
	inspect micro-syringe	daily
	inspect quartz window	daily
	Clean furnace electrodes	daily
	inspect fuel inlet washers	daily
	clean burner heads	daily
	clean auto pipettor	daily
	clean hood with detergent	weekly
	inspect tubing on furnace	weekly
	clean graphite tube	as needed
	change lamps	as needed
Meters/probes	check probe solution	daily
	replace probe filling solution	as needed
	check probe membrane	daily
	change membrane	as needed
Desiccator	change desiccant	as needed
Refrigerators/freezers/ovens	check temperature	daily
	clean	as needed

Table 10.1
Preventive Maintenance Activities (Continued)

Instrument	Activity	Frequency
Balances	clean pans	before and after use
	check alignment	before use
	Class S weight check	daily
	recalib. with NIST-traceable weight	semi-annually
Turbidimeter	clean	before and after use
TCLP apparatus	clean	before and after use
Thermometers	recalib. against NIST-traceable therm.	annually
	check for cracks and gaps in mercury	daily
Autoclave	gasket checked	weekly
	timer checked	semi-annually
	clean interior	monthly
	sterilization indicator tape	daily
UV/Vis Spectrophotometer	clean sample compartment before/after use	daily
	clean cuvettes after each use	daily
	windows cleaned	monthly
	check electronics	as indicated
Automatic samplers	check operation	prior to sampling
	check purge-pump-purge cycle	after installed, daily
	check flow pacer	prior to sampling
	check desiccant	daily
	check battery	daily
	check pumping rate	daily

11.0 QUALITY CONTROL PROCEDURES

11.1 OUALITY CONTROL CHECKS

The following quality control samples are utilized by the laboratory to assess method precision and accuracy. In most cases quality control samples are assigned to sample batches by the analyst performing the test.

11.1.1 GENERAL

Method Reagent Blanks - A sample of appropriate analyte-free matrix is prepared (digested, extracted, etc.) and analyzed with a specified sample set at a rate of one per batch.

Matrix Spikes - At least one sample per batch or 5-10% frequency (depending on method requirements) is prepared and analyzed with and without the addition of spike material. The unspiked sample is designated as the *original.* The spiked sample is identified as a *matrix spike.*

Duplicate Samples - Duplicate samples are analyzed at a minimum of one per batch. There are basically two types of duplicates utilized by the laboratory: *sample duplicates* and *matrix spike duplicates.* In most instances, the laboratory utilizes matrix spike duplicates, which is simply a second matrix spike, analyzed along with the first. In some cases, where spiking is impossible or impractical (such as temperature or conductivity), sample duplicates are performed.

Samples to be analyzed as duplicates are randomly selected based on available sample volume or according to client/project specific instructions.

Quality Control Check Samples – QC check samples are analyzed at least semi-annually. These samples are usually obtained from a commercial QC supplier as blind samples. Corrective actions are initiated when anomalies occur.

Blank Spikes - Blank spikes, or laboratory control samples, are analyte-free water spiked with a known amount of analyte. These are used to help confirm matrix effects, which may cause problems with matrix spikes. Blank spikes are analyzed at a frequency of one per sample batch or 5% frequency, whichever is more frequent.

Calibration Verification Standards - CVSs are analyzed at a rate of 5% of the samples in an analytical run or may be substituted by an acceptable blank spike.

Reagent Purity Checks - All new chemicals are analyzed with a reagent blank to determine their purity and performance in the analytical system.

11.1.2 FIELD QC

Equipment Blanks - Equipment blanks are prepared by rinsing the sampling equipment with analyte-free water prior to the sampling event. Equipment blanks are collected at a rate appropriate to the sampling event or project plan.

Trip Blanks - A trip blank is analyte-free water sealed in the appropriate sample container and travels with the sample kit from kit preparation through sample receipt. Typically, trip blanks are used only for volatile analyses and are provided by the lab per client request.

Field Duplicates - Field duplicates are prepared by duplicating the entire sampling procedure for a single site. They are collected per client request.

Split Samples - Split samples are two halves of a single sample divided into two containers and analyzed by separate laboratories, independent of each other. They should not be *duplicate* samples (which require sampling the same site twice), but rather *split* samples (which require sampling once and dividing the sample). Split samples are usually only taken by our clients.

11.1.3 ORGANIC ANALYSES

Surrogate Standards - Surrogate standards are compounds which have similar characteristics to the compounds of interest, but do not affect the recovery of those compounds. They are added to the sample prior to extraction or purging. Surrogates are used to monitor the performance of the entire analytical procedure.

Internal Standards - Internal standards are used to provide a set, known concentration from which each sample may be reliably quantified, minimizing the effects of fluctuations in instrument sensitivity between samples. Internal standards are added to samples just prior to analysis, but after sample extraction.

11.1.4 MICROBIOLOGY QC

Positive/Negative Controls - Positive and negative control organisms are obtained from the American Type Culture Collection (ATCC) or the State of North Carolina's Drinking Water Laboratory. These controls are analyzed once for every new lot of media.

11.2 ROUTINE METHODS USED TO ASSESS PRECISION AND ACCURACY

11.2.1 PRECISION

Precision is defined as the reproducibility of a method or technique. Samples are analyzed in duplicate (as sample duplicates or matrix spike duplicates) to determine reproducibility. The precision is calculated and reported in terms of the relative percent difference of the two values, or RPD.

The RPD is calculated as follows:

$$\text{RPD} = \frac{\text{Absolute value of the difference of the two results}}{\text{Average of the two results}} \times 100\%$$

or:

$$\text{RPD} = \frac{2 \times |C_1 - C_2|}{C_1 + C_2} \times 100\%$$

where: C1 = Measured concentration of the first replicate
C2 = Measured concentration of the second replicate

11.2.2 ACCURACY

Accuracy is defined as the relative "closeness" of a result to the value that was expected. Blank and matrix spikes are the primary means used to assess accuracy on a routine basis. The calculation for accuracy is known as the percent recovery, or %R. Percent recovery on a spiked sample is defined as follows:

$$\%R = \frac{\text{Conc. of spiked sample} - \text{conc. of unspiked sample}}{\text{Conc. of spike added to sample}} \times 100\%$$

For some methods, however, it is impossible to spike a sample for that particular parameter. (e.g: pH). For these methods, known samples are analyzed to check the analyst's ability to produce a similar result to that which was expected.

11.3 QUALITY CONTROL CHARTS

Quality control charts are used to monitor the ongoing QC analyses in the laboratory. On a regular basis, QC data are collected from the various analyses in order to generate QC limits to be used by the analysts. These limits are plotted on QC charts in order to give a visualization of trends in the QC data over time.

The first requirement for the establishment of a QC chart is to obtain a sample of results from the analysis of matrix spike pairs. When 30 or more data points have been analyzed, the chart may be established using the following methods:

The mean, $\overline{X}$, and the sample standard deviation, s, are calculated from the data set.

The y-axis of the chart represents the %R (for accuracy) or RPD (for precision). The x-axis represents the spiking events.

Horizontal lines are drawn representing the 95% and 99% confidence limits (2s and 3s). The lines corresponding to 99% confidence limits (3s) are called the upper and lower *control* limits, while the lines for the 95% confidence limits (2s) are called the upper and lower *warning* limits. Once the chart has been established, subsequent results obtained from sample spikes are plotted as they are generated. New charts are established at least annually.

11.4 FORMULAS FOR CALCULATION OF CONTROL LIMITS

11.4.1 UPPER/LOWER CONTROL LIMITS

$$UCL = \overline{X} + 3s \qquad LCL = \overline{X} - 3s$$

$\overline{X}$ = average
UCL = Upper Control Limit
LCL = Lower Control Limit
s = sample standard deviation

11.4.2 UPPER/LOWER WARNING LIMITS

$$UWL = \overline{X} + 2s \qquad LWL = \overline{X} - 2s$$

$\overline{X}$ = average
UWL = Upper Warning Limit
LWL = Lower Warning Limit
s = sample standard deviation

11.5 SPIKE CONCENTRATION LEVELS

It is expected that the quality of analytical measurements will change with varying analyte concentration; therefore, precision and accuracy must be consistently assessed at similar analyte levels. The tables in Section 5.0 indicate the precision and accuracy limits for each parameter, along with the concentration range for which the limits are determined. These levels, noted as "Conc. Level" in the table are defined as follows:

L, Low Level - The low level is defined as a spike concentration equivalent to < 20% of the highest standard in the calibration curve.

M, Mid Level - The mid level is defined as a spike concentration equivalent to 20-80% of the highest standard in the calibration curve.

H, High Level - The high level is defined as a spike concentration equivalent to 80-100% of the highest standard in the calibration curve.

11.6 METHOD DETECTION LIMITS AND REPORTING LIMITS

11.6.1 METHOD DETECTION LIMITS

The method detection limit is defined as the minimum concentration of a substance that can be measured and reported with a 99% confidence that the value is above zero. The MDL actually achieved in a given analysis will vary depending on instrumentation sensitivity and matrix effects. Since the vast majority of MDL data published by the EPA (and regulatory limits are often based upon these data) are determined using reagent water as the sample matrix, all MDLs for this laboratory have been determined with reagent water. To determine MDLs in solid matrices, laboratory clean sand is used as the sample matrix.

Since MDLs are derived using the most pristine matrix available, it is surmised that the.MDL is the lowest, reliable detectable level of measurement. Its applicability to real-world samples, with an infinite variety of complex matrices, is unjustifiable; therefore, a more reasonable limit, called the RL (Reporting Limit) is used in the reporting of laboratory data.

The MDL is determined according to the procedure in the current 40CFR, Part 136, Appendix B, which is summarized below

Estimate the detection limit (via published information or empirical data).

Prepare a reagent blank that is as free of analytes as possible.

Spike this blank with the analyte to be determined at 3 to 5 times the estimated MDL.

Process at least 7 aliquots of this spiked blank through the entire analytical method.

Calculate the sample standard deviation (s) for the replicate measurements as follows:

$$s = \sqrt{\frac{\sum_{I=1}^{n} (X - \overline{X})^2}{n - 1}}$$

where: X = individual aliquot's result
$\overline{X}$ = mean of the results for all the aliquots
n = total number of aliquots analyzed

Compute the MDL as follows:

$$MDL = s \times t_{(n-1,1-\alpha=0.99)}$$

where: s = sample standard deviation derived above
$t_{(n-1,1-\alpha=0.99)}$ = student's t-value at a 99% confidence level with n-1 degrees of freedom
For 7 replicates, $t_{(n-1,1-\alpha=0.99)} = 3.143$

If more than seven replicates are used, all replicates must be applied to calculate the MDL value unless a value is determined to be an outlier. The following criteria are used to determine if a value can be omitted from the calculation:

The result is associated with a known error during analysis (Example: spilled sample or extract, bubbles lodged in the spectrophotometer, double spiking).

If a random or spurious error is suspected the Grubbs test is applied to determine if the value is an outlier. However, values should not be removed based on statistical grounds alone.

11.6.2 REPORTING LIMITS

The Reporting Limit (RL) is defined by our laboratory as a value, approximately 3 to 10 times the MDL, and is equal or greater than the lowest point used on the calibration curve. The RL is considered to be the lowest level that can be reliably achieved within specified limits of precision and accuracy during, routine laboratory operating conditions. The signal-to-noise ratio must be evaluated for the calibration standard that corresponds with the RL. The ratio should be at least 5:1.

Prism Laboratories uses the RL to establish reporting limits that have a high degree of confidence, with less probability of reporting false negatives or false positives, which is incurred by reporting down to the MDL level. In certain cases where data must be reported down to the MDL level (such as when regulatory limits are set at or near the MDL), the data will be qualified as to the relatively higher degree of uncertainty of those values.

Method Detection Limits and Reporting Limits are determined during method development and whenever major alterations occur to the analytical system (e.g., new type of column, new instrument, or new analyst).

12.0 DATA REDUCTION. VALIDATION AND REPORTING

This section describes the various processes used in data reduction, validation and final report generation for Prism Laboratories.

12.1 DATA REDUCTION

Data reduction is defined as the process of converting raw data (such as a computer printout, balance weight reading, or a thermometer reading) into reportable data. The methods employed in reducing raw data must be tightly controlled, standardized, and monitored.

Initial data reduction is the responsibility of the analyst or technician making the measurement. Once the raw data are recorded, the analyst may perform various calculations to convert the information into more meaningful, reportable results. Also involved in this process is the determination of quality control results, including spike recoveries, duplicate results, blank results, and calibration verification.

12.1.1 RECORDS

Logbooks and Benchsheets - All analyses performed within the laboratory have an associated laboratory logbook or benchsheet file where all sample entries, calculations, notes and problems are recorded in ink. Any errors are crossed out with a single line, corrected near the original data, initialed and dated by the person making the correction. Some analyses results are recorded on benchsheets. The individual benchsheets are completed and filed in a file folder. Where possible bound preprinted logbooks are for each analysis. Each logbook is uniquely identified and each page sequentially numbered. These logbooks are issued and archived by the Quality Assurance Department. In addition to the data logbooks, each analyst is assigned a personal notebook for non-data notes, such as method notes, historical sample information, etc.

Computerized analytical data - All computer generated data (e.g., raw chromatographic data, analysis data files) are assigned unique filenames by the computer data systems. An entry is made in the instrument run logbook indicating this filename. The instrument run log cross-references the sample ID numbers with the associated data file. All computerized data are archived to magnetic media or CD-ROM. These archives are stored for a minimum of five years.

Hardcopies of data and final reports - All chromatography results and final report copies are printed out and kept for a minimum of five years. A filing system has been implemented to help locate all associated data, such as quality control samples and calibration information.

Other computerized information - Prism Laboratories uses a Laboratory Information Management System (LIMS) for data gathering and reporting. This LIMS is based on the Element 6 software from Promium, Inc. The analytical data stored in the LIMS are entirely traceable to the original, manually recorded raw data. The LIMS operates on a Local Area Network, which is maintained by laboratory staff with expertise in computerized data management. Each night the entire network (and all LIMS data) is backed-up to a backup server in a different building, providing for minimal downtime in the event of catastrophic computer failure. Archiving is done to CD- or DVD-ROM, which are then stored for a minimum of five years in a fireproof filing cabinet.

12.1.2 METALS ANALYSES

A calibration curve is established at the start of all metals analyses. A mid-range external source standard is then analyzed to verify the calibration curve. Concentrations are then read directly as a function of absorbance. Some of the calculations used in the analysis of metals are as follows:

Dilutions - If the concentration of the analyte is such that dilution is required, the following calculation is used:

$$\text{mg/L of metal in sample} = \frac{A \times (B + C)}{C}$$

where:
- A = mg/L of metal in diluted sample from calibration curve
- B = mL of acidified reagent water used for dilution
- C = mL of original sample aliquot used for dilution

Solids - Solids are reported on a dry-weight basis unless requested otherwise:

$$\text{mg/kg of metal in sample (dry weight basis)} = \frac{C \times V \times D}{W \times S}$$

where:
- C = mg/L of metal of digested sample from calibration curve
- V = final volume of the digested sample in mL
- D = dilution factor, if digestate required dilution
- W = wet weight of original solid in kg
- S = % Solids / 100

Method of Standard Additions - When the sample matrix is complex and cannot be accurately matched, the method of standard additions is used. In this method, equal volumes of sample are added to a water blank and to three standards containing different known amounts of the test element. The absorbance of each solution is determined and then plotted on the vertical axis of a graph, with the concentrations of the known standards plotted, on the horizontal axis. When the resulting line is extrapolated back to zero absorbance, the point of interception on the x-axis is the concentration of the unknown.

12.1.3 ORGANIC ANALYSES

Organic results are determined against a calibration curve of three to five points, depending on the method. The concentration in the original sample is then determined by the following:

Aqueous samples- External standard method

$$\text{Concentration } (\mu g/l) = \frac{A_x \times A \times V_t \times D}{A_s \times V_i \times V_s}$$

where:

A_x = Area of analyte peak in sample analysis
A = Amount of standard injected or purged (ng)
V_t = Volume of total extract (µl); for purge-and-trap, $V_t = 1$
D = Dilution, if performed on sample prior to analysis; if none, D = 1
A_s = Area of analyte peak in standard analysis
V_i = Volume of extract injected (µl); for purge-and-trap, $V_i = 1$
V_s = Volume of sample extracted or purged (ml)

Aqueous samples- Internal standard method

$$\text{Concentration } (\mu g/l) = \frac{A_x \times C_{is} \times D}{A_{is} \times Rf \times V_s}$$

where:

A_x = Area of analyte peak in sample analysis
C_{is} = Amount of internal standard added to extract or volume pureed (ng)
D = Dilution, if performed on sample prior to analysis; if none, D = I
A_{is} = Area of analyte peak in standard analysis
V_s = Volume of sample extract or volume purged (ml)
Rf = Response factor for analyte from standar7d, as described below:

$$Rf = \frac{A_s \times C_{is}}{A_{is} \times C_s}$$

where:

A_s = Area of analyte peak in standard analysis
C_{is} = Concentration of the internal standard (µg/l)
A_{is} = Area of internal standard in standard analysis
C_s = Concentration of the analyte in the standard analysis (µg/l)

Non-aqueous samples- External standard method, as dry-weight

$$\text{Concentration } (\mu g/kg) = \frac{A_x \times A \times V_t \times D}{A_s \times V_i \times W}$$

where:

A_x = Area of analyte peak in sample analysis
A = Amount of standard injected or purged (ng)
V_t = Volume of total extract (µl); for purge-and-trap, $V_t = 1$
D = Dilution, if performed on sample prior to analysis; if none, D = 1
A_s = Area of analyte peak in standard analysis
V_i = Volume of extract injected (µl); for purge-and-trap, V_i is amount of methanol added to reagent water
W = Dry weight of sample extracted or purged (mg)

Non-aqueous samples- Internal standard method, as dry-weight

$$\text{Concentration } (\mu g/kg) = \frac{A_x \times C_{is} \times D}{A_{is} \times Rf \times W}$$

where:

A_x = Area of analyte peak in sample analysis
C_{is} = Amount of internal standard added to extract or volume purged (ng)
D = Dilution, if performed on sample prior to analysis; if none, D = 1
A_{is} = Area of analyte peak in standard analysis
W = Dry weight of sample extracted or purged (ml)
Rf = Response factor for analyte from standard, as described below:

$$Rf = \frac{A_s \times C_{is}}{A_{is} \times C_s}$$

where:

A_s = Area of analyte peak in standard analysis
C_{is} = Concentration of the internal standard (µg/l)
A_{is} = Area of internal standard in standard analysis
C_s = Concentration of the analyte in the standard analysis (µg/l)

12.2 DATA VALIDATION

Data validation is the process of reviewing analytical results to assure that they are of a verifiable and acceptable quality. This process relies on the use and success of quality control samples, as well as the experience of the laboratory personnel in determining the integrity of the data generated. Several individuals are responsible for their parts of the validation process. These roles and the data validation process are defined in this section.

12.2.1 DATA INTEGRITY

Each level of data validation requires that an individual check the integrity of various activities and systems which directly affect the validity of the analytical measurement. These individuals and their responsibilities are outlined below:

Raw Data and Calculations - All analysts are responsible for raw data and calculations. Department supervisors are responsible for assuring that members of their staff are trained in data reduction and reporting. All raw data, calculations, and final results are reviewed by department supervisors, who are responsible for all activities and data generated within their respective departments.

Sample Prep Logs - Sample Preparation personnel are responsible for maintaining a current log of all activities conducted within their area. The department supervisor is responsible for reviewing prep logs on a routine basis.

Instrument and Analytical Logs - Any analyst involved in the operation of an instrument is responsible for maintaining a current log of all activities associated with an instrument. It is the responsibility of the appropriate department supervisor to review this log on a regular basis.

Calibration and QC Criteria - Each analyst is responsible for meeting the calibration and QC criteria for their methods. Supervisors review these data before data are released.

Legal Chain-of-Custody - In the event that legal, internal chain-of-custody procedures are required, the laboratory director is responsible for implementing and monitoring the sample custody process, including the procurement of analyst signatures at points of transfer.

Systems Review - The Quality Assurance Manager is responsible for monitoring all of the above systems for completeness and effectiveness.

12.2.2 VALIDATION OF DATA - RESPONSIBILITIES

Laboratory Analyst – The Laboratory Analyst is responsible for the analysis of samples and generation of results. Analysts are trained in raw data reduction, linear regression, and initial data review steps. Analysts check data for accuracy and completeness.

Department Supervisors – Department Supervisors are responsible for reviewing analyst data, QC results, logbooks, and login records.

Project Manager - Several individuals in the laboratory act as a client project manager. The Project Manager is responsible for reviewing the chain-of –custody information against the LIMS login information. This individual is also responsible for the tracking and timeliness of a particular project through the laboratory. In the event that a client request "verbal results", the project manager may advise the client on the applicability and acceptability of such results. In most cases, the project manager is the primary individual responsible for helping a client interpret minor questions concerning the laboratory report and the validity of the reported data.

Login Personnel and Department Supervisors - Responsible for reviewing the chain-of custody information submitted by the client against the samples received.

Laboratory Director/QA Manager –Responsible for conducting audits of logbooks, raw data, holding time violations, calibration records, etc. This person reviews a percentage of laboratory reports prior to reporting. May issue quality assurance notices, data qualifiers, or quality assurance narratives if necessary. The Laboratory Manager QA Manager is responsible for the overall implementation and review of the laboratory's quality systems.

12.2.3 VALIDATION OF DATA – LABORATORY QUALITY CONTROL CHECKS

Method Reagent Blanks - Any contamination present in the method reagent blanks warrants reanalysis of any samples which contain that analyte found in the blank. Some notable exceptions include common laboratory artifacts, such as methylene chloride and phthalates - in such cases, internal guidances have been established to monitor and reduce their presence; however, data will be qualified in the event that laboratory contamination is suspected.

Matrix Spikes - Matrix spike recoveries which fall outside of the established control limits warrant that all samples analyzed within that batch of samples be reanalyzed and qualified, in the event that sample matrix interferences are suspected.

Blank Spikes - Blank spikes, or laboratory control samples, must fall within the guidelines established in each method or within QC limits established by the laboratory, whichever is more stringent.

Quality Control Check Samples - QC Check Samples are analyzed as blind samples at least semiannually. In the event that unacceptable performance is indicated, the analytical method is audited and corrective actions are implemented.

Duplicate Samples - If duplicate samples results fall outside of the allowable range, they shall be reanalyzed to determine if matrix problems are present. No additional data will be reported until the problems have been corrected.

Continuing Calibration Standards - Continuing calibration standards which fall outside of the allowable range shall be reanalyzed. If the acceptance criteria are exceeded again, a new calibration verification standard shall be prepared and analyzed, or a new curve will be run.

