Quality Assurance Project Plan for Corrective Measures Study

ArcelorMittal Tecumseh Redevelopment Site
Lackawanna, New York

March 2009

0071-008-111

Prepared For:

ArcelorMittal Tecumseh Redevelopment, Inc.
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QUALITY ASSURANCE PROJECT PLAN

CORRECTIVE MEASURES STUDY

TECUMSEH REDEVELOPMENT SITE
LACKAWANNA, NEW YORK

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Prepared for:

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ArcelorMittal

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In association with:

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ACKNOWLEDGEMENT

Plan Reviewed by (initial):

Tecumseh: ____________________________________

TurnKey: ____________________________________

TestAmerica Laboratory: ____________________________________

NYSDEC Region 9: ____________________________________

NYSDEC Albany: ____________________________________

Acknowledgement:

I acknowledge that I have reviewed the information contained in this Quality Assurance Project Plan (QAPP), and agree to comply with the requirements of this plan.

NAME (PRINT)	SIGNATURE	DATE

QUALITY ASSURANCE PROJECT PLAN (QAPP)

Tecumseh Redevelopment Site

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1.0 INTRODUCTION

This Quality Assurance Project Plan, or QAPP, presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the proposed investigative scope of work described in the Corrective Measures Study (CMS) Work Plan to be implemented at the Tecumseh Redevelopment Site in Lackawanna, New York (Figure 1). The work is being performed on behalf of ArcelorMittal Tecumseh Redevelopment, Inc. (Tecumseh) under the Resource Conservation and Recovery Act (RCRA) program. The CMS Work Plan will be appended to and become part of an Order on Consent to be entered into by Tecumseh and the New York State Department of Environmental Conservation (NYSDEC). A Sampling, Analysis and Monitoring Plan (SAMP) describing specific protocols for sample collection, sample handling and storage, chain-of-custody, and laboratory and field analyses to be performed as part of the remedial measures is presented in Section 4.0 of this QAPP.

1.1 Background

ArcelorMittal Tecumseh Redevelopment, Inc. (Tecumseh) owns approximately 1,100 acres of land at 1951 Hamburg Turnpike, approximately 2 miles south of the City of Buffalo (see Figure 1). The majority of Tecumseh's property is located in the City of Lackawanna (the City), with portions of the property extending into the Town of Hamburg. Tecumseh's property is bordered by: NY State Route 5 (Hamburg Turnpike) on the east; Lake Erie to the west and northwest; and other industrial properties to the south and the northeast. Figure 2 provides an overview of the Tecumseh Property, including major leased or licensed parcels, and adjacent parcels owned by others.

The Tecumseh property is located on a portion of the site of the former Bethlehem Steel Corporation (BSC) Lackawanna Works in a primarily industrial area. The former BSC-Lackawanna Facility