Surrogate and Internal Recoveries/Responses - Surrogates and internal standards are checked against method requirements or internally generated control limits, whichever are more stringent or appropriate.

12.3 FINAL PROJECT REVIEW

The project manager is responsible for final project review prior to issuance of the final report. The quality assurance manager reviews a portion of all the reports. The key areas that are reviewed prior to submission to the client are:

Field and laboratory raw data
- Transcription errors
- Calculation errors
- Calibration data
- Mass spectral interpretation
- Times and dates of analysis

Chain-of-Custody

Holding Times

Anomalies concerning interdepartmental data

12.4 DATA REPORTING

Data can be reported in several forms depending on the request of the client. In order to protect confidentiality of the data, results or reports will not be sent to someone other than the person originally requesting the data, unless written consent has been given for the release of the data to someone else. Copies of data sheets which may be included in QC data packages are prepared in such a manner that the receiver is not able to review data from other clients on the same data sheet.

12.5 DATA STORAGE

All vital data generated within the laboratory are placed on hardcopy. Raw instrument data are archived to a backup server and than to CD/DVD. All archived information is maintained for a minimum of five years within the laboratory, unless a longer period is required. Archived data are generally stored chronologically; however, final reports are stored by client name, then chronologically (as well as by sample ID), to aid in data retrieval.

Examples of paper records archived include: final reports, sample log-in worksheets, field data sheets and notebooks, chain-of-custody records, and laboratory logbooks.

All such data are protected from environmental degradation and stored in a secure area.

13.0 CORRECTIVE ACTIONS

13.1 INTRODUCTION

Corrective actions are initiated whenever requirements in a procedure are not met and a condition is reached where analytical data or sample integrity is impacted. Also internal and external complaints are treated as situations that may warrant corrective action. Several mechanisms are used to report out of control or complaint situations.

Corrective actions must be undertaken whenever any of the following indicates an “out of control” or “not acceptable” condition:

- Warning Limits
- Control Limits
- Trend Analysis
- Results of performance evaluation samples, blind samples or split samples
- Findings based on audits and inspections
- Internal or external complaints

An incident report form is used to identify the following:

- Description and explanation of the problem
- Samples affected
- Person initiating the report
- Corrective action taken
- Department Supervisor
- Project Manager, client notification information and analysis comment in the final report
- QA department review and additional action taken

13.1.1 WARNING LIMITS

External standards or otherwise specified quality control samples are analyzed and results found to be outside established upper or lower warning limits (UWL, LWL).

Data may be acquired if the upper and lower control limits (UCL, LCL) are not exceeded in this condition, but corrective action must be taken. See also Section 13.3.

13.1.2 CONTROL LIMITS

External standards or otherwise specified quality control samples are analyzed and results found to be outside established upper or lower control limits (UCL, LCL).

Stop all analyses and immediate corrective action is undertaken.

13.1.3 TRENDS ANALYSIS

Analyses are “out of control” whenever any of the following control chart situations occur:

- 1 point is outside the control limits
- 2 consecutive points are outside of the warning limits
- 7 consecutive points are on one side of the mean
- 7 consecutive points increase or decrease
- An obvious trend is observed in the distribution of points

13.2 INITIATING CORRECTIVE ACTIONS

The following individuals are responsible for assessing each QC measure and initiating and/or approving corrective actions:

Laboratory Analysts - Analysts are trained in the methodology incorporated in the analysis and are required to adhere to all procedures as outlined in the methods, SOPs and QAP. Any corrective actions required as indicated by control limit outliers are addressed at this level. If equipment failure is noted, the department supervisor is notified.

Department Supervisor - The department supervisor initiates corrective action when notified of a problem by the analyst, as a result of quality audits, or when requested by the laboratory director or quality assurance manager. The department supervisor is responsible for returning the analysis status to in control.

Laboratory Director - The laboratory director initiates corrective action according to requests by the department supervisors, clients, QA manager, or regulators. This would include all repairs and upgrades to laboratory instrumentation.

Quality Assurance Manager - The quality assurance manager will initiate corrective action according to results of performance evaluation samples, regulator and client system audits, and internal audits. When QC problems are indicated, the quality assurance manager will initiate a corrective action in an attempt to resolve the problem.

All out of control situations must be documented and at least contain the following information:

- Test which is out of control
- Analyst
- Instrument
- A brief description of the problem

The goal is to return the analysis status to “in control” as soon as possible.

13.3 SPECIFIC CORRECTIVE ACTIONS

Although the corrective actions which may be required at the bench are too numerous to document within this manual, there are some common procedures which are generally appropriate to a number of trouble-shooting protocols including:

Review of analytical history:	Is there a sudden problem or has an analysis slowly drifted out of control?
Prepare fresh standards:	Have the standard or stock or working solutions expired or degraded?
Prepare fresh reagents:	Have any reagents expired or degraded?
Review the method:	Has an analyst introduced an unnoticed, methodical error into the procedure?

Corrective actions will also be initiated as needed as a result of audits and inspections, performance evaluation samples, split and blind samples and complaints.

After corrective action has been taken, any sample analyzed during the out of control period must be reanalyzed.

The following corrective actions are taken depending on QC type:

13.3.1 INSTRUMENT BLANKS

Prepare another blank. If same response, determine cause of contamination: reagents, environment, instrument or equipment failure, etc. Re-analyze any samples associated with the unacceptable blank.

13.3.2 CALIBRATION STANDARDS

Reanalyze standards. If still unacceptable, then remake standards. If still unacceptable try an alternate source or prepare from neat standards.

13.3.3 CONTINUING CALIBRATION STANDARDS

Reanalyze standard. If still unacceptable, then recalibrate and rerun samples from the last unacceptable continuing calibration verification.

13.3.4 INTERNAL STANDARDS

Inspect the analytical system for malfunctions and make corrections required. Reanalyze affected samples. If reanalysis does not solve the problem and the system is not malfunctioning, report results with a comment as required for regulatory reporting.

13.3.5 SURROGATES

Check for errors in calculations, formulation of spiking solution, internal standard responses and instrument performance. Reanalyze the samples if none of the above reveals a problem. If an undiluted analysis with acceptable surrogate recoveries is being reported, do not reanalyze diluted samples if the surrogates are outside the limits.

MS/MSDs outside of control limits for surrogates are not reanalyzed except for specific DQO requirements. If the sample and its associated MS/MSD show the same surrogate recovery pattern, document this in a case narrative or analysis comment.

If reanalysis does not solve the problem and the system is not malfunctioning report the results with an analysis comment. Corrective actions are not required for advisory surrogate limits.

For procedures involving extractions, when surrogate recoveries are outside the limits and require corrective action reanalyze the extract first, to determine if the problem was with the analysis. If reanalysis does not solve the problem then re-extract and analyze the second extract.

If surrogate recoveries in an extracted blank do not meet specifications upon re-analysis, re-extract and re-analyze all samples and a blank.

Specifically for GC/MS semi-volatile analysis, if two base/neutral or two acid surrogates are out of limits or if the recovery of any on base/neutral or acid surrogate is below 10% corrective actions are required as described herein.

13.3.6 METHOD BLANKS

Reanalyze blank. If still positive, determine source of contamination. If sample results are greater than 10 times the method blank value or the sample results are below the detectable level, the analysis is acceptable. If necessary, reprocess (i.e. digest or extract) the sample set.

13.3.7 INITIAL CALIBRATION VERIFICATION STANDARDS (ICV)

Reanalyze ICV standards. If still unacceptable, then remake ICV standards and reanalyze. If still unacceptable, then recalibrate and reanalyze ICV. If still unacceptable evaluate source and validity of all standards as appropriate.

13.3.8 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD)

For %Recovery criteria only:

Check for error. If extracted standard (LCS, Blank Spike, QC check sample, etc.) meets criteria then poor recovery is considered to be matrix interference.

Extracted standard or check standard must be prepared in the same prep batch where applicable. Report results with a comment and include in the case narrative.

If extracted standard fails, re-prep and reanalyze all affected samples.

13.3.9 DUPLICATES AND DUPLICATE SPIKES

For RPD criteria only:

Check for error. Poor precision may be due to a non-homogenous matrix. Check sample appearance. If sample is obviously non-homogenous, report result with a comment and include in the case narrative. Sample RPDs exceeding the criteria with no obvious sample in-homogeneity problem must be re-prepped and reanalyzed for all affected samples

13.4 NOTIFICATION OF CORRECTIVE ACTIONS

The laboratory director, department supervisors and QA manager will be notified in writing of any major corrective action undertaken. The corrective action notifications are maintained by the QA manager.

All corrective action related to analytical procedures will also be documented in laboratory notebooks or other appropriate laboratory records (e.g., on chromatograms, data printouts). Corrective action entries will include:

- Identification of the problem
- Corrective actions taken
- Analyst performing corrective action
- Date of corrective action
- Cause of corrective action
- Result of corrective action

In the case of complaints, a notification is sent to the quality assurance manager in the form of a problem identification report. The report will be reviewed by the QA manager and appropriate personnel will be notified to perform corrective action. The report requires documentation of the recommended improvement and identification of the persons responsible and the dates action must be taken. To complete the report, the corrective actions that are taken must be documented.

14.0 PERFORMANCE AND SYSTEMS AUDITS

14.1 LABORATORY SYSTEMS AUDITS

Systems audits are performed on a periodic basis to ensure that the measurement systems, which include instrumentation, documentation, and other components necessary to generate acceptable and reliable data, are within the appropriate guidelines.

14.1.1 EXTERNAL SYSTEMS AUDITS

Regularly scheduled systems audits are performed by various regulatory agencies, including the North Carolina Department of Environment, Health, and Natural Resources. Prism Laboratories welcomes any potential client or regulating agency to perform on-site external system audits. We firmly believe that such audits play a vital and necessary role in monitoring and improving our data quality.

14.1.2 INTERNAL SYSTEMS AUDITS

The quality assurance manager or his designee(s) perform internal audits on an annual basis. Internal audits are performed according to an internal audit master schedule. This schedule lists the area that is inspected, audit due date, inspector, audit date, and when the results of the audit were reported.

Audit findings are reported by means of a quality assurance inspection report that is initiated by the quality assurance manager who assigns a unique number to the report. The report lists laboratory procedure(s) inspected, inspector, date of the report and the inspection, observations, and requested corrective action.

The quality assurance report is routed to personnel responsible for taking corrective action, the president of the company, and returned to the quality assurance manager for review of the corrective action plan/schedule that was indicated in the report.

The quality assurance manager tracks the status of all corrective actions by maintaining a list of corrective actions.

If problems are found that cast doubt on the validity of the results, the client must be notified in writing within three days after the discovery of the problem. Notification should include a description of the problem and estimated impact on the sample results. An overview of corrective action steps taken to correct the problem should also be given. A re-inspection will take place within 30 days of the inspection report issue date to verify that proper corrective action has been taken.

14.2 SYSTEMS AUDITS OF FIELD OPERATIONS

Systems audits of the company's field sampling operations are conducted in a similar fashion as the laboratory audits. Field operations are audited to check such practices as decontamination, meter and sampler calibration, documentation, and sample handling and custody.

The quality assurance manager is responsible for auditing the field operations and generating the appropriate corrective actions.

14.3 PERFORMANCE AUDITS

Performance audits are conducted on an ongoing basis as part of the operational procedure of the laboratory activities. These audits are independent checks to evaluate the data produced by a laboratory's analytical system. There are several ways this is done:

Worksheet/logbook review

Observation and interview of laboratory personnel

Independent or check sample review

Performance evaluation sample analysis review

14.3.1 INTERNAL PERFORMANCE AUDITS

The quality assurance unit conducts worksheet and logbook reviews at a minimum frequency of once per year. These reviews will consist of evaluations of all data and related supporting documentation to assure that all required QC checks are being made and evaluation criteria followed. Reports relating to internal performance audits are confidential and will be released only upon approval from the President of Prism Laboratories.

At least one blind sample (usually a commercially available QC sample) is submitted by the quality assurance manager for each analytical group at a minimum of once per year. The more common analyses are audited at least twice a year. The results of the audit are analyzed, documented, given to the lab director, supervisors, and company owners, and archived for future reference..

14.3.2 EXTERNAL PERFORMANCE AUDITS

Performance studies for certifiable parameters are analyzed semiannually. All results from the performance studies remain on file and are available for review. Two drinking water (WS) and two environmental (WP) performance audits are conducted annually. North Carolina DEHNR also submits performance evaluation samples at least annually.

14.4 SOLICITING FEEDBACK FROM CLIENTS

Project Managers speak to clients on a daily basis and make inquiries about the customer service provided by the Company. Project Managers are responsible for making client contacts notes in the Customer Relationship Management software. These contact notes include client feedback, both positive and negative, regarding the services provided by the company and may include sample kit preparation, sample receiving, field services, testing services, quality control, sample disposal, final

laboratory reporting and invoicing. This client feedback is discussed during management meetings and corrective action is decided, if necessary, to prevent reoccurrence of problems.

14.5 REVIEW OF PURCHASED SERVICES

Sub-contracted services are reviewed on the basis of current laboratory certification information, audit results and performance evaluation study results. Additionally, blind standards can be used and an on-site inspection performed.

14.6 REPORTING AUDITS

Audits are reported by using a quality assurance inspection report that describes the observations during the audit, corrective action requested (including due dates and person responsible), corrective action taken and result of a re-inspection. This form has a coversheet that indicates the areas/procedures inspected, date and inspector name and a routing list which includes the quality assurance manager, supervisor, vice president of analytical services and the company president.

APPENDIX B

AMEC STANDARD OPERATING PROCEDURES

AMEC Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, North Carolina 27703

Tel: (919) 381-9900
Fax: (919) 381-9901

www.amec.com

MONITORING WELL SAMPLING

1.0 PURPOSE

This procedure describes the monitoring well sampling procedures to be used by AMEC Program personnel.

2.0 SCOPE

This document applies to all AMEC personnel involved in ground-water and sampling activities.

This procedure has been developed to serve as management-approved professional guidance for the AMEC Program. As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment to accommodate unforeseen circumstances. Deviation from this procedure in planning or in the execution of planned activities must be approved by the Project Manager and AMEC Program Manager.

3.0 DEFINITIONS

None.

4.0 RESPONSIBILITIES

The Project Manager is responsible for ensuring that these standard ground-water sampling activities are utilized during projects conducted under the AMEC Program.

The Field Supervisor is responsible for ensuring that all project field staff utilize these procedures.

The AMEC Program Manager is responsible for conducting evaluations to ensure that these procedures are being utilized throughout the AMEC Program.

Minimum qualifications for sampling personnel are that one individual in the field team shall have a minimum of 6 months of experience with sampling monitoring wells.

It is the responsibility of the field sampler and/or task manager to directly supervise the ground-water sampling procedures and ensure that they are conducted according to proper protocol as described within this procedure and to record all pertinent data collected during sampling. If deviations from the procedure are required due to anomalous field conditions that may arise or be encountered, these must be brought to the attention of the AMEC Program Manager and documented in the field logbook.

5.0 PROCEDURE

5.1 PURPOSE

This procedure establishes the method for sampling ground-water monitoring wells for water-borne contaminants and general ground-water chemistry.

5.2 PREPARATION

5.2.1 SITE BACKGROUND INFORMATION

A thorough understanding of the purposes of the sampling event shall be established prior to commencing field activities. A review of all available data obtained from the site and pertinent to the water sampling shall also be conducted. Available well history data to be reviewed shall include but not be limited to: well locations, sampling history, purging rates, turbidity problems, previously-used purging methods, well installation methods, well completion records, well development methods, previous analytical results, presence of an immiscible phase, historical water levels, and general hydrogeologic conditions.

Review of previous ground-water development and sampling logs can allow anticipation of well purging rates and types of problems that may be encountered during sampling, such as excessive turbidity and low well yield. They can also indicate where dedicated pumps are placed in the water column. The order of well purging and sampling, as well as water level measurement collection, shall generally be from least contaminated to most contaminated to help minimize the potential for cross-contamination and shall be established utilizing previous analytical results. This order may be changed in the field if conditions warrant, particularly if dedicated sampling equipment is used. A review of prior sampling procedures and results may also identify which purging and sampling techniques are appropriate for the parameters to be tested under a given set of field conditions.

5.2.2 GROUND-WATER ANALYSIS SELECTION

The types of field and laboratory analyses necessary to satisfy project requirements shall also be established prior to performing water sampling. This shall include identification of the types and numbers of quality assurance/quality control (QA/QC) samples that shall be collected (refer to Procedure FP-F-2, Field QC Samples). The type and volume of sample preservatives, adequate sample containers (e.g., coolers), and ice and/or other chilling materials shall also be established prior to performing water sampling. The sampling personnel shall use this information to ensure that an appropriate number of properly-sized sample containers are taken into the field. Additional sample containers shall be taken in case of breakage or unexpected field conditions. A written Analytical Plan shall be prepared prior to the sampling event and included in the project specific sampling and analysis plan.

5.3 GROUND-WATER SAMPLING PROCEDURES

Ground-water sampling procedures at a site shall generally consist of the following: 1) measurement of depth to ground water and well depth; 2) assessment of the presence/ absence of an immiscible phase; 3) calculation of the purge volume; 4) purging of static water within the well and well bore; and 5) obtaining a ground-water sample. These steps are presented within this document in the general order in which they shall be conducted in the field. Additional steps may be necessary, depending upon specific field conditions. A complete description of the methodologies to be utilized for each step of the sampling process is presented in the following paragraphs. In general, well sampling should not be conducted in conjunction with well development and at least 24 hours should separate the two events.

5.3.1 MEASUREMENT OF STATIC WATER LEVEL ELEVATION

The depth to standing water and the total depth of the well shall be obtained to provide baseline hydrologic data, to calculate the volume of water in the well, and to provide information on the integrity of the well (e.g., identification of siltation problems). The measurement shall be taken to the nearest 0.01 foot. Each well shall have a permanent, easily identified reference point for water level measurements whose location and elevation have been surveyed.

Before purging any well, water levels should be measured in all of the wells present at the site. Water levels should be measured twice in quick succession and each measurement recorded. This will provide a water level data base reflective of the water levels across the

site at one time (a synoptic sampling). A water table contour map can then be generated that reflects the water levels in all the wells at a given time. This will account for the possibility of water levels being affected by purging at adjacent wells, tidal effect, or the activation of onsite water supply wells. In addition, the water level in each well shall also be measured immediately prior to well purging.

The device used to measure the water level surface and depth of the well shall be sufficiently sensitive and accurate so that a measurement to the nearest 0.01 foot can be obtained reliably. An electronic water level meter will usually be appropriate for this measurement; however, when the ground water within a particular well is highly contaminated, an inexpensive weighted tape measure can be used to determine well depth to prevent adsorption of contaminants onto the meter tape. The presence of light, non-aqueous phase liquids (LNAPLS) and/or dense, non-aqueous phase liquids (DNAPLS) in a well requires measurement of the elevation of the top and the bottom of the product, generally using an interface probe. Water levels in such wells must then be corrected for density effects to accurately determine the elevation of the water table.

5.3.2 DECONTAMINATION OF EQUIPMENT

If needed due to the type and quantity of sampling equipment available, a decontamination station shall be established prior to commencement of sampling. The station shall consist of an area of at least 4 feet by 2 feet covered with plastic sheeting and be located upwind of the well being sampled. The station shall be large enough to fit the appropriate number of wash and rinse buckets, and have sufficient room to place equipment after decontamination. One central cleaning area may be used throughout the entire sampling event; however, wash and rinse fluids in buckets shall be changed following the sampling of each well. The area around the well being sampled shall also be covered with plastic sheeting to prevent spillage. Further details should be presented in the FSP for the site and in Procedure FP-D-5 (Equipment Decontamination).

Each piece of equipment shall be decontaminated prior to entering the well. Additionally, each piece of equipment used at the site shall be decontaminated prior to leaving the site. Dedicated sampling equipment need only be decontaminated prior to installation within the well. Clean sampling equipment shall not be placed directly on the ground or other contaminated surfaces prior to insertion into the well. Dedicated sampling equipment which has been certified by the manufacturer as being decontaminated can be placed in the well without onsite decontamination.

5.3.3 DETECTION OF IMMISCIBLE PHASE LAYERS

The following procedures for detecting the presence of light, non-aqueous phase liquids (LNAPL) and/or dense, non-aqueous phase liquids (DNAPL) shall be undertaken before the well is evacuated for conventional sampling:

1. Sample the headspace in the well head immediately after the well is opened for organic vapors using either a photoionization detector (PID) or an organic vapor analyzer (OVA), and record measurements;
2. Lower an interface probe or transparent bailer into the well to determine the existence of any immiscible layer(s), LNAPL and/or DNAPL, and record measurements;
3. If an interface probe is used, confirm the presence or absence of an immiscible phase by slowly lowering a bailer to the appropriate depth, then visually observing the results after sample recovery; and
4. In some cases, it may be necessary to utilize hydrocarbon- and water-sensitive paste for measurement of LNAPL thicknesses. This is accomplished by smearing adjacent, thin layers of both hydrocarbon- and water-sensitive pastes along a steel measuring tape and inserting the tape into the well. An engineering tape showing tenths and hundredths of feet is required. Depth to water, as shown by the mark on the water-sensitive paste, and depth to product, as shown by the mark on product-sensitive paste, shall be recorded. In wells where the approximate depth to water and product thickness are not known, it is best to apply both pastes to the tape over a fairly long interval (5 feet or more). Under these conditions, measurements are obtained by trial and error, and may require several insertions and retrievals of the tape before product and water are encountered by the paste covered interval of the tape. In wells where approximate depths of air-product and product-water interfaces are known, pastes may be applied over shorter intervals. Water depth measurements should not be used in preparation of water-table contour maps until they are corrected for depression by the product.

If the well contains an immiscible phase, it may be desirable to sample this phase separately. Immiscible phase sampling procedures are presented in Sections 5.3.5.1 and 5.3.5.2. It may also not be meaningful to conduct water sample analysis of water obtained from a well containing LNAPLs or DNAPLs. The Project Manager and AMEC Program Manager shall be consulted if this situation is encountered.

5.3.4 PURGING EQUIPMENT AND USE

The water present in a well prior to sampling may not be representative of in-situ ground-water quality and shall be removed prior to sampling. The evacuation procedure

shall ensure that all stagnant water is replaced by fresh formation water upon completion of purging.

Purging shall be accomplished by removing ground water from the well at low flow rates using a pump. According to the USEPA (1992), the rate at which ground water is removed from the well during purging ideally should be less than approximately 0.2 to 0.3 L/min. The USEPA further states that wells should be purged at rates below those used to develop the well to prevent further development of the well, to prevent damage to the well, and to avoid disturbing accumulated corrosion or reaction products in the well. The USEPA also indicates that wells should be purged at or below their recovery rate so that migration of water in the formation above the well screen does not occur.

Realistically, the purge rate should be low enough that substantial drawdown in the well does not occur during purging. A low purge rate also will reduce the possibility of stripping VOCs from the water, and will reduce the likelihood of mobilizing colloids in the subsurface that are immobile under natural flow conditions.

The sampler shall ensure that purging does not cause formation water to cascade down the sides of the well screen. Wells shall not be purged to dryness if recharge causes the formation water to cascade down the sides of the screen, as this will cause an accelerated loss of volatiles. This problem should be anticipated; water shall be purged from the well at a rate that does not cause recharge water to be excessively agitated unless an extremely slow recharging well is encountered where complete evacuation is unavoidable.

In high yield wells (wells that exhibit 80 percent recovery in less than 2 hours), purging shall be conducted at relatively low flow rates and shall remove water from the entire screened interval of the well to ensure that fresh water from the formation is present throughout the entire saturated interval. In general, the intake of the purge pump shall be placed 2 to 3 feet below the air-water interface within the well to allow purging and at the same time minimize disturbance/overdevelopment of the screened interval in the well. During the well purging procedure, water level and/or product level measurements shall be collected to assess the hydraulic effects of purging. The well can then be sampled when it recovers sufficiently to provide enough water for the analytical parameters specified.

For low yield wells (those that do not have 80 percent recovery in less than 2 hours), one borehole volume of water shall be removed. The well then shall be allowed to recover sufficiently to provide enough water for the specified analytical parameters, and sampled.

Water samples shall be collected on a regular basis during well evacuation and analyzed in the field preferably using in-line devices for temperature, pH, specific conductivity, and turbidity. At least 3 readings shall be taken during the purging process. These parameters

are measured to demonstrate that the natural character of the formation waters has been restored. Purging shall be considered complete when two or three consecutive field parameter measurements stabilize within approximately 10 percent. This criterion may not be applicable to temperature if a submersible pump is used during purging due to the heating of the water by the pump motor. All information obtained during the purging and sampling process shall be entered into a ground-water sampling log (Figure FP-D-3-1). All blanks on this field log shall be completed during field sampling.

In cases where an LNAPL has been detected in the monitoring well, a stilling tube of a minimum diameter of 2 inches shall be inserted into the well prior to well purging. The stilling tube shall be composed of a material that meets the performance guidelines for sampling devices. The stilling tube shall be inserted into the well to a depth that allows ground water from the screened interval to be purged and sampled, but that is below the upper portion of the screened interval where the LNAPL is entering the well screen. The goal is to sample the aqueous phase (ground water) while preventing the LNAPL from entering the sampling device. To achieve this goal, the stilling tube must be inserted into the well in a manner that prevents the LNAPL from entering the stilling tube. One method of doing this is to cover the end of the stilling tube with a membrane or material that will be ruptured by the weight of the pump. A piece of aluminum foil can be placed over the end of the stilling tube. The stilling tube is lowered slowly into the well to the appropriate depth and then attached firmly to the top of the well casing. When the pump is inserted, the weight of the pump breaks the foil covering the end of the tube, and the well can be purged and sampled from below the LNAPL layer. The membrane or material that is used to cover the end of the stilling tube must be fastened firmly so that it remains attached to the stilling tube when ruptured. Moreover, the membrane or material must retain its integrity after it is ruptured. Pieces of the membrane or material must not fall off of the stilling tube into the well. Although aluminum foil is mentioned in this discussion as an example of a material that can be used to cover the end of the tube, a more chemically inert material may be required, based on the site-specific situation. Stilling tubes shall be thoroughly decontaminated prior to each use.

Unless specifically required, well purge water will be disposed of at the ground surface sampling location, provided no water will discharge from the site. If required, ground water removed during purging shall be collected and stored onsite until its disposition is determined based upon laboratory analytical results. Storage shall be in secured containers such as DOT-approved drums. Containers of purge water shall be labeled with the standard AMEC IDW label.

The following paragraphs list available purging equipment and methods for their use.

BAILERS AND PUMPS

1. **Bailer:** Using a bailer to purge a well should generally be avoided because it can result in overdevelopment of the well and create excessive purge rates. If a bailer must be used, the bailer, bailer wire, and reel must be decontaminated as described in Section 5.3.2 prior to its use. Teflon®-coated cable mounted on a reel is recommended for lowering the bailer in and out of the well.

   The bailer shall be lowered below the water level of the well with as little disturbance of the water as possible to minimize aeration of the water in the well. One way to gauge the depth of water on the reel is to mark the depth to water on the bailer wire with a stainless steel clip. In this manner, less time is spent trying to identify the water level in the well. Use of bailers for well development shall be approved in advance by the AMEC Program Manager.

Figure FP-D-3-1

Well Sampling Data Form

Date_____ Client_____
Ogden _____ Site _____
Ogden Project _____ Ogden Field Team _____

Well Construction/Liquid Level

Well _____ Boring _____
Well Casing _____ Total _____
Annular Space (AS) _____ Depth to Bottom _____
Depth to Water _____ Column of Water in Well (DTB -

Purge Volume

Volume to be____
Gallons per Foot of AS (from = _____
Column of water or length x _____
Volume of Annular = _____
Gallons per Foot of Casing (from = _____
Column of x _____
Volume of = _____
Total Volume (Volume of AS + Volume of _____
Number of Volumes to be x _____
Total Volume to be = _____
Method of Purging (Pump, Bailer, _____

	Field Analysis				
Paramete	1	2	3	4	5
Tem					
pH					
Conductivi					
Dissolved					
Turbidit					

Sample _____ Sample _____
Total Volume _____gallon
Parameters to be _____
Description of Purge _____

Signature
Field Team _____ Date_____
Reviewe_____ Date_____

2. **Bladder Pump:** A stainless steel and/or Teflon® bladder pump can be utilized for purging and sampling wells up to 200 feet in depth for volatile, semivolatile, and non-volatile constituents. Additionally, the bladder pump can be utilized for purging and obtaining ground-water samples overlain by a LNAPL layer as long

as care is taken not to draw the product layer into the bladder pump. Use of the bladder pump is most effective in low to moderate yield wells where the pump can cause depression of the water table and allow significant inflow of fresh formation water.

The bladder pump can be operated by either compressed dry nitrogen or compressed dry air depending upon availability. Note that the driving gas utilized must be dry to avoid damage to the bladder pump control box. Decontamination of the bladder pump must be accomplished prior to use. Once purging is complete, the samples can also be collected directly from the bladder pump.

3. **Air Lift Pump:** Air lift pumps are not appropriate for purging or sampling.

4. **Submersible Pump:** A stainless steel submersible pump may also be utilized for the purging of both shallow and deep wells prior to sampling the ground water for volatile, semivolatile, and non-volatile constituents. For wells over 200 feet deep, the submersible pump is one of the few technologies available to feasibly accomplish purging under any yield conditions. For shallow wells with low yields, submersible pumps are generally inappropriate due to overpumpage of the wells, (<1 gallon per minute) which causes increased aeration of the water within the well.

   Prior to the placement of the pump in the well, the pump and drop pipe shall be steam cleaned or otherwise decontaminated. The submersible pump shall be equipped with an anti-backflow check valve to limit the amount of water that will flow back down the drop pipe into the well. The pump intake shall be placed approximately 2 to 3 feet below the air-water interface within the well and maintained in that position during purging. In addition, when the pump is being pulled out of the well subsequent to purging, care shall be taken to avoid dumping water within the drop pipe and pump stages back into the well.

5. **Centrifugal or Diaphragm Pump:** A centrifugal or diaphragm pump can also be utilized to purge a well if the water level is within 20 feet of ground surface. A new or properly decontaminated hose can be lowered into the well and water withdrawn at a rate that does not cause excessive well drawdown. The hose bottom shall be placed approximately 2 to 3 feet below the air-water interface and maintained in that position during purging.

5.3.5 MONITOR WELL SAMPLING METHODOLOGIES

5.3.5.1 SAMPLING LIGHT, NON-AQUEOUS PHASE LIQUIDS (LNAPL)

LNAPL, if present, must be collected prior to any purging activities. The sampling device shall generally consist of a dedicated or disposable bailer equipped with a bottom-discharging device. The bailer shall be lowered slowly until contact is made with the surface of the LNAPL, and lowered to a depth less than that of the immiscible fluid/water interface depth as determined by measurement with the interface probe. The bailer shall then be allowed to fill with the LNAPL and retrieved.

When sampling LNAPLs, bailers should never be dropped into a well and should be removed from the well in a manner that causes as little agitation of the sample as possible. For example, the bailer should not be removed in a jerky fashion or be allowed to continually bang against the well casing as it is raised. When using bailers to collect LNAPL samples for inorganic analyses, the bailer shall be composed of fluorocarbon resin. Bailers used to collect LNAPL samples for organic analyses shall be constructed of stainless steel. The cable used to raise and lower the bailer shall be composed of an inert material (e.g., stainless steel) or coasted with an inert material (e.g., PTFE).

5.3.5.2 SAMPLING DENSE, NON-AQUEOUS PHASE LIQUIDS (DNAPL)

DNAPL shall also be collected prior to any purging activities. The best method for collecting DNAPL is to use a double check valve, stainless steel bailer, or a Kemmerer (discrete interval) sampler. The sample shall be collected by slow, controlled lowering of the bailer to the bottom of the well, activation of the closing device, and retrieval.

5.3.5.3 GROUND-WATER SAMPLING METHODOLOGY

The well shall be sampled after it has recovered sufficiently to provide enough volume for the ground-water sampling parameters. A time period of no more than 2 hours shall elapse between purging and sampling to prevent ground water interaction with the casing and atmosphere. This may not be possible with a slow recharging well. A water level shall be measured and recorded prior to sampling to demonstrate the degree of recovery of the well. Sampling equipment (e.g., especially bailers) shall never be dropped into the well, because this could cause aeration of the water upon impact. In addition, the sampling methodology utilized shall allow for the collection of a ground-water sample in as undisturbed a condition as possible, minimizing the potential for volatilization or aeration. This includes minimizing agitation and aeration during transfer to sample containers.

Sampling equipment shall be constructed of inert material. Equipment with neoprene fittings, PVC bailers, tygon tubing, silicon rubber bladders, neoprene impellers, polyethylene, and viton is not acceptable. If bailers are used, an inert cable/chain (e.g., fluorocarbon resin-coated wire or single strand stainless steel wire) shall be used to raise and lower the bailer. Generally, bladder and submersible pumps are acceptable sampling devices for all analytical parameters. The following text describes sampling methods utilizing bailers, bladder pumps, and submersible pumps.

1. **Bailers:** A single- or double-check valve Teflon® or stainless steel bailer equipped with a bottom discharging device can be utilized to collect ground-water samples. Bailers have a number of disadvantages, however, including a tendency to alter the chemistry of ground-water samples due to degassing, volatilization, and aeration; the possibility of creating high ground-water entrance velocities; differences in operator techniques resulting in variable samples; and difficulty in determining where in the water column the sample was collected. Bailers therefore shall be used for ground-water sampling only when other types of sampling devices cannot be utilized for technical or logistical reasons. The use of bailers for sampling shall be approved in advance by the AMEC Program Manager.

   The bailer shall be thoroughly decontaminated before being lowered into the well if they are not disposable bailers sealed in plastic. Two to three rinse samples shall be collected and discharged prior to acquisition of the actual sample. Each time the bailer is lowered to the water table, it shall be lowered in such a way as to minimize disturbance and aeration of the water column within the well.

   A preferred alternative when using bailers for sampling is to use disposable Teflon® bailers equipped with bottom-discharging devices. Use of disposable bailers reduces decontamination time and limits the potential for cross-contamination.

2. **Bladder Pump:** A gas-operated Teflon® or stainless steel bladder pump with adjustable flow control can be effectively utilized to collect a ground-water sample and is considered to be the best overall device for sampling inorganic and organic constituents. Positive gas displacement bladder pumps shall be operated in a continuous manner so that they minimize discharge pulsation that can aerate samples in the return tube or upon discharge. If a bladder pump is utilized for the well purging process, the same bladder pump can also be utilized for sample collection after purging is complete.

The pumping rate of the bladder pump shall be lowered prior to sample collection. When collecting samples using a bladder pump, where volatile constituents or gases are of interest, pumping rates shall not exceed 100 to 300 ml/minute. Higher rates can increase the loss of volatile constituents and can cause fluctuation in pH and pH-sensitive analytes. The pump shall be operated at this low flow rate for several minutes to ensure that ground water being sampled was withdrawn at the low extraction rate. Once the portions of the sample for the analysis of volatile components have been collected, a higher pumping rate may be used, particularly if a large sample volume must be collected. The sampling flow rate shall not exceed the flow rate used while purging.

3. **Submersible Pumps:** Submersible pumps when operated under low-flow rate conditions (100 to 300 ml/minute or less) are as effective as bladder pumps in acquiring samples for volatile organic analysis as well as other analytes. The submersible pump must be specifically designed for ground-water sampling (i.e., pump composed of stainless steel and PTFE, sample discharge lines composed of PTFE) and must have a controller mechanism allowing flow of the required low flow rate. The pump rate must be adjusted so that flow is continuous and does not pulsate to avoid aeration and agitation within the sample discharge lines. The pump shall be run for several minutes at the low flow rate used for sampling to ensure that the ground water in the lines was obtained at the low flow rate. Higher pumping rates than 100 to 300 ml/minute may be used when collecting samples to be analyzed for non-volatile constituents.

4. **Dedicated Bladder Pumps:** A gas operated compressor with a control box (allowing adjustments of flow) can be effectively used in conjunction with Teflon® lined polyethylene tubing connected to a submerged, stainless steel bladder pump.

   Before the compressor is started, several precautions must be taken. First, position the gas operated compressor downwind of the well cap. Second, ground the engine block. This can be done by connecting a wire (with clips on either end) to the engine and to a stake that has been hammered into the ground. Third, make sure the purge water exiting the well is collected into a drum or bucket. Finally, connect the red compression hose from the well cap to the control box. Do not connect the compression hose from the compressor to the control box until after the engine has been started.

   When all precautions are completed and the engine has been started, connect the block compression hose to the control box. Slowly adjust the control knobs so as

to discharge water in the shortest amount of time but maintaining a near constant flow. This does not suggest that the compressor must be set so as to discharge the water as hard as possible. The optimal setting is one that produces the largest volume of purge water per minute (not per purge cycle) while maintaining a near consistent flow rate.

Prior to sampling, the flow rate (purge rate) must be adjusted so as to yield 100 milliliter (ml) 1 minute or less, but avoid settings that produce pulsating streams of water instead of steady stream. The flow rate of 100 ml/minute must be obtained so as not to cause fluctuation in pH, pH-sensitive analytes, and the loss of volatile constituents. Higher flow rates can be used once the samples for the analysis of volatile components have been collected. At no time shall the sample flow rate exceed the flow rate used while purging.

For those samples requiring filtration, it is recommended that an in-line high capacity filter be used after all nonfiltered samples have been collected.

5.3.6 SAMPLE HANDLING AND PRESERVATION

Many of the chemical constituents and physiochemical parameters that are to be measured or evaluated during ground-water monitoring programs are not chemically stable, and therefore sample preservation is required. *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods (SW-846),* published by the U.S. Environmental Protection Agency, includes a discussion of appropriate sample preservation procedures. In addition, SW-846 specifies the sample containers that shall be used for each constituent or common set of parameters. In general, check with specific laboratory requirements prior to obtaining field samples. In many cases, the laboratory will supply the necessary sample bottles and required preservatives.

Improper sample handling may alter the analytical results of the sample. Therefore, samples shall be transferred in the field from the sampling equipment directly into the container that has been specifically prepared for that analysis or set of compatible parameters (see Table FP-D-3-1). It is not an acceptable practice for samples to be composited in a common container in the field and then split in the laboratory, or poured first into a wide mouth container and then transferred into smaller containers.

Ground-water samples shall generally be collected and placed in their proper containers in the order of decreasing volatility and increasing stability. A preferred collection order for some common ground-water parameters is:

- Volatile organic constituents (VOCs) and total organic halogens (TOX);
- Dissolved gases, total organic carbon (TOC), total fuel hydrocarbons;
- Semivolatile organics, pesticides;
- Total metals, general minerals (unfiltered);
- Dissolved metals, general minerals (filtered);
- Phenols;
- Cyanide;
- Sulfate and chloride;
- Turbidity;
- Nitrate and ammonia; and
- Radionuclides.

When sampling for VOCs, water samples shall be collected in vials or containers specifically designed to prevent loss of VOCs from the sample. These vials shall be provided by an analytical laboratory, preferably by the laboratory which will perform the analysis. Ground water from the sampling device shall be collected in vials by allowing the ground water to slowly flow along the sides of the vial. Sampling equipment shall not touch the interior of the vial. The vial shall be filled above the top of the vial to form a positive meniscus with no overflow. No headspace shall be present in the sample container once the container has been capped. This can be checked by inverting the bottle once the sample is collected and tapping the side of the vial to dislodge air bubbles. Sometimes it is not possible to collect a sample without air bubbles, particularly water that is aerated. In these cases, the investigator shall note the problem to account for possible error. Cooling samples may also produce headspace, but this will typically disappear once the sample is warmed prior to analysis. In addition, if the samples are shipped by air, air bubbles form most of the time. Field logs and laboratory analysis reports shall note any headspace in the sample container(s) at the time of receipt by the laboratory, as well as at the time the sample was first transferred to the sample container at the wellhead.

Table FP-D-3-1
RECOMMENDED SAMPLE SIZE, CONTAINER TYPE, PRESERVATIVE, AND HOLDING TIME REQUIREMENTS FOR ORGANIC AND INORGANIC PARAMETERS[1]

Analysis	Method #[1]	Minimum Sample Size[3]	Container*	Preservative[2]	Holding Time
Inorganic Parameters					
Acidity	305.1	100 ml	P,G	Cool, 4	14 days
Alkalinity	310.1, .2	50 ml	P,G	Cool, 4	14 days
Ammonia	350.1, .2, .3	15 ml	P,G	Cool, 4 to pH< 2	28 days
pH	9040, 9041, 150.1, .2	25 ml	P,G	None	14 days
pH	9045	25 grams	P,G	None	
Bromide	320.1	50 ml	P,G	None	28 days
Boron		100 ml	P	None	28 days
Chloride	9250, 9251, 9252, 325.1,.2,.3	50 ml	P,G	None	28 days
Cyanide, total and amenable to chlorination	9010, 9012, 335.1, .2, .3	100 ml	P,G	Cool, 4 NaOH to pH> 12 and 0.6 g ascorbic Dark storage	14 days
Color	110.1, .3	50 ml	P,G	None	48 hrs
Fluoride	340.1, .2, .3	100 ml	P	None	28 days
Iodide	345.1	300 ml	P,G	Cool, 4 to pH< 2	24 hrs
Iodine		500 ml	P,G	Determine onsite	None
NH3-N	353.1, .2, .3	25 ml	G	Cool, 4 to pH< 2	28 days
Total Kjeldahl Nitrogen (TKN)	351.1, .2, .3, .4	100 ml	P,G	Cool, 4 to pH< 2	28 days
Nitrate and Nitrite	353.1, .2, .3	50 ml	P,G	Cool, 4 to pH< 2	28 days
Nitrate only	9200, 325.1	50 ml	P,G	Cool, 4	48 hrs
Nitrite only	354.1	50 ml	P,G	Cool, 4	48 hrs
Phosphorus, elemental		100 ml	G	Cool, 4 to pH< 2	48 hrs
Phosphorus, total as phosphate	365.4	100 ml	P,G	Cool, 4 to pH< 2	28 days
Orthophosphate	365.1, .2, .3	100 ml	P,G	Filter immediately Cool, 4	48 hrs
Phenolics	9065, 9066, 9067	100 ml	G	Cool, 4 to pH< 2	28 days
Silica	370.1	50 ml	P	Cool, 4	28 days
Solids (residue)		100 ml	G	None	7 days

Table FP-D-3-1(continued)
RECOMMENDED SAMPLE SIZE, CONTAINER TYPE, PRESERVATIVE, AND HOLDING TIME REQUIREMENTS FOR ORGANIC AND INORGANIC PARAMETERS[1]

Analysis	Method #[1]	Minimum Sample Size[3]	Container*	Preservative[2]	Holding Time
Total Dissolved (TDS)					
Total Suspended (TSS)					
Total Volatile (TVS)					
Sulfate	9035, 9036, 9038, 375.1, .2, .3, .4	50 ml	P,G	Cool, 4	28 days
Sulfide	9030, 376.1, .2	100 ml	P,G	Cool, 4 4 drops 2N ZN acetate/100 ml and NaOH to pH> 9	7 days
Sulfite	377.1	50 ml	P,G	Determine on site	None
Metals -dissolved	6010, 7000	500 ml	P,G	Filter onsite, HNO3 to pH< 2	6 mos.
Metals - total	6010, 7000	500 mg	P,G rinsed with HNO	HNO3 to pH< 2	6 mos.
Mercury dissolved		100 ml	P,G rinsed with HNO	Filter onsite, HNO3 to pH< 2	28 days in glass/14 days in plastic
Mercury total		100 ml	P,G	Cool, 4 to pH< 2	same as above
Oil & Grease	9070, 9071, 413.1, .2	200 ml	G, wide mouth	Cool, 4 to pH< 2	28 days
Total Organic Halide (TOX)	9020, 9022	100 ml	G with Teflon septum	H2SO4 or HCl to pH< 2	28 days
Total Organic Carbon (TOC)	9060, 415.1, .2	100 ml	G with Teflon septum	Cool, 4 to pH< 2	7 days
Biological Oxygen Demand (BOD)	405.1	500 ml	P,G	Cool, 4	48 hrs
Chemical Oxygen Demand (COD)	410.1, .4	50 ml	P,G	Cool, 4 to pH< 2	28 days
Hardness	130.1, .2	25 ml	P,G	HNO3 or H2SO4 to pH< 2	6 mos.
Electrical Conductivity	9050	50 ml	P,G	Cool, 4	28 days
Specific Gravity		100 ml	G	Cool, 4	28 days
Flash Point		100 ml	G	Cool, 4	28 days
Turbidity		10 ml	P,G	Store in dark	48 hrs
Surfactants (MBAS)	425.1	250 ml	P,G	None	48 hrs
Chromium, hexavalent	7195, 7196, 7197, 7198	300 ml	P,G rinse with HNO	Cool, 4	24 hrs

Table FP-D-3-1(continued)
RECOMMENDED SAMPLE SIZE, CONTAINER TYPE, PRESERVATIVE, AND HOLDING TIME REQUIREMENTS FOR ORGANIC AND INORGANIC PARAMETERS[1]

Analysis	Method #[1]	Minimum Sample Size[3]	Container*	Preservative[2]	Holding Time
Quaternary Amines		25 ml	G	Cool, 4	30 days
Volatile Organic Compounds					
VOC (CLP)	OLMO1.8	40 ml in duplicate	G with Teflon lined septum	Cool, 4	14 days
Liquid matrix	8010, 8020, 8240, 603, 624, 8015/5030	40 ml in duplicate	G with Teflon lined septum	Cool, 4	(14 days with HCL)
Semi-VolatileOrganic Compounds					
Liquid matrix	8040, 8060, 8080, 8140, 8150, 8015/3550, 611, 612, 617, 619, 622, 625, 630, 632, 8270 (SW846/EPA 600)	1.0 liter/500 grams	G with Teflon lined cap	Cool, 4	7 days until extraction; 40 days after extraction
609 610		1.0 liter	G with Teflon lined cap	Cool, 4 dark	7 days until extraction; 40 days after extraction
Dioxins	8280, 8290	1.0 liter	G with Teflon lined cap	Cool, 4 dark	15 days until extraction; 15 days after extraction
Dioxins	8280, 8290	500 grams	G with Teflon lined cap	Cool, 4 dark	30 days until extraction; 15 days after extraction

1 Reference: CLP SOW (3/90), SW-846 September 1986 Revision, and EPA 600
2 All liquid samples require preservation with 0.008 percent Na2S2O3 if residual chlorine is
3 Depends on laboratory requirements and distance from field site to laboratory. If it will be
* Containers: G = Glass
P = Polyethylene or polypropylene plastic

Special Handling Considerations

Samples requiring analysis for organics shall not be filtered. Samples shall not be transferred from one container to another as losses of organic material onto the walls of the container or aeration could occur. Total organic halogens (TOX) and total organic carbon (TOC) samples shall be handled and analyzed in the same manner as VOC samples.

If required, ground-water samples to be analyzed for metals shall be split into two portions. One portion shall be filtered through a 0.45-micron membrane filter, transferred to a container, preserved with nitric acid to a pH less than 2 (see Table FP-D-3-1), and analyzed for dissolved metals. Remember to include a filter blank for each lot of filters used and always record the lot number of the filters. In addition, allow at least 500 ml of effluent to flow through the filter prior to sampling. The remaining portion shall be transferred to a container, preserved with nitric acid, and analyzed for total metals. Any difference in concentration between the total and dissolved fractions may be attributed to the original metallic ion content of the particles and adsorption of ions onto the particles.

5.3.6.1 FIELD SAMPLING PRESERVATION

Preservation of samples should take place immediately upon collection of samples. Ideally, containers have preservatives of known concentration and volume present within the container during the initial filling of the container to a predetermined final sample volume. For example, metals require storage in aqueous media at pH of 2 or less. Typically, 0.5 ml of 1:1 nitric acid added to 500 ml of ground water will produce a pH less than 2.0. Certain matrices that have alkaline pH (greater than 7) may require more preservative than is typically required. An initial assessment of preservation techniques, such as the use of pH strips after initial preservation, may therefore be appropriate. It should be noted that introduction of preservatives will dilute samples, and may require normalization of results. Guidance for the preservation of environmental samples can be found in the EPA "Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA 1982). Additional guidance can be found in other EPA documents (EPA 1986a, EPA 1986b).

5.3.6.2 FIELD SAMPLING LOG

A ground-water sampling log (Figure FP-D-3-1) shall be maintained that documents the following:

- Identification of well;
- Well depth;

- Static water level depth and measurement technique;
- Presence of immiscible layers and detection method;
- Well yield;
- Purge volume and pumping rate;
- Time that the well was purged;
- Collection method for immiscible layers;
- Sample identification numbers;
- Well evacuation procedure/equipment;
- Sample withdrawal procedure/equipment;
- Date and time of collection;
- Well sampling sequence;
- Types of sample containers used and sample identification numbers;
- Preservative(s) used;
- Parameters requested for analysis;
- Field analysis data;
- Sample distribution and transporter;
- Field observations on sampling event;
- Name of collector; and
- Climatic conditions including air temperature.

6.0 RECORDS

Information collected during ground-water sampling should be documented on the ground-water sampling log form in indelible ink. Copies of this information shall be sent to the Project Manager and to the project files.

7.0 HEALTH AND SAFETY

Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. The site-specific Health and Safety Plan (HSP) should be reviewed with specific emphasis placed on the control measures planned for the well sampling tasks. Preliminary area monitoring of sampling wells should be conducted to determine the potential hazard to sampling personnel. If significant

contamination is observed, contact with potential contaminants in both vapor phase and liquid matrix shall be minimized through the use of respirators and disposable clothing.

Depending upon the type of contaminant expected or determined in previous sampling efforts, the following safe work practices will be employed:

Particulate or Metal Compounds:

1. Avoid skin contact with and/or incidental ingestion of purge water.
2. Utilize long sleeve protective gloves and splash protection (i.e. Saranex or splash suits and face shields) as warranted.

Volatile Organic Compounds:

1. Avoid breathing constituents venting from the well by approaching upwind, and/or by use of respiratory protection.
2. Presurvey the well head-space with a FID/PID prior to sampling.
3. If monitoring results indicate organic vapors that exceed action levels as specified in the HSP, sampling activities may need to be conducted in Level C protection. At a minimum, skin protection will be required by use of Tyvek or other media that is protective against the media being encountered.

Physical Hazards Associated With Well Sampling:

1. To avoid lifting injuries associated with pump and bailers retrieval, use large muscles of the legs, not the back.
2. Stay clear of all moving equipment and avoid wearing loose fitting clothing.
3. When using pocket knives for cutting purposes, cut away from self.
4. To avoid slip/trip/fall (wet) conditions as a result of pump discharge, use textured boots/boot cover bottoms.
5. To avoid heat/cold stress as a result of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1-2 cups/hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.
6. Be aware of restricted mobility due to the wearing of PPE.

In addition, standard health and safety practices should be observed according to the site-specific HSP. Suggested minimum protection during well sampling activities shall include inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an ANSI-Standard hard hat. Half-face respirators and cartridges and Tyvek suits may be necessary depending on the contaminant concentrations and shall always be available onsite.

8.0 REFERENCES

EPA. 1982. Handbook for Sampling and Sample Preservation of Water and Wastewater. EPA-600/4-82-029. September 1982.

NJDEP. 1986. Field Sampling Procedures Manual. New Jersey Department of Environmental Protection.

USEPA. 1986a. RCRA Ground Water Monitoring Technical Enforcement Guidance Document.

USEPA. 1986b. Test Methods for Evaluating Solid Waste–Physical/Chemical Methods (SW-846). November 1986.

USEPA. 1992. RCRA Ground-water Monitoring: Draft Technical Guidance.

U.S. EPA Environmental Response Team. 1988. Response Engineering and Analytical Contract Standard Operating Procedures. U.S. EPA, Research Triangle Park, NC.

9.0 ATTACHMENTS

None.

EQUIPMENT DECONTAMINATION

1.0 PURPOSE

The purpose of this procedure is to provide standard equipment decontamination methods for use during site activities at AMEC Program sites.

2.0 SCOPE

These procedures shall be employed where applicable during decontamination of field equipment used for sampling environmental media.

This procedure has been developed to serve as management-approved professional guidance for the AMEC Program. As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment to accommodate unforeseen circumstances. Deviation from this procedure in planning or in the execution of planned activities must be approved by the Project Manager and AMEC Program Manager.

3.0 DEFINITIONS

None.

4.0 RESPONSIBILITIES

The Field Program Manager is responsible for ensuring that all field equipment is decontaminated according to this procedure.

The Project Manager is responsible for identifying instances of non-compliance with this procedure and ensuring that decontamination activities are in compliance with this procedure.

The AMEC Program Manager is responsible for ensuring that decontamination activities conducted during all projects are in compliance with this procedure.

5.0 PROCEDURES

Decontamination of ground-water monitoring well drilling and developing equipment, as well as ground-water, surface water, sediment, waste, wipe, asbestos, and unsaturated zone sampling equipment is necessary to prevent cross-contamination, and to maintain the highest integrity possible in collected samples. Planning a decontamination program requires consideration of the following:

- The location where the decontamination procedures will be conducted;
- The types of equipment requiring decontamination;
- The frequency of equipment decontamination;
- The cleaning technique and types of cleaning solutions;
- The method for containing the residual contaminants and wash water from the decontamination process; and
- The use of a quality control measure to determine the effectiveness of the decontamination procedure.

This subsection describes standards for decontamination. The techniques to be used, frequency of decontamination, cleaning solutions, and effectiveness are among the standards presented.

5.1 DECONTAMINATION AREA

An appropriate location for the decontamination area at a site shall be selected based on the ability to control access to the area, control residual material removed from equipment, store clean equipment, and access to the area being investigated. The decontamination area shall be located at an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean equipment. Once equipment is cleaned, it shall be stored sufficiently far enough away from the potential contamination sources and the decontamination area to ensure that the equipment remains clean.

5.2 TYPES OF EQUIPMENT

Decontamination of drilling equipment includes drill bits, auger sections, drill-string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, and steel cable. Decontamination of monitoring well development and ground-water sampling equipment includes submersible pumps, bailers, interface probes, water level meters, bladder pumps, air lift pumps, peristaltic pumps, and lysimeters. Other sampling equipment that requires decontamination includes, but is not limited to, hand trowels, shovels, stainless steel

spoons and bowls, soil sample liners, wipe sampling templates, COLIWASA samplers, and dippers. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and shall be properly disposed after one use.

5.3 FREQUENCY OF EQUIPMENT DECONTAMINATION

Down-hole drilling equipment and monitoring well development and purging equipment shall be decontaminated prior to initial use and between each borehole or well. However, down-hole drilling equipment may require more frequent cleaning to prevent cross-contamination between vertical zones within a single borehole. Where drilling through a shallow contaminated zone and installing a surface casing to seal-off the contaminated zone, the drilling tools shall be decontaminated prior to drilling deeper. Ground-water sampling shall be initiated by sampling in the location where the least contamination is suspected. All ground-water, surface water, and unsaturated zone sampling devices shall be decontaminated prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

5.4 CLEANING SOLUTIONS AND TECHNIQUES

Decontamination can be accomplished using a variety of techniques and fluids. The preferred method of decontamination of major equipment such as augers, drill string, pump drop-pipe, submersible pumps, etc., involves the use of steam cleaning. Steam cleaning is accomplished using a portable, high pressure steam cleaner equipped with a pressure hose and fittings. For this method, equipment shall be thoroughly steam washed and rinsed with water of known chemical quality to remove particulates and contaminants.

A rinse decontamination procedure is acceptable for equipment such as bailers, water level meters, re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following: 1) wash with a non-phosphate detergent (alconox, liquinox, or other suitable detergent) and potable water solution, 2) rinse in a bath with potable water, 3) spray with isopropyl alcohol (aqueous sampling devices for organic samples only), and 4) rinse with deionized or distilled water. If possible, equipment shall be disassembled prior to cleaning. A second wash should be added at the beginning of the process if very soiled equipment is present.

Submersible pumps require additional effort to properly decontaminate because internal surfaces become contaminated during usage. These pumps shall be decontaminated by washing and rinsing the outside surfaces using the procedure described for small

equipment or by steam cleaning. The internal surfaces shall be decontaminated by recirculating fluids through the pump while it is operating. This recirculation can be done using several large diameter pipes (4-inch or greater) equipped with bottom caps. These pipes shall be filled with the decontamination fluids, the pump placed within the closed pipes, and the pump operated while recirculating the fluids. The decontamination sequence shall include 1) detergent and potable water wash, 2) potable water rinse, 3) isopropyl spray into the pump, and 4) potable water rinse. The decontamination fluids shall be changed after each decontamination cycle.

Solvents other than isopropyl alcohol may be used, depending upon the contaminants involved. For example, if polychlorinated biphenyls (PCBs) or chlorinated pesticides are contaminants of concern, hexane may be used as the decontamination solvent. However, if samples are also to be analyzed for volatile organics, hexane shall not be used. In addition, some decontamination solvents have health effects which must be considered. Decontamination solvents to be used during field activities will be specified in Project Work Plans or Quality Assurance Project Plans (QAPPs).

Equipment for measuring field parameters such as pH, temperature, specific conductivity, and turbidity shall be rinsed with deionized or distilled water after each measurement.

5.5 CONTAINMENT OF RESIDUAL CONTAMINANTS AND CLEANING SOLUTIONS

Unless required otherwise, site decontamination water will be disposed of on the ground surface at the sampling location provided the water will not discharge from the site.

When contaminated material and cleaning fluids must be contained from heavy equipment such as drill rigs and support vehicles, the area must be properly floored, preferably with a concrete pad which is sloped toward a sump pit. If a concrete pad is impractical, planking can be used to construct a solid flooring that is then covered by a nonporous surface and sloped toward a collection sump. If the decontamination area does not have a collection sump, plastic sheeting and blocks or other objects should be used to create a bermed area for collection of equipment decontamination water. Items such as auger flights that can be placed on stands, saw horses, or other similar equipment, should be situated on this equipment during decontamination to prevent contact with fluids generated by previous equipment decontamination. Clean equipment should also be stored in a separate location than the decontamination area to prevent recontamination. Decontamination fluids contained within the bermed area shall be collected and stored in secured containers as described below.

Catchment of fluids from the decontamination of lighter-weight drilling equipment and hand-held sampling devices shall be accomplished using wash buckets or tubs. The

decontamination fluids shall be collected and stored onsite until its disposition is determined based upon laboratory analytical results. Storage shall be in secured containers such as DOT-approved drums. Containers shall be labeled in accordance with FP-B-8.

5.6 EFFECTIVENESS OF DECONTAMINATION PROCEDURES

A decontamination program needs to incorporate quality control measures for determining the effectiveness of the cleaning methods. Quality control measures typically include collection of equipment rinsate samples or wipe testing. Equipment rinsates consist of analyte-free water which has been poured over or through the sample collection equipment after its final decontamination rinse. Wipe testing is performed by wiping a cloth over the surface of the equipment after cleaning. Further descriptions of these samples and their required frequency of collection is provided in the field procedure entitled Field QC Samples (Water, Soil). These quality control measures provide "after-the fact" information that may be useful to determine whether or not the cleaning methods were effective in removing the contaminants of concern.

6.0 RECORDS

Records shall be maintained as required by implementing procedures.

7.0 HEALTH AND SAFETY

Section 10 of the AMEC Health and Safety Management Plan, provides decontamination (decon) guidelines primarily for personnel. There is however, some information on equipment decon in this section also. It is the responsibility of the Onsite Health and Safety Coordinator (OHSC) to set up the site zones (i.e., exclusion, transition, and clean) and decon areas. Generally the decon area is located within the transition zone, upwind of intrusive activities, and serves as the area where both personnel and equipment are washed to minimize the spread of contamination into the clean zone. For equipment, a series of buckets within a visqueen-lined bermed area is set up for decon purposes. In addition, separate spray bottles containing isopropyl alcohol and distilled water are available for final rinsing of equipment. Depending on the nature of hazards and the site location, decontamination of heavy equipment such as, augers, pump drop pipe, and vehicles may be accomplished using a variety of techniques. Guidelines for equipment selection, cleaning solutions and decontamination techniques are provided in Section 10.6 of the AMEC Health and Safety Management Plan.

Personnel responsible for equipment decon, must wear the PPE specified in the site-specific Health and Safety Plan (HSP). Generally this includes at a minimum: Tyvek

coveralls, steel-toed boots with boot covers or steel-toed rubber boots, safety glasses, ANSI-Standard hard hats, and hearing protection (if heavy equipment is in operation). It should also be noted that air monitoring by the OHSC as required in Section 6 of the AMEC Health and Safety Management Plan may warrant an upgrade to the use of half-face respirators and cartridges in the decon area; therefore, this equipment must be available onsite. If safe alternatives are not achievable, site activities will be discontinued immediately.

In addition to the aforementioned precautions, the following safe work practices will be employed:

Chemical Hazards Associated With Equipment Decontamination:

1. Avoid skin contact with and/or incidental ingestion of decon solutions and water.
2. Utilize PPE as specified in the site-specific HSP to maximize splash protection.
3. Refer to MSDSs, safety personnel, and/or consult sampling personnel regarding appropriate safety measures (i.e., handling, PPE - skin, respiratory, etc.).
4. Take necessary precautions when handling detergents and reagents.

Physical Hazards Associated With Equipment Decontamination:

1. To avoid possible back strain, it is recommended that the decon area be raised 1-2 feet above ground level.
2. To avoid heat stress, over exertion, and exhaustion, it is a recommended AMEC health and safety policy that equipment decon be rotated among **all** AMEC site personnel.
3. Take necessary precautions when handling field sampling equipment.

8.0 REFERENCES

U.S. EPA Environmental Response Team. 1988. Response Engineering and Analytical Contract Standard Operating Procedures. U.S. EPA, Research Triangle Park, NC.

9.0 ATTACHMENTS

None.

LOGBOOKS

1.0 PURPOSE

This procedure describes the activities and responsibilities of the AMEC Program organization pertaining to the identification, use, and control of logbooks and associated field data records.

2.0 SCOPE

This document applies to all AMEC personnel involved with the use and control of logbooks and associated records pertaining to quality-related activities.

This procedure has been developed to serve as management-approved professional guidance for the AMEC Program. As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment to accommodate unforeseen circumstances. Deviation from this procedure in planning or in the execution of planned activities must be approved by management personnel and documented.

3.0 DEFINITIONS

3.1 LOGBOOK

A bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the affected activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 DATA FORM

A predetermined format utilized for recording field data that may become, by reference, a part of the logbook.

4.0 RESPONSIBILITIES

The Project Manager is responsible for determining which team members shall record information in field logbooks and for obtaining and maintaining control of the required logbooks.

The logbook user is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The logbook user is also responsible for safeguard of the logbook while having custody of it.

The QA Program Manager or a designee is responsible for reviewing logbook entries to determine compliance with this procedure and to ensure that the entries are adequate to meet the project requirements.

5.0 PROCEDURE

The field logbook serves as the primary record of field activities. Entries shall be made chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events.

Individual data sheets may be generated to provide systematic data collection. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data sheets shall reference the applicable logbook and page number.

All field descriptions and observations are entered into the logbook, as described in Attachment 1.

Typical information to be entered includes, but is not limited to, the following:

- Field work documentation;
- Field instrumentation readings;
- Personnel present;
- Photograph references;
- Sample tag or label numbers;
- Field descriptions, equipment used, and field activities accomplished to reconstruct field operations;
- Meeting information;

- Important times and dates of telephone conversations, correspondence, or deliverables;
- Field calculations;
- Calibration records;
- Subcontractors present;
- Weather conditions;
- Date and time of all onsite activities;
- Site location and description.

Entry errors are corrected by drawing a single line through the incorrect entry, initialing and dating, and entering an explanation for the correction.

Each entry or group of entries shall be signed by the person making the entry at least at the end of each day or whenever the logbook is returned to Project Office, whichever is sooner.

Field notes may be transcribed onto clean information sheets for purposes such as database entry. Any such transcription shall be independently reviewed for accuracy by an individual designated by the Project Manager.

6.0 RECORDS

The field logbook shall be retained as a permanent project record.

7.0 REFERENCES

AMEC Program, Quality Assurance Management Plan.

8.0 ATTACHMENTS

1. Description of Logbook Entries

ATTACHMENT 1
DESCRIPTION OF LOGBOOK ENTRIES

Logbook entries shall contain the following information, as applicable, for each activity recorded.

Name of Activity

e.g., Asbestos Bulk Sample, Charcoal Canister Sampling.

Task Team Members and Equipment

Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information.

Activity Location

Indicate location of sampling area as indicated in the Field Sampling Plan.

Weather

Indicate general weather and precipitation conditions.

Methods

Indicate method or procedure number employed for the activity.

Sample Numbers

Indicate the unique numbers associated with the physical samples. Identify QC samples.

Sample Type and Volume

Indicate the media, container type, preservative, and the volume for each sample.

Time and Date

Record the time and date when the activity was performed (e.g., 0830/08/OCT/89). Utilize the 24-hour clock for recording the time and two digits for recording the day of the month and the year.

Analyses

Indicate the appropriate code for analyses to be performed on each sample, as specified in the Field Sampling Plan.

Field Measurements

Indicate measurements and field instrument readings taken during the activity.

Chain-of-Custody and Distribution

Indicate chain-of-custody for each sample collected and indicate to whom samples are transferred and the destination.

References

If appropriate, indicate references to drawings or photographs employed in the activity.

Narrative (including time and location)

Create a factual, chronological record of the team's activities throughout the day, including the time and location of each activity. Include descriptions of any general problems encountered and their resolution. Provide the names and affiliations of non-field team personnel who visit the site, request changes in activity, impact the work schedule, request information, or observe team activities. Record any visual or other observations relevant to the activity, the contamination source, or the sample itself.

It should be emphasized that logbook entries are for data recording and chronologies of events. As a part of this, the logbook author must include observations and descriptive notations, taking care to be objective and recording no opinions or subjective comments.

Recorded by

Include the signature of the individual responsible for the entries contained in the logbook and referenced forms.

Checked by

Include the signature of the individual who performs the review of the completed entries.

APPENDIX C

HEALTH AND SAFETY PLAN

AMEC Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive, Suite 100
Durham, North Carolina 27703

Tel: (919) 381-9900
Fax: (919) 381-9901

www.amec.com

AMEC Environment & Infrastructure, Inc.

Health & Safety Plan for

Alcatel Sourcing USA, LP
Soil Sampling and Excavation

Former Alcatel Facility
2912 Wake Forest Road
Raleigh, North Carolina

Prepared For:

Alcatel-Lucent
2301 Sugar Bush Road
Raleigh, North Carolina

Prepared By:

AMEC Environment & Infrastructure, Inc.
2200 Gateway Centre Blvd., Suite 205
Morrisville, North Carolina 27560

AMEC Project No.: 565280000

March 2012

FORMER ALCATEL FACILITY
SOIL SAMPLING AND EXCAVATION
2912 WAKE FOREST ROAD
RALEIGH, NORTH CAROLINA

This Site-Specific Health and Safety Plan (HSP) has been developed by AMEC Environment & Infrastructure, Inc. (AMEC) to comply with requirements under OSHA 29 CFR 1910 and 1926. This HSP may require periodic updates, as appropriate, if new work tasks are required, or if site conditions/potential hazards change from those outlined herein.

REVIEW AND APPROVALS

Reviewed and Certified by:

_____ 4/2/12
Harold M. Thurston Date
Senior Project Manager

Prepared by:

_____ 3/30/12
Amy Orcutt Date
HSE Coordinator

Approved by:

_____ 4/2/12
Bonani Langan Date
Project Manager

HASP EMERGENCY SUMMARY SHEET

The Site Health and Safety Coordinator (SHSC), the Project Manager (PM), the Raleigh Office SHE Coordinator, and Corporate Health and Safety Director (CHSD) shall be notified immediately if worker exposure, accidents, or site conditions not anticipated in this document are encountered.

RESPONDING EMERGENCY AGENCIES

Service	Telephone Number
Ambulance	911
Fire Department	911
Police Department	911

PROJECT EMERGENCY CALL LIST

Title	Name	Telephone Number
Senior Project Manager (PM)	Harold Thurston	(919) 600-0964 (cell)
Project Manager (PM)	Bonani Langan	(919) 610-8933 (cell)
Field Manager(s) (FM) / SHSC(s)	Beth Espitia Anthony Kellogg	(919) 345-1636 (cell) (716) 474-6247 (cell)
Corporate Health & Safety Director	Vladimir Ivensky, CIH, CSP	(610) 877-6144 (office)
HSE Coordinator	Amy Orcutt	(919) 447-2750 (office) (919) 796-6876 (cell)
Client – Alcatel-Lucent	Dikran Kabbendjian	(919) 850-6248
Workers' Compensation	Gabe Sandholm, HR - Kirkland, WA	(800) 437-2104 ext. 3134
* In the event of an occupational accident or incident, please indicate to the medical facility that this is a Workers' Compensation case; that your employer is AMEC; and that the insurance administrator is AIG Claims. Subcontractors will provide internal Workers' Comp. policy information; this may be provided to the SHSC at the prework meeting.		

EMERGENCY TELEPHONE NUMBER LIST

Organization	Telephone Number
OSHA – North Carolina Office	(919) 807-2900 – Allen McNeely, Director
National Response Center	(800) 424-8802
EPA Environmental Response Team – Region IV	(404) 562-8700
Poison Control	(800) 222-1222
WorkCare 24/7 Hotline (**Must Call Within 1 Hour**)	(888) 449-7787

Nearest Phone: Carry cellular phone.
Nearest Water: Carry water.

POTENTIAL PHYSICAL HAZARDS: including but not limited to back injuries; cold/heat stress; discharge of static electricity; drill rigs and heavy equipment operation/vehicle(s); entanglement; ergonomic stress; inclement weather and shut-down condition; noise; slips, trips, and falls; and UV exposure.

POTENTIAL CHEMICAL HAZARDS: 1,2-dichloroethane (1,2-DCA), 1,1-dichloroethene (1,1-DCE), Cis-1,2-dichloroethylene (cis-1,2-DCE), 1,1,2,2-tetrachloroethane, tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1-TCA, 1,4-Dioxane, ethanol, vinyl chloride (VC), sodium persulfate and sodium hydroxide.

CHEMICAL MATERIALS HANDLED AT THE SITE: Alconox detergent and Calibration gases (e.g., isobutylene), sodium persulfate and sodium hydroxide.

RECOMMENDED AIR MONITORING EQUIPMENT: Flame-ionization Detector (FID)

REQUIRED PERSONAL PROTECTIVE EQUIPMENT AND AIR MONITORING EQUIPMENT: Modified Level D and FID.

ACTION LEVELS AND ACTION

EQUIPMENT/ CONTAMINANTS	ACTION LEVEL	ACTION TO BE TAKEN
FID/VOCs	<10 ppm-equivalents above background in the breathing zone (BZ).	Maintain Level D or Mod. D.
	>10 ppm-equivalent above background in the BZ	Upgrade to Level C PPE.
	>10 ppm-equivalent above background on the site perimeter	Cease operations until levels fall to within background readings, and/or investigation area is ruled out as source of elevated reading.

HOSPITAL INFORMATION (for Map/Directions see next page)

IN CASE OF LIFE THREATENING INJURIES, **CALL 911**

USE AMBULANCE TO CLOSEST TRAUMA CENTER

NOTE: In case of any hazard exposure during and/or prior to medical attention, the hospital and any emergency response personnel shall be notified that patient and/or the patient's clothing may be contaminated.

Hospital Directions:

HOSPITAL NAME:	HOSPITAL ADDRESS:
Duke/Raleigh Medical Center	**3400 Wake Forest Rd Raleigh, NC 27609**
HOSPITAL TELEPHONE:	**DIRECTIONS:**
(919) 954-3000	1. Start at 2912 Wake Forest Rd, Raleigh going toward Wake Towne Drive. Go 0.6 mi 2. Arrive at 3400 Wake Forest Rd, Raleigh, on the **RIGHT**

Hospital Route Map:

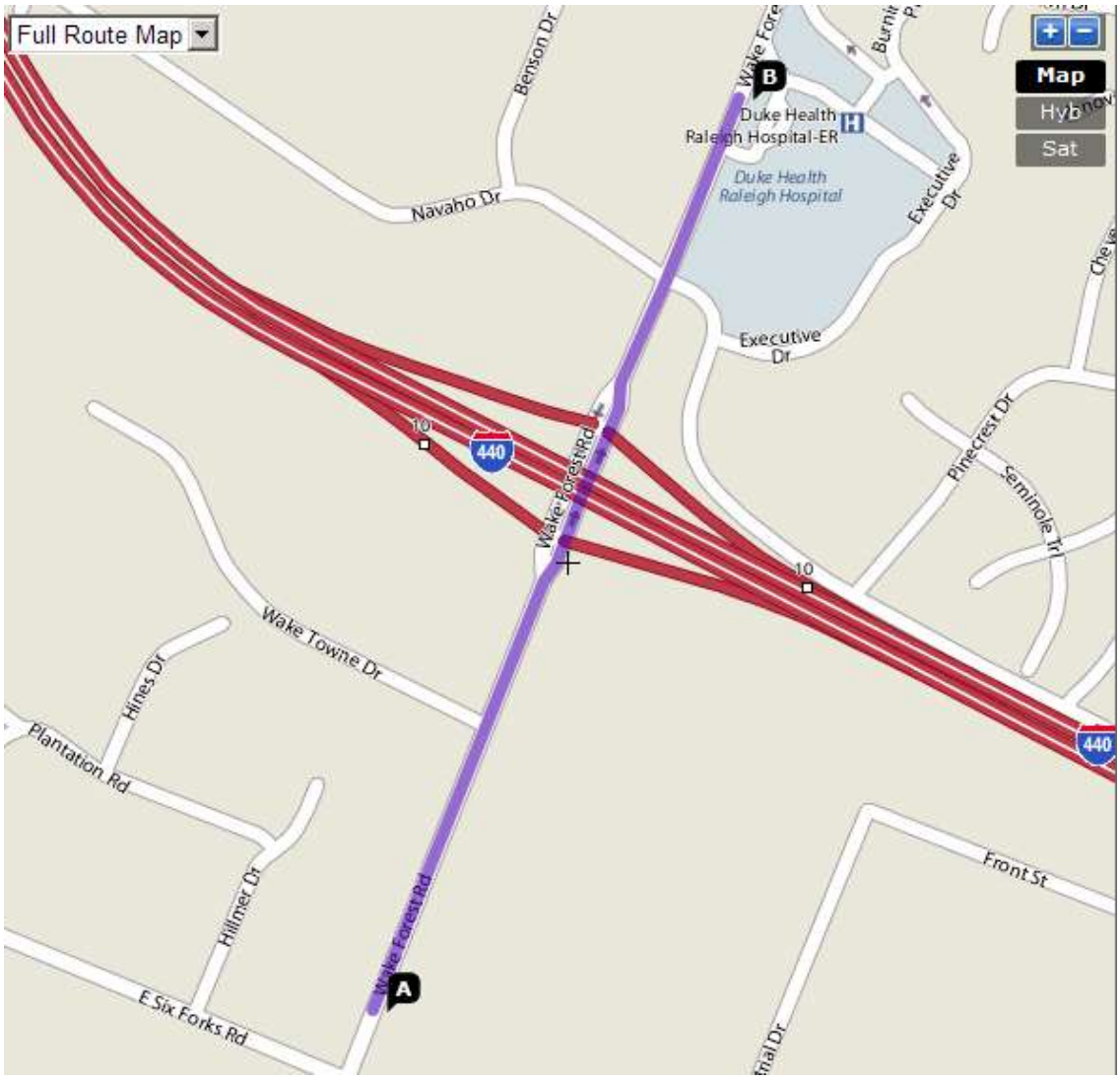


TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1
1.1 GENERAL INFORMATION/SCOPE OF WORK 1
1.2 SCHEDULED ON-SITE PERSONNEL* 2
1.3 PERSONNEL RESPONSIBILITIES 2

2.0 PERSONNEL PROTECTION 3
2.1 ADMINISTRATIVE CONTROLS 3
2.1.1 Medical Surveillance 3
2.1.2 Training 3
2.1.3 Accident Prevention 4
2.1.4 Safe Work Practices 5
2.1.5 Logs, Reports, and Record Keeping 6
2.2 ENGINEERING CONTROLS 7
2.2.1 Barriers 7
2.2.2 Noise Reduction 7
2.3 PERSONAL PROTECTIVE EQUIPMENT 7

3.0 HAZARD EVALUATION 9
3.1 CHEMICAL EXPOSURE 9
3.2 HAZARD ANALYSIS OF SITE WORK TASK 17

4.0 SITE CONTROL 18
4.1 VISITOR ACCESS 18
4.2 SITE SECURITY 18
4.3 COMMUNICATIONS 19

5.0 SANITATION AND ILLUMINATION 19

6.0 EMERGENCY ACTIONS 20
6.1 PREPLANNING AND GENERAL PROCEDURES 20
6.2 SITE-SPECIFIC RESPONSE SCENARIOS 21
6.3 MEDICAL EMERGENCY RESPONSE 21
6.4 BLOODBORNE PATHOGEN EXPOSURE CONTROL PLAN 22
6.5 SPILL OF HAZARDOUS SUBSTANCES 23
6.6 ACCIDENT REPORTING AND RECORD KEEPING 23
6.7 EMERGENCY REFERENCE LIST 24

7.0 DECONTAMINATION PROCEDURES 24
7.1 EQUIPMENT DECONTAMINATION 24
7.2 DISPOSAL PROCEDURES 25

8.0 HEALTH AND SAFETY PLAN ACCEPTANCE 26

LIST OF TABLES

TABLE 1 Site Characterization 10
TABLE 2 Chemical hazards 11
TABLE 3 Summary of Physical and Operational Safety Hazards 12

LIST OF APPENDICES AND FIGURES

APPENDIX 1 Site Location
APPENDIX 2 Map to Nearest Medical Facility
APPENDIX 3 Site Forms

LIST OF ACRONYMS AND ABBREVIATIONS

CIH	Certified Industrial Hygienist
CFR	Code of Federal Regulations
CPR	Cardio Pulmonary Resuscitation
COC	Constituents of Concern
COPC	Chemicals of Possible Concern
CRZ	Contamination Reduction Zone
dBA	Decibels A-Weighted
DOT	Department of Transportation
EC	Emergency Coordinator
EPA	Environmental Protection Agency
EZ	Exclusion Zone
FT	Foot/feet
HAZWOPER	Hazardous Waste Operations Emergency Response
HBV	Hepatitis B Virus
HIV	Human Immunodeficiency Virus
HSM	Health and Safety Manager
HSP	Health and Safety Plan
lbs	Pounds
IDLH	Immediately Dangerous to Life and Health
IDW	Investigation Derived Waste
mph	Miles Per Hour
MW	Monitoring Well

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

OSHA	Occupational Safety and Health Administration
PM	Project Manager
PPE	Personal Protective Equipment
ROC	Record of Change
SC	Safety Coordinator
SHSC	Site Health and Safety Coordinator
SOP	Standard Operating Procedures
SZ	Support Zone
TWA	Time-Weighted Average
US	United States
µg/L	Micrograms per liter
VOC	Volatile Organic Compounds

1.0 INTRODUCTION

1.1 General Information/Scope of Work

This site-specific Health and Safety Plan (HSP) has been prepared by AMEC Environment & Infrastructure, Inc. (AMEC) exclusively for safety and health requirements related to soil excavation and chemical injections at the former Alcatel Sourcing USA, LP (Alcatel) facility located at 2912 Wake Forest Road, Raleigh, Wake County, North Carolina, hereafter referred to as the "site". This HSP presents the minimum requirements for safety and health that must be met by AMEC and its subcontractors. All field and contractor personnel shall read, understand, and comply with the requirements of this HSP. *All visitors shall also be required to review, sign, and comply with this approved HSP to gain site entry.*

It is the responsibility of individual subcontractors to implement an appropriate health and safety program for their employees, including as appropriate:

- **Compliance with 29 CFR 1910.120 Occupational Safety and Health Administration (OSHA) guidelines regarding 40-hour Hazardous Waste Operations Emergency Response (HAZWOPER) and/or 24-hour Awareness training;**
- **Medical Monitoring, Medical Examination for Fitness to Work including Respirator Use pursuant to 29 CFR 1910.134 OSHA Respiratory Protection Standard, if required,**
- **Supplying Personal Protective Equipment (coveralls, respirators, boots, gloves, etc.) as required by site conditions; and,**
- **Compliance with 29 CFR 1926 OSHA Construction Standard.**

This HSP is provided as a guide only. Copies documenting the above training and programs should be kept on-site by all subcontractors.

The HSP has been written to be consistent with all applicable federal, state, and local safety and health requirements. Specific references consulted in assembling the HSP include:

- 29 CFR 1910 OSHA General Industry and 1926 OSHA Construction Standards
- AMEC SHE Program and field operating practices

Client:
Alcatel –Lucent USA, Inc.

Access to the Site is from Wake Forest Road in Raleigh, North Carolina (see site map in **Appendix 1**). Scope of work is as follows:

1. Soil Excavation
2. Chemical oxidation through soil blending using sodium persulfate and sodium hydroxide

1.2 Scheduled On-Site Personnel*

NAME	COMPANY	PROJECT TITLE
Anthony Kellogg	AMEC	Field Personnel/Site Health and Safety Coordinator
Beth Espitia	AMEC	Field Personnel/ Site Health and Safety Coordinator
Bonani Langan	AMEC	Project Manager
Harold Thurston	AMEC	Senior Project Manager

* The Record of Change (ROC) form must reflect all personnel changes. All new personnel will be added to the On-site Personnel Record.

1.3 Personnel Responsibilities

Site Health and Safety Coordinator
Reports jointly to the AMEC Health and Safety Manager (HSM) and the Project Manager (PM) for all aspects of the project and is the primary contact for health and safety during all field activities, establishes work zones, evacuation routes, and assembly areas. The Site Health and Safety Coordinator (SHSC) makes the day-to-day decision to modify levels of protection provided in the HSP based on site conditions or monitoring data and has the authority to stop all work if conditions are judged to be hazardous to on-site personnel or the public, and reports and investigates accidents and near misses. Other specific responsibilities are detailed within Section 3 of Volume II, Health and Safety Program for Site Investigations, of the AMEC Corporate Health and Safety Manual.

The SHSC or designee must carefully document the implementation of this HSP by maintaining the Project Health and Safety Files.

Field Staff selected as Safety Coordinators (SC) will be expected to immediately report any accidents, near misses, and/or unsafe conditions to the SHSC or the PM. The SC will perform daily tailgate safety meeting reports for remote sites and all documentation will be reviewed by the SHSC on a regular basis.

Health and Safety Manager
The HSM is a Certified Industrial Hygienist (CIH) or Safety Professional with five or more years of Occupational Safety and Health experience that is responsible for the review and approval of the HSP and may help coordinate the implementation of health and safety procedures through supervision/direction of the SHSC. The HSM is responsible for approval of all changes made to this HSP.

Project or Field Manager/ Supervisor
The PM has responsibility for all field activities, enforcement of safe work practices, and ensuring that daily tailgate meetings are conducted, and serves as the Emergency Coordinator (EC) in emergency situations. The PM assumes (or assigns to a qualified person) the SHSC duties and responsibilities when the SHSC is not on-site.

Field Team Members
All AMEC and subcontracting personnel are responsible for compliance with this HSP in its entirety. They are responsible for taking all reasonable precautions to prevent injury to themselves and to their fellow employees and for being alert to potentially harmful situations. Field team members are expected to perform only those tasks that they believe can be done safely and to immediately report any accidents, near misses, and/or unsafe conditions to the SHSC or the PM.

2.0 PERSONNEL PROTECTION

The prescribed methods and procedures used to protect personnel (site workers and adjacent community) from overexposure to hazardous materials and hazardous conditions posed by site operations are grouped into three primary categories: Administrative Controls, Engineering Controls, and Personal Protective Equipment (PPE).

2.1 Administrative Controls

2.1.1 Medical Surveillance

Periodic Comprehensive Exam:

For this field project, personnel are required to be on the Medical Surveillance Program due to possible exposure to hazardous materials and wastes.

Emergency Medical Treatment:

Personnel who exhibit signs and symptoms of cold or heat overexposure, or have been injured on the job, will seek medical services. See also the Emergency Response (Section 6) for specific information regarding emergency services and logs, reports, and record keeping; Section 2.1.5, for required report submittals. The map to the nearest medical facility is located in **Appendix 2**.

2.1.2 Training

Comprehensive:

All routine on-site general site workers performing intrusive activity or having potential to receive exposures exceeding permissible limits will have completed OSHA 40-hour HAZWOPER training, 24-hour on-site supervised training and appropriate annual (within 12 months) refresher training. Supervisors will have completed the above and an additional 8 hours of OSHA Supervisory Training. In accordance with 49 CFR 172, Department of

Transportation (DOT) HM126F training is required for all employees who handle, transport, or prepare to transport hazardous materials.

Occasional site workers that are not expected to receive exposures exceeding permissible exposure limits (e.g., geophysical and land surveyors) require only 24 hours of OSHA HAZWOPER training and 1 day of on-site training and supervision.

At least one AMEC staff member on-site will have completed training in First Aid/CPR, PPE usage, field training, fire extinguisher usage and hazard communication before starting any field work operations. Occasional site workers require only one day of on-site training and supervision.

Specialized:

Prior to the initiation of site activities, the SHSC and PM will conduct a health and safety "kick-off" meeting. At this time, pertinent AMEC Standard Operating Procedures (SOPs) and the site-specific HSP will be discussed in detail with special attention being given to site chemical and physical hazards, PPE, emergency procedures, etc. Upon completion of this briefing, all routine field personnel will be required to read and sign the acceptance sheet of this HSP.

Site visitors and non-routine field staff who do not attend this meeting will be required to undergo a specialized health and safety orientation, as documented on the HSP acceptance form in Section 8.0.

Daily:

"Tailgate" safety meetings will be conducted by the SHSC or SC to discuss designated PPE and any task changes. "Tailgate" safety meetings will be conducted daily by the SHSC, SC, or PM for all phases of work. Topics of discussion will include work tasks and designated PPE, emergency procedures, evacuation routes, instruction in use of safety equipment (as required), prior safety problems, recognition of signs and symptoms of overexposure, importance of proper decontamination, and personal hygiene, etc. **These meetings must be documented and will be reviewed by SHSC, HSM, and PM);** forms are provided in **Appendix 3**. Completed Tailgate Meeting forms will be turned into the AMEC Office SC for the required monthly safety documentation submittal.

2.1.3 Accident Prevention

Accident prevention measures are as follows:

- The buddy system will be adhered to at all times. All crews will consist of a minimum of two people. The team members can include one AMEC and one client/sub-contractor member.
- Required PPE will be worn and inspected prior to and after each use. Any questions on PPE will be brought to the SHSC immediately before performing any operation.

- Good housekeeping practices will be used at all times.
- All personnel will use proper lifting techniques.

2.1.4 Safe Work Practices

1) **Unauthorized personnel** are not allowed on-site.
2) Work groups will always consist of at least two team members.
3) A high standard of personal hygiene will be observed. Smoking, eating, drinking, chewing gum or tobacco, taking medication, and applying cosmetics will not be permitted within any restricted area.
4) Personnel under the obvious influence of alcohol or controlled substances are not allowed on-site; those taking medications must notify the SHSC.
5) Personnel should notify the SHSC of any defective emergency or other protective/ safety equipment.
6) A supply of potable water or electrolyte replacement solutions and sufficient lighting will be maintained on-site; sanitary facilities will be accessible to personnel.
7) Owners/operators of heavy equipment and vehicles will ensure that they are in good working order by performing daily inspections and routine maintenance.
8) Deficiencies affecting health and safety shall be corrected prior to equipment use.
9) All unsafe conditions shall be made safe immediately. All unsafe conditions not in the scope of the project shall be reported to the PM and SHSC.
10) All site personnel will familiarize themselves with these and the emergency procedures during daily pre-work tailgate safety meetings.
11) No employee shall report to work or be permitted to work while he/she is in any way unfit to perform his/her duties in a safe and efficient manner.
12) Following safe work practices reduces the likelihood of an accident, illness, or injury during field activities.
13) Do not fuel engines while vehicle is running.
14) Store tools in clean, secure areas so they will not be damaged, lost, or stolen.
15) All personal PPE must be approved by the SHSC before use.
16) Get help in lifting any item that is so bulky, awkward, or heavy that you feel you cannot lift it safely.
17) If a repetitive task causes you discomfort, or you feel it is unsafe or unhealthy, report it to your PM and SHSC immediately.
18) Obey all safety warning signs and signals. Do not remove any safety warning signs or signals until the danger is eliminated.
19) Wear seat belts at all times when in vehicles used for company business. This includes drivers and passengers in rental cars, personal vehicles used for business activities, and company-provided vehicles.
20) Do not engage in any activities that interfere with your ability to operate a vehicle safely.
21) Cell phones will not be used in vehicle access areas (i.e. access roads for construction vehicles/ equipment). Cell phones can only be used in moving vehicles if you are a passenger or if wireless headsets are used. The headset must be approved for use by the SHSC before project work begins.

2.1.5 Logs, Reports, and Record Keeping

Submittal of Certifications:

Proof of health and safety training and medical certifications must be submitted to the SHSC prior to the mobilization of field crews. The SHSC will maintain on-site a copy of the certifications (and all Record of Change [ROC] forms for revisions of personnel additions and substitutions) certifying that all AMEC personnel have satisfied the minimum training and medical requirements listed above. Supporting documentation and certificates will remain on file with the HSM. Field projects will not be allowed to take place in the absence of adequate documentation.

Site Monitoring, Reports, and Records:

The health and safety field files maintained by the SHSC, or his/her designee, will be the primary form of record keeping and documentation of site health and safety activities. These documents will be completed in sufficient detail to document the work performed; any unusual or significant circumstances under which the work was performed; any unanticipated/unplanned action taken to mitigate or to otherwise cope with unexpected field conditions; and pertinent comments about site-specific conditions that could have a bearing on the work performed. Documentation is required for all phases of work. See also the SHSC duties listed under Personnel Responsibilities. Record keeping practices will follow 29 CFR 1910.120.

The Health and Safety Binder will contain the following documents; all blank forms (designated by an asterisk) are provided in **Appendix 3** to this HSP:

* Certification of medical and training requirements when not filed in main office;
* Signed acceptance sheet of this HSP (signed by all routine on-site personnel and visitors);
* Safety inspection records including violations and remedial action plans;
* Daily tailgate safety meeting reports;
* Supervisor's report of injury or illness and first-aid incident reports;
* Accident/First-Aid Incident Summary Log;
* Incident Report (for environmental incidents, equipment damage, and work stoppages); and
* Completed Record of Change Forms to this HSP.

2.2 Engineering Controls

2.2.1 Barriers

Barricades:

Barricades, traffic cones, and/or marking/caution tape will be erected at a safe distance from excavations, pits, hazardous areas, and moving equipment to prevent unauthorized access to work areas from vehicular and pedestrian traffic. Barriers will be appropriate for the level of work activities and anticipated traffic.

2.2.2 Noise Reduction

Site activities in proximity to heavy equipment often expose workers to excessive noise. It is anticipated that situations may arise when noise levels may exceed the OSHA Action Level of 85 decibels A-weighted (dBA) in an 8-hour time-weighted average (TWA). An example of this possibility is working in close proximity to the contractor/sub-contractor during equipment operations such as sampling during Geoprobe operations. If excessive noise levels occur, efforts will be made to control this by issuance of ear plugs to all personnel and by implementing a system of hand signals understood by all.

2.3 Personal Protective Equipment

AMEC personnel will wear the following PPE during all field work: *steel-toed shoes/boots, safety reflective vests when required, nitrile 4 mil gloves, hard hat when required, safety glasses (minor spill protection) or goggles when pouring or transferring liquids, ear plugs/muffs or both when required, and appropriate hot/cold/inclement weather clothing when working outside of company and rental vehicles (see Section 3.2).* **All PPE must be approved by the SHSC before use. Potable water will be provided on-site and personnel will monitor heat and sun exposure to prevent heat related injuries.**

Levels of Protection

Initial levels of protection for the Project Area for all tasks is Level D, but may vary depending on the task. Protection may be upgraded or downgraded depending upon monitoring data (compared with action levels) and Project Area conditions, as determined by the SHSC. The following outlines the **minimum** guidelines for each level of protection that is assigned or potentially assigned.

Level D PPE:

- Work shirt and full-length pants or coveralls
- American National Standards Institute (ANSI) standard safety-toe work boots
- ANSI standard hard hat (working around heavy equipment or overhead “bump” hazards)
- ANSI standard safety glasses
- EPA-approved hearing protectors (when working in high noise areas, e.g., steam cleaners and heavy equipment)

Modified Level D PPE:

- Level D equipment
- Tyvek® coverall or equivalent (upgrade to polyethylene [PE] or Saranex-coated Tyvek® as needed)
- Outer chemical-resistant gloves and inner nitrile gloves
- Boot covers or chemical-resistant boots

Level C PPE:
- Modified Level D equipment, with taping of coverall to boots and gloves, as necessary
- National Institute for Occupational Safety and Health (NIOSH)-approved, half-face or full-face air-purifying respirator with organic vapor/acid gas cartridges and particulate prefilters (respirator usage clearance is defined in SOP H-13, Respiratory Protection, Volume VI of the CHSM).

Level B PPE:
- Modified Level D equipment, use of chemical-resistant coverall, taped to boots and gloves
- NIOSH-approved, pressure-demand, full-face piece self-contained breathing apparatus (SCBA) or pressure-demand supplied-air respirator with escape-SCBA (additional employee training is required for Level B operations).

Level A PPE:
- Level B equipment, use of fully-encapsulating suit

Chemical Cartridge Change Out Schedule

Based upon OSHA requirements and manufacturer recommendations, organic vapor cartridges used with the air purifying respirator will be changed out daily whenever the level of PPE is increased to Level C or when Level C is initially required. The used cartridges will be disposed of as part of the project investigation-derived waste (IDW).

PPE Donning/Doffing Procedure

The following procedures are given as a guide. Failure to adhere to these procedures may result in the PPE being ineffective against contaminants. These procedures may be altered by the SHSC if improvements can be made and these changes are warranted in the field. Also, some articles of PPE may not be necessary for all Project Area tasks.

PPE Donning Procedure (for Mod. Level D and greater):
- Inspect all protective gear before donning.
- Don Tyvek® coverall or equivalent, inner gloves and outer gloves, secure with tape, as required, leave pull tab. If coverall is loose, secure with tape to avoid capture in moving or rotating equipment.
- Don respirator. If not in Level C, maintain respirator in a sealed plastic bag at the Project Area in case of an upgrade.

PPE Doffing Procedure:

- Wash/rinse (if necessary) excess mud or other debris from outer boots, gloves, and clothing.
- Remove tape using pull tab and remove outer clothing in the order of boots, outer gloves, and coverall suits. Place disposable and reusable PPE in designated (separate) containers.
- Remove respirator (if applicable). Decontaminate and fit-check prior to reuse.
- Remove inner gloves.
- Wash face, neck, and hands.
- Enter the Support Zone (SZ).

ACTION LEVELS AND ACTION

EQUIPMENT/ CONTAMINANTS	ACTION LEVEL	ACTION TO BE TAKEN
FID/VOCs	<10 ppm-equivalents above back-ground in the breathing zone (BZ).	Maintain Level D or Mod. D.
	>10 ppm-equivalent above background in the BZ	Upgrade to Level C PPE.
	>10 ppm-equivalent above background on the site perimeter	Cease operations until levels fall to within background readings, and/or investigation area is ruled out as source of elevated reading.

3.0 HAZARD EVALUATION

Chemical, physical, energy, biological, and operational safety hazards anticipated during this project will be evaluated in the tables and sections that follow Section 3.1. The tables provide the details that support the task-specific hazard analyses. Table 1 provides a general overview of the contaminants of concern; Table 2 provides chemical properties and exposure assessment data; and Table 3 summarizes the physical and operational safety hazards and control measures identified for this project. A complete hazard analysis of each site work task and the list of protective measures complete this section of Hazard Evaluation. Further details of specific control measures for these hazards are presented under the section heading: "Personnel Protection."

3.1 Chemical Exposure

The primary entry routes of potential contaminants and hazardous materials on-site include inhalation of vapors; skin contact with contaminated materials; and ingestion materials from hand-to-mouth contact due to inadequate personal hygiene. To minimize these exposure pathways, suppression techniques will be employed by all personnel in contact with these contaminants. In addition, all required PPE as specified in the Hazard Analysis of Site Work Tasks section will be worn, and personal hygiene will be carefully monitored. See Table 2 for more details.

TABLE 1

SITE CHARACTERIZATION

ANTICIPATED PHYSICAL STATE OF CONTAMINANT(S):

(**x**) Liquid ( ) Sludge ( ) Unknown
(**x**) Solid (contaminated soil) (**x**) Gas/ Vapors ( ) Other _____
Notes: Minor vapors when opening wells depending on temperature.

MATRIX:

(**x**) Surface soils ( ) Surface water ( ) Free product (possible)
(**x**) Soils at depth (**x**) Groundwater ( ) Other _____
Notes:

POTENTIAL HAZARDOUS PROPERTIES:

( ) Corrosive (**x**) Flammable/ Combustible ( ) Radioactive
(**x**) Toxic (**x**) Volatile ( ) Reactive
( ) Inert (**x**) Carcinogenic (possible) ( ) Unknown
( ) Asphyxiant ( ) Compressed gas ( ) Other _____
Notes:

CONTAINER/STORAGE SYSTEM INFORMATION:

( ) Tanks _____ ( ) Landfills/Dumps ( ) Subsurface
(**x**) Drums _____ ( ) Impoundments ( ) Uncontainerized
( ) Pipes _____ ( ) Size/capacity ( ) In-Service
( ) Quantity _____ ( ) Surface
( ) Other_____
Notes:

CONDITION OF CONTAINER/STORAGE SYSTEM(S):

(**x**) Sound/Undamaged ( ) Confirmed leaks
( ) Deteriorated/Unsound ( ) N/A
( ) Unknown ( ) Suspected leaks
( ) Other _____
Notes:

ORIGIN OR INDUSTRIAL APPLICATION OF CHEMICALS OF CONCERN:

Industrial Process

( ) Manufacturing ( ) N/A
( ) Maintenance/Repair ( ) Prev. Use
( ) Painting/Coating ( ) Storage
( ) Power Generation (**x**) Other Spill
Notes:

Chemicals Used or Identified

( ) Acids ( ) Metals ( ) Phenols
( ) Caustics ( ) Pesticides/ Fungicide ( ) Paints
( ) Halogen ( ) PCBs (**x**) Chlorinated Solvents
(**x**) Other: See Table 2.
Notes:

Oils/Fuels

( ) Fuel Oil ( ) AVGAS ( ) Gasoline
( ) Waste Oil ( ) MOGAS ( ) Diesel
( ) Hydraulic Oil ( ) Jet Fuel ( ) Other _____
Notes: None at this site.

Sludges

( ) Metal sludges ( ) Oily sludges ( ) Septic sludges
( ) Other: _____
Notes: None at this site.

Solids

( ) Asbestos ( ) Sandblast grit ( ) Landfill refuse
( ) Other: _____
Notes: None at this site.

TABLE 2
CHEMICAL HAZARD INFORMATION

Chemical Name	Route of Exposure	Potential Concerns	Control Measures
Volatile and Semi Volatile Organic Compounds			
1,2-Dichloroethane; 1,1-Dichloroethene; Cis-1,2-Dichloroethylene; 1,1,2,2-Tetrachloroethane; Tetrachloroethene; Trichloroethene; 1,1,1-TCA; 1,4-Dioxane; Ethanol; Vinyl Chloride	Ingestion; Dermal; Inhalation *Confirmed and possible human carcinogens (causes cancer)	Personnel may come into brief contact when groundwater/ soil sampling, handling waste, and preparing samples for shipment.	Wear protective gloves and safety glasses when handling soil and/or groundwater. Personnel should wash hands and face as soon as possible after work cessation and/or before eating, drinking, using the restroom, or smoking
Sodium Persulfate	Ingestion; Dermal; Inhalation	A skin, eye, and respiratory tract irritant; May cause skin sensitization, dermatitis, and asthma after prolonged contact	Wear protective gloves and safety glasses when handling soil and/or groundwater. Personnel should wash hands and face as soon as possible after work cessation and/or before eating, drinking, using the restroom, or smoking

Chemical Name	Route of Exposure	Potential Concerns	Control Measures
Sodium Hydroxide	Ingestion; Dermal; Inhalation (can cause pulmonary edema)	Liquid causes second or third degree burns after short contact. Can cause irritation of the respiratory system.	Wear protective gloves and safety glasses when handling soil and/or groundwater. Personnel should wash hands and face as soon as possible after work cessation and/or before eating, drinking, using the restroom, or smoking

TABLE 3
SUMMARY OF PHYSICAL AND OPERATIONAL SAFETY HAZARDS

OPERATIONAL SAFETY HAZARDS	CONTROL OR PROTECTIVE MEASURES
Physical hazards associated with drill rigs and other heavy equipment	See also Excavation, Trenching, Shoring SOP; Drilling Safety SOP, Equipment will be inspected on a daily basis by the owner/operator, daily logs will be maintained. All discrepancies shall be corrected prior to placing the equipment in service. Blades, buckets, and other heavy equipment will be kept fully lowered when not in use; parking brakes must be engaged. Drill rods or core barrels shall not be left balancing, leaning, or other-wise unsecured on the rig. Equipment parked on inclines shall have the wheels chocked or blocked and the parking brake set. Equipment shall not be used on unstable or unsafe inclines.
Back injuries due to improper lifting of equipment	Workers will use proper lifting techniques, lifting with the legs and not the back. Loads >**40** lbs. require a second person or mechanical device. Whenever possible, mechanical devices such as drum dollies, hand trucks and tool hoists (for lifting augers) should be used to lift or move heavy loads.
Noise	Hearing protection shall be worn during operation of heavy equipment, pneumatic power tools, steam cleaners and other equipment that potentially generates >85 dBA. See also Hearing Conservation SOP, Vol. VI, Corp Health and Safety Manual.
Chemicals	A "toxic substance" is defined as any substance "which is listed in the latest printed edition of the National Institute for Occupational Safety and Health Registry of Toxic Effects of Chemical Substance" or has yielded positive evidence of acute or chronic health hazards in human, animal or other biological testing." While this definition may seem unusually broad, the NIOSH Registry of Toxic Effects of Chemical Substances alone lists over 85,000 toxic chemicals. This number does not include substances for which no toxicity information exists (but which may have a considerable toxic or hazardous potential). General precautions: • Know the composition of the materials you are using. • Choose the safest materials possible. • Use adequate ventilation. • Protect yourself and the area against a potential fire. • Have appropriate safety and personal protective equipment. • Inspect all chemical containers before using them. • Store and/or dispose of all unused chemicals immediately after use, in a proper manner. Inspect your own individual storage area regularly.

TABLE 3 (Continued)
SUMMARY OF PHYSICAL AND OPERATIONAL SAFETY HAZARDS

Inclement weather	Work shutdown conditions: • Poor visibility. • Precipitation severe enough to impair safe movement or travel. • Lightning in the immediate area. • Steady winds >40 mph. • Other conditions as determined by the SHSC, PM or HSM. • Imminent threat of severe tropical storm or hurricane. Complete an Incident Report (Appendix 3) within 24 hrs for all work shutdowns.
Domestic and Wild Animals	Field employees are at risk from exposure to all types of animals, their waste products and their carcasses. Rodents and other animals can harbor disease-causing agents very harmful to humans. Care should be taken to avoid all wild animals and domestic animals that have the potential to harm you. To avoid accident or injuries associated with rodents and other animals observe the following guidelines: • Be aware of your surroundings and note any wild or suspicious acting animals in your work area. If necessary, seek safe shelter from these animals. • Avoid reaching or stepping into or over hidden areas that may contain such animals. • When working with soil, be aware of signs that indicate above or below ground animal nests and take appropriate action to prevent contamination by dust or injury from bites. • If an animal bite occurs, clean the wound with soap and water, and follow appropriate first aid procedures. Immediately report the incident to your supervisor. • Transport any bite victim to the hospital. (Have animal control safely capture the animal so it can be tested for any known disease-causing agents.) • If exposure to airborne particles and dust from a nest does occur, immediately report the incident to your supervisor. (If possible, and without exposing yourself, mark the site without disturbing it so trained personnel can collect samples to determine if any disease-causing agents are present.) • Avoid direct contact with bird, bat and other animal droppings. Areas where birds and bats roost should be avoided or appropriate respiratory protection shall be used. • Avoid direct contact with animal blood. Wear rubber gloves if contact with animal blood can not be prevented. Dispose of rubber gloves properly. Wash hands thoroughly with an antibacterial soap after disposal of rubber gloves and before eating, drinking or smoking.
Overhead Power/Utility Lines	• Keep an eye out overhead at all times; take time to examine the hazard. • Before operating equipment, make a safety plan that prevents contact. • Take extra care and precautions. • Check the height of you equipment or load. • Plan your moves: are there power lines to pass under or avoid? • Look out for uneven ground that may cause your vehicle to bounce. • Think about wind and temperature - they may affect the power line's height. • Never ride or climb on equipment or a load when near a power line. • Work around power lines is to be done only during daylight hours. • Don't ground your equipment around a power line. • Do not allow equipment or objects to approach the overhead power line closer than the specified safe limit of approach. • If work is being carried out near the "safe limit of approach", use a trained signaler to act as an observer to ensure that the required distance is maintained. (Communication by radio or air horn.) • Do not place materials under or adjacent to the overhead power line if it reduces the clearance above ground required by O.H. & S. regulations. Contact the electrical utility for assistance to determine the required clearance between the power line and the ground. • Do not allow excavations to reduce the support required for power poles. Contact the electrical utility to determine support required. Request line locators in case of grounding grids buried at the base of power poles. • Keep a safe working distance between your equipment and power lines

TABLE 3 (Continued)
SUMMARY OF PHYSICAL AND OPERATIONAL SAFETY HAZARDS

OPERATIONAL SAFETY HAZARDS	CONTROL OR PROTECTIVE MEASURES
Housekeeping and Sanitation	• Good housekeeping is important for maintaining a safe workplace. • Each employee is responsible for maintaining a clean and sanitary • All materials must be properly stored with stock being placed neatly in racks or bins wherever possible. • Clear all floors and walkways of tripping hazards on a regular basis. • Place trash in proper receptacle. • Do not throw it on the floor or ground. Provide a waste receptacle that is in good condition and appropriate for the type of waste material.
Biological agents	• Workers will not be exposed to infectious agents or wastes with the current scope of work; however, responders to first-aid incidents may contact bloodborne pathogens and will follow the Bloodborne Pathogen Exposure Control Plan in this HSP. • Workers shall be protected from hazards of irritant and toxic plants and be suitably instructed in the first-aid treatment available. • Personnel with known reactions to insect bites or stings should be identified during the "kickoff" meeting so that the appropriate emergency treatment can be made available on-site. Locations of any known bite or sting medication in the employee's possession will be identified daily. • Workers should not attempt to capture any wild or semi-wild animals due to the possibility of a bite or parasitic infection. • Diminish exposure to dust when possible by wetting soil.
Entanglement in rotating or moving equipment	• Equipment shall not be operated without guards. • Loose-fitting or dangling clothes, hair jewelry are prohibited. • Stay clear of rotating augers and pinch points, such as cables and pulleys. • Passage under, or stopping over, a moving stem or auger is prohibited. • Drill crews are not allowed on the mast while the drill bit/auger is in operation or during transport. • Long-handled shovels will be used to remove cuttings from the auger. • Only the drill crew and the SHSC will be aware of the location and proper operation of the rig's emergency shut-down equipment (kill-switches, etc.), and procedures.
Cold Stress	• See Cold Stress SOP, H-3. • A worker should go immediately to a warm shelter if any of the following symptoms are spotted: the onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, and irritability. • If possible, a change of dry work clothing should be provided to prevent people from returning to work with wet clothing. • Alcohol should not be consumed while in the warmer environment. • If possible, the most stressful tasks should be done during the warmer parts of the day. Double shifts should be avoided. Rest periods should be extended to cope with increases in cold stress. • A worker should weigh themselves at the beginning and end of the workday to check for weight loss that might occur from progressive dehydration.
Heat Stress	• Provide shelter or shaded area for work tasks (as feasible) and break areas. • Adjust work schedules by rotation of personnel or alternate job functions to minimize heat stress or overexertion at one task. • Work during cooler hours of the day (or night), as feasible. • To maintain normal body fluid levels, drink 16 ounces (oz) (2 cups) of water before each shift and about 8 oz (1 cup) every 15 to 20 minutes. Drink 2 gallons of water during an 8-hour period. • Wear nonbinding cotton clothing (e.g., medical scrubs and cotton undergarments) under personal protective equipment (PPE) to absorb moisture and to help prevent heat rash. • Where feasible, set up field “showers” or hose-down areas to cool down body.

TABLE 3 (Continued)
SUMMARY OF PHYSICAL AND OPERATIONAL SAFETY HAZARDS

OPERATIONAL SAFETY HAZARDS	CONTROL OR PROTECTIVE MEASURES
Slips, trips, and falls	• Clear work area of obstructions and debris prior to rig set-up. • Level and stabilize the rig prior to raising the mast. • Keep drill platforms, stairs, and immediate work areas clear; do not allow oil/grease and excessive mud to accumulate in these areas. • The discharge of drilling fluids and foam will be channeled away from the work area to prevent ponding or slippery conditions. • A safety harness and shock absorbing lifeline or adequate fall protection, shall be provided and its use required for each employee working >6 ft. above the platform or main work deck. • Open boreholes should be immediately backfilled, or be capped and flagged; open excavations will be barricaded or be covered with steel traffic plates. • Wherever possible, slip, trip and fall hazards will be eliminated or clearly identified with caution tape, barricades, or equivalent means.
Field Emergency Response	• Review Safe Operating Procedures for applicable equipment and perform pre-operational checks. • Make sure all emergency and warning lighting is working. • Wear appropriate personal protection equipment consistent with the hazard. • Protective clothing and other equipment may be required. • Avoid working under suspended loads. Wear hard hats around backhoes, cranes and excavators. • Be alert for heat buildup, vapors, rumbling noises, leaks, dampness, unusual debris and • Strange odors caused by airborne contaminants. • Park in areas that: provide safe entrance and exit of work area; do not create potential conflicts with other vehicles/equipment operating in the work area; and provide maximum protection for workers entering and exiting the vehicle. • Employees on foot must use caution to stay clear of operating equipment. • Be aware of escape routes in case of emergencies. It is a good practice to work facing on-coming traffic when on foot. • Always establish eye contact with the operator before approaching equipment. • Be aware of loose material, excavation drop-off, tripping hazards, uneven ground and other obstructions. • Take extra precautions to prevent heat and cold stress when working in extremely hot and cold temperatures. • Be aware of escape routes in case of emergency. • All work should be performed in well ventilated areas.

TABLE 3 (Continued)
SUMMARY OF PHYSICAL AND OPERATIONAL SAFETY HAZARDS

OPERATIONAL SAFETY HAZARDS	CONTROL OR PROTECTIVE MEASURES
Poisonous Snakes, Insects and Plants	Like most accidents and injuries, prevention is important in controlling hazards from poisonous snakes, insects and plants. Therefore, each employee should review the work activities planned to determine what exposures might exist. Efforts should then be made to minimize situations which might result in a snakebite, insect sting or exposure to poisonous plants. Employees should also avoid wearing bright clothes, perfumes, after-shaves, etc., to help minimize attraction of snakes or insects. **Snakes** Employees should wear work boots, long pants and long sleeved shirts when going into hazardous areas; make as much noise as possible when approaching a possible snake area to give the snake time to leave; be equipped with a bush ax for clearing underbrush and for protection; avoid reaching or stepping into hidden areas whenever possible. If a snakebite should occur, the employee should: a) Remain as calm as possible. b) Move away from the snake. c) Apply a constricting bandage (not tourniquet) between the wound and heart. A finger should be able to pass under it. Apply ice to bite area, if available. d) Allow a fellow worker to transport him/her to closest medical facility. e) If possible, kill snake and carry to medical facility for identification. Under no circumstances should incisions and suction be used to treat a snakebite unless: a) The victim is over 1.5 hours from medical assistance, and b) The person administering first aid has received advanced training in medical assistance such as First Responder, EMT, etc. **Insect Stings** Employees should: 1. Wear appropriate clothing. 2. Avoid areas where insects might be whenever possible. 3. Schedule work in infested areas during the cool months. 4. Avoid high smelling after-shaves, colognes, etc., that may attract insects. 5. Use available insect repellents. 6. If a sting does occur, any stinger should be removed with a knife blade or fingernail. The area should then be treated with Sting Kill Swabs and/or Hydrocortisone. **Ticks** Ticks are especially important because of the possibility of Rocky Mountain Spotted Fever or Lyme Disease. To minimize exposure, employees should follow these guidelines: 1. Wear appropriate clothing when working in wooded areas. 2. Check yourself at least twice a day, paying particular attention to the hair, neck and groin area. 3. Use the available Tick Repellent. **Poisonous Plants** The typical AEE employee has exposure to at least three types of poisonous plants: poison oak, poison ivy and poison sumac. Reactions range from mild (very little or none) to severe (rash and blisters). To avoid problems with poisonous plants, employees should: 1. Avoid working in severely infested areas if at all possible. (Learn what the plants look like.) 2. Wear long sleeve shirts, long pants, and work gloves. If you are performing clearing activities with either hand (e.g., bush axes, machetes, etc.) or powered tools use eye goggles/safety glasses to prevent poisonous plants from entering your eyes. 3. Use silicone protective or other barrier creams where available. 4. Use TECNU Poison Ivy Wash on any place that may have been exposed. In some cases, even 24 hours after exposure may help. 5. Be sure that any clothes or shoes that may have been exposed receive a thorough washing. Leftover oils on anything could cause a reaction even days later. 6. If a severe reaction develops, contact your medical provider for possible treatments. 7. Avoid rubbing your eyes if you have been in contact with poisonous plants.

3.2 Hazard Analysis of Site Work Task

TASK NAME: EXCAVATION AND CHEMICAL INJECTION

Potential Hazards: (Check all that apply to either existing conditions or that result from site operations)

(**x**) Rotating Machinery
(**x**) Heat Stress
( ) Cold Stress
(**x**) Heavy Equipment
(**x**) Intrusive Activ's (underline)
- Trenching
- Drilling
- Soil Vapor Surv.
- Sampling

(**x**) Uneven terrain, slips, trips, falls
(**x**) Trench/excavation collapse

( ) Projectiles
(**x**) Physical Exertion
(**x**) Noise (>85 dBA)
(**x**) Vehicle Traffic
( ) Fire/ Explosion (underline)
- Flam. Materials
- Low-lying Areas
- Fuel lines

( ) Work near water (lagoons, streambeds, ravines, bay ocean)

( ) Confined Space
(**x**) Biological (plants, rodent virus, marine species, soil borne or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals) †
( ) Electrical (utilities)
(**x**) Chemical Exposure
(**x**) Other (List) overhead

†Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (see also Table 2)

(**x**) Tailgate Meetings
( ) Operator Training
(**x**) Engineering Controls: Work Zones
(**x**) SOPs: See Table 3
( ) Other: _____

(**x**) PPE
(**x**) Site Control

(**x**) Air Monitoring
(**x**) Decontamination

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned for this work task based on the potential risk of exposure. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC. Any modification to the levels of PPE below must be noted here and documented with a completed ROC form (see Appendix 3 for blank forms).

Level Of Protection: ( ) A ( ) B ( ) C ( ) D (**x**) **Modified D**

Respirator: (Level C and above)
( ) SCBA, Airline ( ) Purify. Resp. ( ) Escape Mask
( ) OV/AG Cart. ( ) Other _____

Protective Clothing:
( ) Encap. Suit ( ) Tyvek® ( ) PE Tyvek®
( ) Saranex ( ) Splash Suit (**x***) Safety Vest
(**x**) Other Field clothing to protect from cold/sun/heat exposure- long pants, shirts (cotton) with sleeves. Rain gear should be available when conditions warrant.

Head/Eye/Ear:
(**x****) Hard Hat (**x**) Safety Glasses (**x**) Goggles
( ) Splash Shield ( ) Ear Plugs/ Muffs
( ) Other

Gloves: (outer) (**x**) Nitrile ( ) Neoprene ( ) PVC
(inner) ( ) N-dex Nitrile ( ) Vinyl ( ) Other

Footwear:
(**x**) Safety-toe (steel toed) ( ) Overboots
( ) Safety-toe Rubber ( ) Other _____

Level Of Protection: ( ) A ( ) B (**x**) **C** ( ) D ( ) Modified D

Respirator: (Level C and above)

( ) SCBA, Airline (**x**) Purify. Resp. ( ) Escape Mask
(**x**) OV/AG Cart. ( ) Other _____

Protective Clothing: ( ) Encap. Suit (**x**) Tyvek® ( ) PE Tyvek®
( ) Saranex ( ) Splash Suit (**x***) Safety Vest
(**x**) Other Field clothing to protect from cold/sun/heat exposure- long pants, shirts (cotton) with sleeves. Rain gear should be available when conditions warrant.

Head/Eye/Ear: (**x****) Hard Hat (**x**) Safety Glasses (**x**) Goggles
( ) Splash Shield ( ) Ear Plugs/ Muffs
( ) Other

Gloves: (outer) (**x**) Nitrile ( ) Neoprene ( ) PVC
(inner) ( ) N-dex Nitrile ( ) Vinyl ( ) Other

Footwear: (**x**) Safety-toe (steel toed) ( ) Overboots
( ) Safety-toe Rubber ( ) Other _____

Modifications Permitted: As determined by the SHSC. *Safety vests are required in areas where vehicles are operated, parked, and around roadways for visibility. **Hard hats will be worn when around heavy equipment operation or overhead hazards.

X = required PPE; * = modifications permitted; † =in case of upgrade.

4.0 SITE CONTROL

4.1 Visitor Access

All site visitors (except OSHA inspectors) must receive prior approval from the PM and client, and may do so only for the purposes of observing site conditions or operations. Upon arrival, visitors will report to the SHSC where he/she will receive and sign the Health and Safety Plan Acceptance form in Section 8.0. All visitors, regardless of their rank or professional level, will not be allowed into work areas unless training and medical requirements have been met and documented.

4.2 Site Security

Access will be limited to all controlled areas. All site staff and visitors will review the HSP and sign the acceptance page in Section 8.0. All equipment, tools, and property shall be secured at the end of the day. Personnel shall be aware of site control measures designed to minimize potential contamination of personnel and the potential to spread contamination outside the Exclusion Zone (EZ). These measures attempt to control contamination through defining the work zones and establishing decontamination procedures. The following discussion defines the different work zones in general and describes their purpose.

- **Exclusion Zone (EZ)** - the area(s) where work activities are being conducted with the potential for encountering Chemicals of Possible Concern (COPC).
- **Contamination Reduction Zone (CRZ)** - the area where personnel and equipment exiting are decontaminated.
- **Support Zone (SZ)** - the area outside the EZ and CRZ used for project management and coordination, and storage of equipment and vehicles.

The CRZ shall be located and sized to provide for easy but controlled site access and egress by personnel, vehicles, and equipment. The CRZ shall consist of an area to drop equipment, plastic bags for disposal of protective clothing, adequate soap and water for personnel and equipment decontamination. A first-aid kit, fire extinguisher (20 lb. ABC-type), and portable eyewash shall be located on the clean side of the CRZ. The type of equipment to be staged in the CRZ will be dependent on the work activities and the potential COPC present.

The SZ shall be located near to, and upwind (when possible) of, the worksite to minimize potential exposures to site-associated contaminants. It shall be positioned and sized to provide adequate space for the staging and support activities. Provided that the entire property has the potential to be impacted to some extent by COPC from overspray of agricultural chemical, the SZ will be located in an area that is least likely to be impacted.

4.3 Communications

The "buddy system" will be enforced for field activities involving potential exposure to hazardous or toxic materials. Each person will observe his/her buddy for symptoms of chemical or cold/heat overexposure and provide first aid or emergency assistance when warranted. A mobile phone or hand held radio will be maintained on-site for emergency use.

5.0 SANITATION AND ILLUMINATION

Potable drinking water shall be supplied in tightly closed containers and shall be clearly marked for its intended use. If vehicles are available for use by field crews, restrooms and a field washing area with potable water will be available within a reasonable distance from the site. If such toilet facilities are not located within a reasonable distance, portable facilities will be installed for use by field employees. Since the nature of the project is mobile and of a duration less than six months, no permanent on-site restroom will be provided.

It is anticipated that all site work will be conducted during daylight hours. If circumstances arise in which field work is to be conducted before or after daylight, or sunlight is obstructed, illumination within all general site areas will be maintained at or above five foot-candles for general site areas.

6.0 EMERGENCY ACTIONS

6.1 Preplanning and General Procedures

GENERAL EMERGENCY INFORMATION:

Site personnel should be constantly alert to recognize potentially unsafe work practices, hazardous work environments, and immediately dangerous to life and health (IDLH) conditions and they should be routinely reminded of signs and symptoms of chemical and heat overexposure. Emergency response procedures (this section) should be reviewed daily; and should be updated, as necessary, following incidents. Prearrange access for emergency crews when necessary.

EMERGENCY COORDINATOR:

The SHSC or PM will serve as the EC during an actual emergency response situation. The SHSC or PM will serve as the primary EC at all times; first-aid and rescue duties are shared between the first-aid/CPR trained team members. All foreseeable first-aid and rescue equipment should be stored on-site in an accessible area. The EC will contact offsite emergency response agencies and serve as the main spokesperson when the responders arrive on-site.

SITE MAPS:

An updated site map (**see Appendix 1**) that is used during daily tailgate meetings will be used to inform the staff of hazardous areas, site terrain, evacuation routes, work crew locations, and any site changes. In the unlikely event that an emergency occurs, the problem areas will be pinpointed on the site map, and pertinent information, such as weather and wind direction, temperature, and forecast, will be added as obtained. This map will be provided to the responding agencies.

EMERGENCY EQUIPMENT:

Maintained in field vehicle and all items must be checked and maintained by the SHSC or SC at least weekly and after each use.

(**X**) First-aid Kit	(**X**) Fire Extinguisher*	( ) Field showers
( ) SCBA	( ) Escape Packs	( ) Alarms
( ) Spill Equipment	(**X**) Mobile Phone	( ) Fire Blanket
( ) Other	(**X**) Hospital Route Map	

*Fire Extinguisher is maintained/supplied by the subcontractor and located on the subcontractor vehicle.

EVACUATION PROCEDURES:

In the unlikely event that an evacuation is necessary, all personnel will immediately proceed to the predetermined safe refuge area.

6.2 Site-Specific Response Scenarios

WEATHER-RELATED EMERGENCIES:

All work will cease should any of the following weather conditions arise:

- Poor visibility
- Precipitation severe enough to impair safe movement/travel
- Lightning in the immediate area
- Winds in excess of 40 miles per hour
- Flooding
- Other conditions as determined by the SHSC or PM

FIRE OR EXPLOSION:

Sound the emergency alarm (continuous blast on a vehicle horn or direct oral communication) to summon the EC who will decide whether to call the Fire Department for outside assistance. Small-scale fires (less than one-half of the responder's height) should be extinguished with an accessible, ABC fire extinguisher by any team member who has received training. Trained emergency crews will be summoned to control any large-scale or potentially unmanageable incident. Any off-site responding agencies will be briefed about the site-specific hazards so that they can be optimally helpful in an emergency situation. The EC will evacuate all personnel within the working zone to a place of safe refuge in the event of a release.

6.3 Medical Emergency Response

SITE PERSONNEL RESPONSE ACTIONS:

Sound emergency alarm (continuous blast on a vehicle horn) or direct verbal communication to summon the ECs who will assess the situation, taking first the necessary precautions for personal safety. The ECs will determine whether to transport the injured party, or summon an ambulance by calling 911. The Site Control Measures will be implemented. Any offsite responding agencies will be informed about the site-specific hazards so that they can be optimally helpful in an emergency situation.

The EC will direct that the employees responding provide first aid to the extent possible while awaiting medical attention. Medical treatment may range from bandaging of minor cuts and abrasions to lifesaving techniques; therefore, first-aid/ CPR training are required for all AMEC staff. The SHSC will serve as the primary caregiver and bloodborne pathogen officer (see also Bloodborne Pathogen Control Plan), but these duties are shared between qualified team members. It is essential that all site personnel in need of emergency care receive treatment. Appropriate documentation and notification will be discussed later in this section.

EMERGENCY FIRST AID PROCEDURES	
To Stop Bleeding	**CPR**
1. Give medical statement. 2. Assure airway, breathing, and circulation. 3. Use **DIRECT PRESSURE** over the wound with clean dressing or your hand (use non-permeable gloves). Direct pressure will control most bleeding. 4. Bleeding from an artery or severe injury may require **DIRECT PRESSURE** on a **PRESSURE POINT**. Use pressure points for 30 – 60 seconds to help control severe bleeding. 5. Continue primary care and seek medical aid as needed.	1. CHECK the scene and ill/ injured person. 2. CALL 911. 3. CHECK for breathing, if not, give 2 rescue breaths. 4. If no sign of life or movement, give CARE by starting CPR. 5. Chin lift and give 2 rescue breaths followed by 30 chest compressions until a more qualified person arrives, there are no signs of life, or you are too tired to continue.

6.4 Bloodborne Pathogen Exposure Control Plan

EXPOSURE DETERMINATION:

First-aid responders have the potential to be exposed to bloodborne pathogens. The potential for exposure to bloodborne pathogens outside of emergency response is not anticipated.

Exposure Control

UNIVERSAL PRECAUTIONS:

Use of the Center for Disease Control "Universal Precautions" as an approach to infection control, which assumes that all human blood and certain human body fluids are treated as if known to be infectious for Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), and other bloodborne pathogens.

PERSONAL PROTECTION EQUIPMENT:

While rendering first aid where exposure to blood may occur, AMEC employees will don, at a minimum, latex or nitrile gloves. Protective gloves will be available in the field first-aid kit in a packet.

EXPOSURE INCIDENT EVALUATION:

All first-aid incidents involving exposures must be reported to the HSM before the end of the work shift in which the incident occurs. A First-aid Incident Report (see **Appendix 3**) must be completed describing the circumstances of the accident and response in addition to the Supervisor's Report of Injury or Illness form. Following a report of an exposure incident, AMEC shall provide to the exposed employee monitoring for HIV or HBV antibodies and medical counseling in cases of positive tests for HIV or HBV.

WASTE DISPOSAL:

Should bio-hazardous waste be generated as a result of a field related injury, the "contaminated" waste and area will be cleaned to the extent possible and arrangements for the pickup and final disposal of the waste will be made by calling an appropriate waste hauler.

HBV VACCINATION DECLINATION:

For whatever reason (religious, personal, or otherwise), employees may decline or refuse the HBV vaccination by contacting the HSM. In instances where the vaccination is required, the employee will be required to sign a waiver (see SHSC for form) indicating he/she has chosen at that time to refuse the vaccination, but may elect to receive it in the future at no expense to him/her.

HBV vaccination is not required for this project.

6.5 Spill of Hazardous Substances

AMEC personnel will not be working with large quantities of hazardous substances during this project. If a small spill does occur and after taking precautions for personal safety, AMEC or the subcontractor will contain the spill if possible with on-site equipment, to the extent that the responder's training and capability allows. The EC will evacuate all non-response personnel and visitors to the refuge area. Contained materials must be properly drummed and handled as hazardous waste. The PM will notify the client to contact the US EPA within 24 hours after occurrence, provided the spill is greater than the reportable quantity.

6.6 Accident Reporting and Record Keeping

The SHSC will contact the HSM and conduct an investigation jointly with the PM. The PM will complete the Supervisor's Report of Injury or Illness and First-aid Incident Report (see **Appendix 3**). **These completed reports must be transmitted to the HSM and Office SC within 24 hours of an occurrence**; a fax is acceptable. The HSM will submit the appropriate reports to the AMEC Human Resources department (for Workers' Compensation), the CHSD (according to the Accident Reporting SOP), and OSHA (as applicable).

In case of environmental incidents, property damage, power disruption, or mandated work "shutdowns," an Incident Report (see **Appendix 3**) will be prepared by the PM. Any damage, loss, or theft of AMEC property (items/tools/equipment) will be reported to the office HSC.

Any release of information to unauthorized persons or agencies in these reports is prohibited unless it is first approved by the client. Certain agencies or persons, such as OSHA or OSHA inspectors, can request this information and its release will be permitted. Review the Emergency Call List for additional contact names and phone numbers.

6.7 Emergency Reference List

RESPONDING EMERGENCY AGENCIES

SERVICE	NAME	CONTACT NUMBER
Ambulance	Local EMS	911
Fire Department	Local Fire	911
Police Department	Local Police	911
National Response Center	N/A	800-424-8802
Poison Control Center	N/A	800-222-1222
OSHA	N/A	800-321-OSHA (6742)

AMEC CALL LIST:

TITLE	NAME	CONTACT NUMBER
Project Manager	Bonani Langan	919-447-2750 (Office)
Field Team Member/SHSC	Anthony Kellogg Beth Espitia	716-474-6247 (cell) 919-346-1636 (cell)
Client – Alcatel-Lucent	Dikran Kabbendjian	(919) 850-6248
Corporate Health and Safety Director	Vlad Ivensky, CIH	610-877-6144 (Office)
Office Safety Coordinator	Amy Orcutt	919-447-2750 (Office)
WorkCare 24/7 Hotline (**Must Call Within 1 Hour**)		(888) 449-7787

*In the event of an occupational accident or incident, please indicate to the medical facility that this is a Workers' Compensation case.

7.0 DECONTAMINATION PROCEDURES

7.1 Equipment Decontamination

All equipment that will potentially contact samples will be decontaminated prior to, and following, sampling events according to procedures specified in the sampling plan and field procedure. Temporary decon stations (bucket wash) will be located near work areas and will be positioned upwind or crosswind of operations. Please refer to the AMEC Sampling Equipment, Heavy Equipment, and Vehicle Decontamination SOP H-5, for additional guidance.

For this project, the sample equipment will be decontaminated between well locations with an Alconox or Liqui-nox solution followed by a tap water rinse and then a deionized water rinse. Purge water will be placed in the existing groundwater treatment system for treatment and discharge.

7.2 Disposal Procedures

All discarded materials that accumulate from on-site activities (PPE, decon fluids, supplies, etc.) will be segregated by matrix and by source location; placed in approved containers, and stored in a secure, location at the site designated by the client. Analytical results will be evaluated prior to disposal. All investigation-derived waste (IDW) will be handled, labeled, stored, inventoried and disposed of in accordance with the Work Plan.

Purge water will be placed in the existing groundwater treatment system for treatment and discharge.

8.0 HEALTH AND SAFETY PLAN ACCEPTANCE

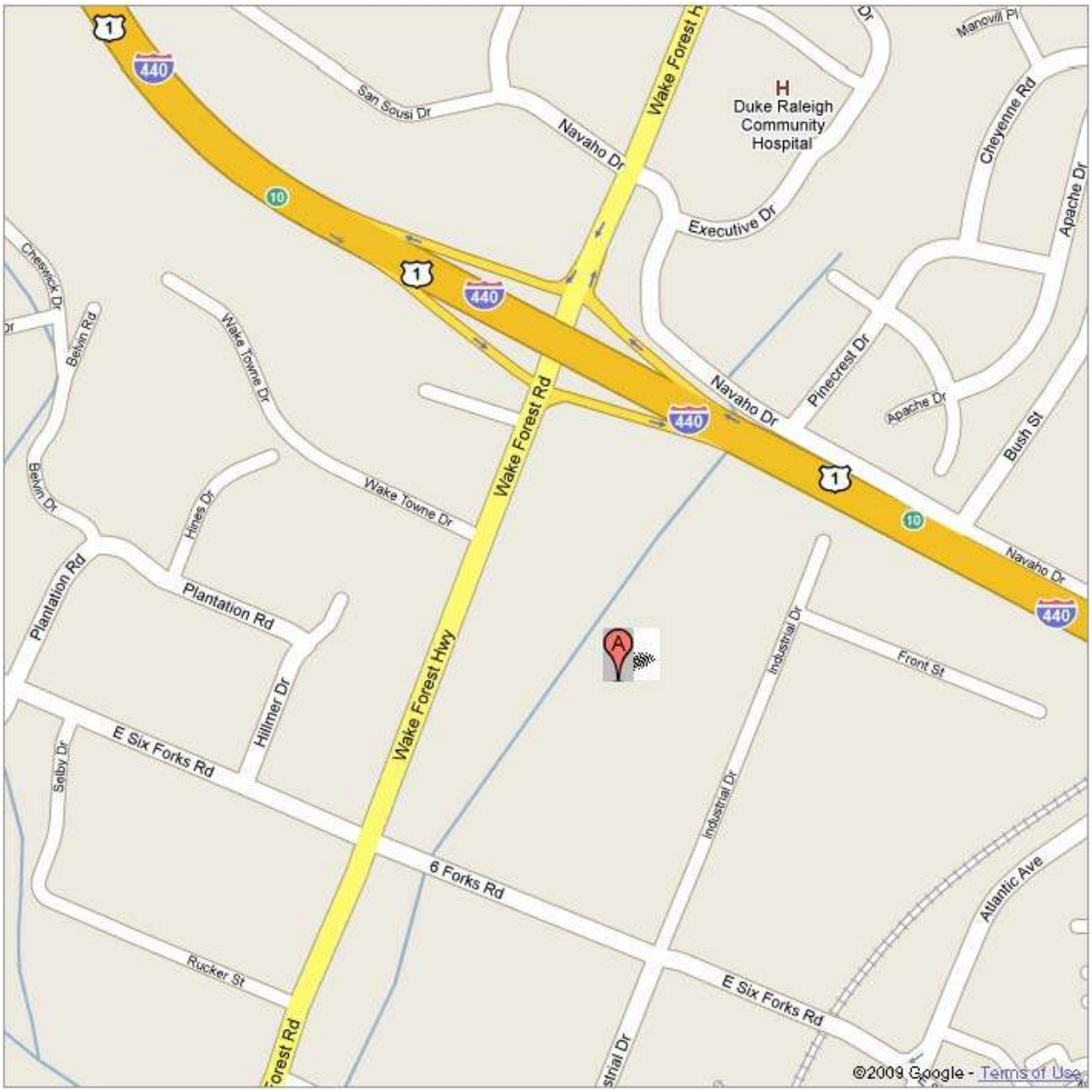
I have had the opportunity to read and ask questions about this HSP. ***My signature certifies that I understand the procedures, equipment, and restrictions of this plan and agree to abide by them.***

PRINTED NAME	SIGNATURE*	COMPANY	DATE

* This acceptance form is required for all routine site staff and subcontracting personnel.

APPENDIX 1

SITE LOCATION

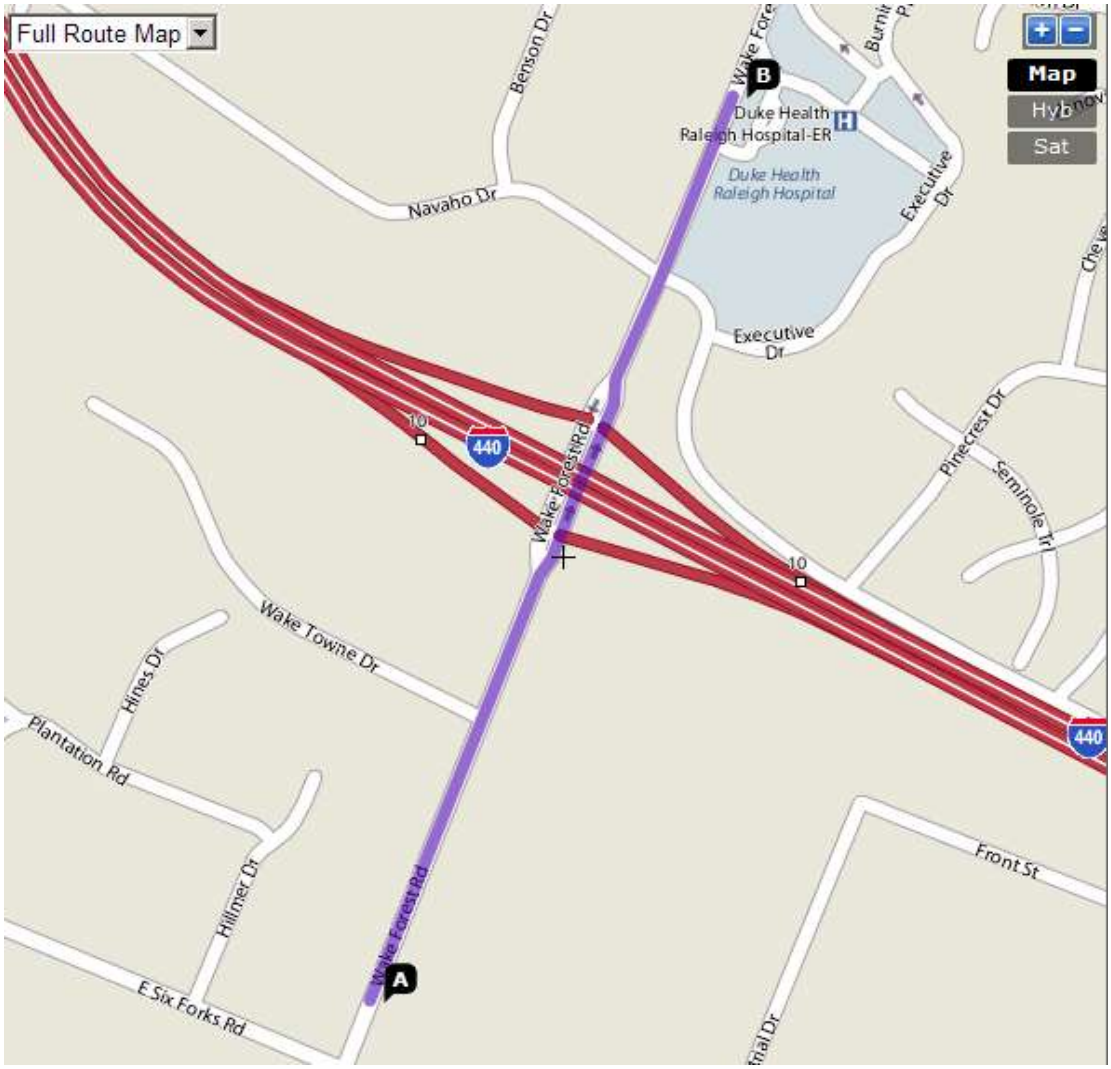


APPENDIX 2

MAP TO NEAREST MEDICAL FACILITY

Hospital Directions:

HOSPITAL NAME:	HOSPITAL ADDRESS:
Duke/Raleigh Medical Center	**3400 Wake Forest Rd Raleigh, NC 27609**
HOSPITAL TELEPHONE:	**DIRECTIONS:**
(919) 954-3000	1. Start at 2912 Wake Forest Rd, Raleigh going toward Wake Towne Drive. Go 0.6 mi 2. Arrive at 3400 Wake Forest Rd, Raleigh, on the **RIGHT**



APPENDIX 3

SITE FORMS

Check one
Initial Report: ☐
Update: ☐
Final Report: ☐ ____

INCIDENT ANALYSIS REPORT

AMEC Environment & Infrastructure

Confidential - Privileged

Incident Potential
Letter: Select One
Number: Select One
Investigation Level: Select One

Group: Select One Group HSE Manager: ____ Incident Review Panel Team (if applicable): ____

Incident Date: _____ Report Date: _____

Section 1 – General Information

Employee Name: ____ Sex: ☐ M ☐ F Date of Birth: ____ Age Range: Select One

Job Position: Select One Hire Date: ____ Time employee began work: _____ Time of incident: ____ ☐ am | ☐ pm

Business Line: Select One Department Number: ____ Project Manager: ____

Project Name: ____ Project Number: ____ Client: ____

Office where employee works from: ____ Immediate Supervisor: ____ Hours employee worked during last 7 days: ____ hrs

Location: Select One Is this a Company controlled work site: ☐ Yes ☐ No Incident Assigned to: Select One

Location description: ____

Section 2 – Incident Type - Process (**mark at least ONE BOLD TYPE** and all that apply)

☐ **Fatality** ☐ **Environmental** ☐ **Injury/Illness Incident** If Injury/illness: Select One

☐ **Security** ☐ **Near Miss / Hazard ID** ☐ **Property Damage** If Damage: Select One ☐ 3rd Party?

☐ Hospitalization ☐ Regulatory Inspection ☐ Notice of Violation or Citation ☐ Agency Reportable?

☐ Motor Vehicle Incident Involving Injury ☐ Other (describe): ___

Outcome/Result: Select One Source of Hazard: Select One If "other", specify: ___ Immediate Cause: Select One

A. If **injury/illness**: Indicate the part of the body: Select One If "other", specify: ___
   Indicate body part location: Select One If "other", specify: ___
   Injury Type: Select One If "other", specify: ___ Illness Type: Select One If "other", specify: ___
B. If **property damage**: describe what happened and estimate ($) of damage to all objects involved? ___
C. If **environmental**: Type of Environmental incident?: Select One Name, CAS#, physical state and quantity? ___
   Receiving Environment?: Select One Mechanism of Incident?: Select One If "other", specify: ___
   Nature of Breach?: Select One Duration of Breach?: Select One
D. If **security**: Security Incident Type: Select One If Physical: Select One If Criminal: Select One If Intellectual: Select One
E. If an **inspection by a regulatory agency**, what agency, who were the inspectors, inspector contact information? ___

Section 3 – Incident Description

Attach and number additional pages, as needed, to ensure all details related to the incident are captured.

A. List the names of all persons involved in the incident, and employer information: ___
B. List the names of any witnesses, their employer, and a local/company telephone number or address: ___
C. Name of Employee's supervisor: ___ Contact phone number for supervisor: ___
D. What specific job/task or action was the employee(s) doing just prior to the incident: ___
E. Was a tool or equipment involved? ☐ Yes ☐ No What was it: ___ Last Inspection Date: ___Defects: ___
F. Explain in **detail** what happened: ___
G. Explain in **detail** what object or substance directly harmed the employee: ___

H. What were the weather conditions at time of incident?: ____

I. What was the lighting like at time of incident? Bright ☐ Shadows ☐ Dark ☐ Other: ____

J. List any damaged equipment or property (other than motor vehicles). Provide model and serial number **and** estimated costs to repair/replace damaged equipment or property, if applicable: ____

Section 4 - Incident Analysis

A. Was a Health and Safety Plan (HASP) or Activity Hazard Analysis (AHA) completed for the work being performed? ☐ Yes ☐ No
If "yes", Who prepared the document?: ____

B. Who and when was the last manager (Project, Unit, etc.) at the site of the incident?: ____

C. When and what safety training **directly related** to the incident has the person(s) involved had?: ____

D. List attached documentation (HASP acknowledgement forms, kickoff/daily/weekly meetings, inspections, photographs): ____

Section 5 - Incident Investigation Results and Corrective Actions

This section to be completed by the Group HSE Manager/IRP with support from location where incident occurred, in accordance with AMEC A-Z List of Accident Causes.

Causal Factors (Acts or Omissions / Conditions)

(Attach and number any additional pages as needed to completely address this section)

	IMMEDIATE CAUSE	IMMEDIATE CAUSE SUB-TYPE	DESCRIPTION
1	Select One	_____	_____
2	Select One	_____	_____
3	Select One	_____	_____
4	Select One	_____	_____

Root Cause(s) Analysis - The below items represents major root cause categories which have been determined to be Less Than Adequate (LTA). A more detailed determination of the root cause will be facilitated, if needed, by the applicable Group HSE Manager / IRP.

	ROOT CAUSE TYPE	ROOT CAUSE SUB-TYPE	DESCRIPTION
1	Select One	_____	_____
2	Select One	_____	_____
3	Select One	_____	_____
4	Select One	_____	_____

Corrective Actions

Root Cause #	Corrective Actions Taken (Attach additional pages as needed to completely address this section)	Responsible Person	Proposed Completion Date	Closed on Date	Verified by and Date Verified
_____	____	____	____	____	____
_____	____	____	____	____	____
_____	____	____	____	____	____
_____	____	____	____	____	____

Section 6 - Notifications, Certification & Approvals

Check the appropriate boxes indicating the applicable reports have been made to the following applicable organizations:

Auto Insurance Carrier was called ☐ **Group HSE Manager Notified** ☐

WorkCare was called ☐ **Post-incident Drug/Alcohol Testing Performed** ☐

Incident Report prepared by: ___

Employee (s):	Date:	Employee's Supervisor:	Date:
HSE Coordinator/Project/Unit Manager:	Date:	Group HSE Manager:	Date:

ATTACHMENT 2

VEHICLE INCIDENT REPORT

Confidential - Privileged

Section 1 - General Information Date of Incident: _____

Time incident occurred: _____ ☐ am | ☐ pm | Illumination: ☐ Dark ☐ Dusk ☐ Light | Road Condition: ☐ Dry ☐ Wet ☐ Icy/snow

Were police summoned to scene? ☐ Yes ☐ No Police Department and Location: _____

Report #; _____ Officer's Name: _____ Officer's Badge Number: _____

Section 2 - Company Driver and Vehicle

Driver's name: _____ D/L #: _____ State: _____

Driver's home office address: _____ Driver's Phone #: _____

Company Vehicle #: _____ Year: _____ Model: _____ License #: _____ State: _____

Company car?: ☐ Yes ☐ No Personal Vehicle?: ☐ Yes ☐ No Rental Vehicle?: ☐ Yes ☐ No

If rental, rented from: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Damage to vehicle: _____

Was an employee injured?: ☐ Yes ☐ No If yes, please describe: _____

Injuries to others?: ☐ Yes ☐ No If yes, please describe: _____

Vehicle was being used for: Company business ☐ Yes ☐ No Personal business ☐ Yes ☐ No

Towed?: ☐ Yes ☐ No If yes, by whom?: _____ To Where?: _____

Section 3 - Other Driver and Vehicle Information

Driver's Name: _____ D/L # : _____ State: _____

Current address: _____ City: _____ State: _____

Telephone: _____ Work: _____ Cell: _____

Registered Owner's Name: _____ Address: _____ City: _____ State: _____

(verify registration document)

The Other Vehicle: Make: _____ Model: _____ Year: _____ License #: _____ State: _____

Insurance company name: _____ Address: _____ Phone #: _____

Policy No.: _____ Contact Person: _____ Phone #: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Damage: (*Make note of pre-existing damage and take pictures if possible – you may attach additional pages if necessary):* _____

Injuries to other driver/passengers: _____

Section 4 – Approvals (signatures required)

Form completed by (please print): _____ Date: _____

Signature: _____

Office/Project Manager (please print): _____ Date: _____

Signature: _____

© AMEC 2012

Things to Do First In The Event Of a Motor Vehicle Incident

GENERAL INFORMATION

1. Do not decide on your own whether a particular incident is "covered" by insurance. Should there be any doubt, it is always preferable to report an occurrence, as this allows underwriters, the Risk Management Department and insurance adjusters to determine if a covered loss has taken place.

2. Policy Conditions do require that all losses and occurrences, which may result in a claim be promptly reported.

3. Do not admit liability or offer your opinion of liability to anyone.

4. Complete this IAR/VIR form promptly and forward with all applicable supporting documentation. It is essential both division and location information be provided.

5. For automobile collisions within the **United States**, please indicate on the IAR form that you have contacted Zurich at:

Zurich Insurance Company
1-800-987-3373 or
1-877-928-4531
24 hours a day, 7 days a week

6. For automobile collisions within **Canada**, please indicate on the IAR form that you have contacted Zurich at:

Crawford Adjusters Canada
Claims Alert
1-888-218-2346
24 hours a day, 7 days a week

The more details you have the better but, don't delay reporting if you don't have all of the information - that may be obtained later. A Zurich trained operator will answer your call and ask for all relevant information regarding the incident. The initial information required includes:

- Your division,
- Office location and division contact name – advise that you are an AMEC Company
- Name, drivers license and phone number of the driver involved in the loss
- Description of the vehicle which he/she was driving (i.e., year, make, model, license plate number, serial number)
- Date, time and location of incident
- Passenger information (if applicable)
- Third party information (i.e., name, phone number, address, vehicle information, insurance information)
- If any injuries occurred (if applicable)
- Police information
- Witness information (if applicable)

Call 911 if there are serious injuries!

If you are injured or think you were injured, **contact your supervisor and call WorkCare at 888-449-7787**. Your supervisor will notify your HSE Coordinator and your Group HSE Manager. For additional instructions on what to do, go to AMEC's HSE website at:

http://ee.amecnet.com/she/sheweb/incident_reporting.htm

1. Call for an officer if the incident occurred on public property (streets, highways or roads). Disputes often arise between the parties involved as to who was at fault; therefore, a police report is important. If an officer is unable to attend the scene of the collision, a counter police report may be filed at most stations. Insurance companies rely on police reports to determine liability.

2. Complete the Incident Investigation Report and the Vehicle Incident Report forms. It is important that both these forms are completed in detail. Include a diagram of the incident on the provided sheet. Incomplete information may lead to delays in processing associated claims and in helping to prevent this type of incident from occurring again.

3. Give only information that is required by the authorities or as directed by AMEC contractual requirements.

4. Sign only those statements required by the authorities or as directed by AMEC contractual requirements. Do not sign away your or the company's rights.

© AMEC 2012

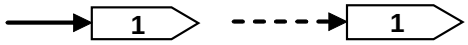
Vehicle Incident Diagram

This or a similar diagram <u>must be completed</u> with all VIRs

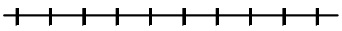
Instructions:

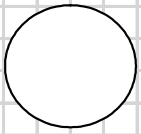
1. Number each vehicle and show directions

2. Use a solid line to show path before incident and use a dotted line to show path after incient



(before) (after)

3. Show pedestrian/non-motorist by:
4. Show railroad by: 
5. Indicate north by arrow as:
6. Show street or highway names or numbers
7. Show signs, signals, warning and traffic controls.



Indicate North
by Arrow

Prepared by: _____ Date: _____

© AMEC 2012

GROUND DISTURBANCE INCIDENT REPORT

AMEC Environment & Infrastructure

Section 1 – General Information

Employee Name: _____ Time of incident: _____ ☐ am | ☐ pm Time Reported:_____☐ am | ☐ pm Report Date: _____

Project Name: _____ Project Number: _____ Client: _____

List of All Parties Present

Name	Company	Telephone No.	Role
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____

Describe the chronological description of Incident and response:____

Section 2 – Date and Location of Event

A. *Date of Event: (MM/DD/YYYY)

B. ***Country** ***State** ***County** **City**

C. **Street address** **Nearest Intersection**

D. *Right of Way where event occurred

E. Public: ☐ City Street ☐ State Highway ☐ County Road ☐ Interstate Highway ☐ Public-Other

F. Private: ☐ Private Business ☐ Private Land Owner ☐ Private Easement

G. ☐ Pipeline ☐ Power /Transmission Line ☐ Dedicated Public Utility Easement

☐ Federal Land ☐ Railroad ☐ Data not collected ☐ Unknown/Other

List attached documentation (Public Utility Locates, Private Utility Locates, Copy of notifications submitted to Owner or other utility Owners, photographs): _____

Section 3 – Affected Facility Information

***What type of facility operation was affected?**

☐ Cable Television ☐ Electric ☐ Natural Gas ☐ Liquid Pipeline ☐ Sewer (Sanitary Sewer)

☐ Steam ☐ Telecommunications ☐ Water ☐ Unknown/Other

***What type of facility was affected?**

☐ Distribution ☐ Gathering ☐ Service/Drop ☐ Transmission ☐ Unknown/Other

Was the facility part of a joint trench?

☐ Unknown ☐ Yes ☐ No

Was the facility owner a member of One-Call Center?

☐ Unknown ☐ Yes ☐ No

Section 4 – Excavation Information

***Type of Excavator**

☐ Contractor ☐ County ☐ Developer ☐ Farmer ☐ Municipality ☐ Occupant
☐ Railroad ☐ State ☐ Utility ☐ Data not collected ☐ Unknown/Other

***Type of Excavation Equipment**

☐ Auger ☐ Backhoe/Trackhoe ☐ Boring ☐ Drilling ☐ Directional Drilling
☐ Explosives ☐ Farm Equipment ☐ Grader/Scraper ☐ Hand Tools ☐ Milling Equipment
☐ Probing Device ☐ Trencher ☐ Vacuum Equipment ☐ Data Not Collected ☐ Unknown/Other

***Type of Work Performed**

☐ Agriculture ☐ Cable Television ☐ Curb/Sidewalk ☐ Bldg. Construction ☐ Bldg. Demolition
☐ Drainage ☐ Driveway ☐ Electric ☐ Engineering/Survey ☐ Fencing
☐ Grading ☐ Irrigation ☐ Landscaping ☐ Liquid Pipeline ☐ Milling
☐ Natural Gas ☐ Pole ☐ Public Transit Auth. ☐ Railroad Maint. ☐ Road Work
☐ Sewer (San/Storm) ☐ Site Development ☐ Steam ☐ Storm Drain/Culvert ☐ Street Light
☐ Telecommunication ☐ Traffic Signal ☐ Traffic Sign ☐ Water ☐ Waterway Improvement
☐ Data Not Collected ☐ Unknown/Other

Section 5 – Pre-Excavation Notification

***Was the One-Call Center notified?**

☐ Yes ☐ No If Yes, which One-Call Center? Ticket number:

Was Private Contract Locator used?

☐ Yes ☐ No

Section 6 – Locating and Marking

***Type of Locator**

☐ Utility Owner ☐ Contract Locator ☐ Data Not Collected

***Were facility marks visible in the area of excavation?**

☐ Yes ☐ No ☐ Data Not Collected

***Were facilities marked correctly?**

☐ Yes ☐ No ☐ Data Not Collected

What technology was used to locate utilities?

☐ Maps ☐ Active(transmitter+receiver) ☐ Passive (receiver only) ☐ GPR
☐ Acoustic ☐ Magnetic ☐ Infrared ☐ Unknown/Other

What Factors affected the ability to locate services?

☐ Soil Type:_____ ☐ Non-Grounded ☐ Common Bonded ☐ Depth
☐ Electromagnetic interference ☐ Parallel facilities ☐ Congested facilities ☐ Unknown/Other

Section 7 – Excavator Downtime

Did Excavator incur down time?

☐ Yes ☐ No

If yes, how much time?

☐ Unknown ☐ Less than 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 or more hours Exact Value _____If

Estimated cost of down time?

☐ Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value _____

Section 8 – Description of Damage

***Was there damage to a facility?**
☐ Yes ☐ No (i.e. near miss)
***Did the damage cause an interruption in service?**
☐ Yes ☐ No ☐ Data Not Collected ☐ Unknown/Other
If yes, duration of interruption
☐ Unknown ☐ Less than 1 hour ☐ 1 to 2 hrs ☐ 2 to 4 hrs ☐ 4 to 8 hrs ☐ 8 to 12 hrs ☐12 to 24 hrs
☐ 1 to 2 days ☐ 2 to 3 days ☐ 3 or more days ☐ Data Not Collected Exact Value _____
Approximately how many customers were affected?
☐Unknown ☐ 0 ☐ 1 ☐ 2 to 10 ☐ 11 to 50 ☐51 or more Exact Value _____
Estimated cost of damage / repair/restoration
☐Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value _____
Number of people injured
☐ Unknown ☐0 ☐ 1 ☐ 2 to 9 ☐ 10 to 19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value _____
Number of fatalities
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 9 ☐ 10 to 19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value _____

Was there a Product Release?
Product Release: ☐ No ☐ Yes ☐ N/A Type: ____ **If Yes, Incident Type is Environmental Report.**
Volume: ____ Spill Controls: ____
Repair Process: ____

Section 9 – Description of the Root Cause

Please choose one

One-Call Notification Practices Not Sufficient
☐ No notification made to the One-Call Center
☐ Notification to one-call center made, but not sufficient
☐ Wrong information provided to One Call Center

Locating Practices Not Sufficient
☐ Facility could not be found or located
☐ Facility marking or location not sufficient
☐ Facility was not located or marked
☐ Incorrect facility records/maps

Excavation Practices Not Sufficient
☐ Failure to maintain marks
☐ Failure to support exposed facilities
☐ Failure to use hand tools where required
☐ Failure to test-hole (pot-hole)
☐ Improper backfilling practices
☐ Failure to maintain clearance
☐ Other insufficient excavation practices

Miscellaneous Root Causes
☐ One-Call Center error
☐ Abandoned facility
☐ Deteriorated facility
☐ Previous damage
☐ Data Not Collected
☐ Other

Section 10 - Notifications, Certification & Approvals

Check the appropriate boxes indicating the applicable reports have been made to the following applicable organizations:

One Call was called ☐ **Spills Reporting Agency Notified** ☐

Emergency Responders (Fire) was called ☐ **Post-incident Drug/Alcohol Testing Performed**

List of All Agencies Contacted

Name/Agency	Phone #	Date	Time

Incident Report prepared by: ____

Employee (s): ____ Date: ____

Employee's Supervisor: ____ Date: ____

HSE Coordinator/Project/Unit Manager: ____ Date: ____

Group HSE Manager:____ Date: ____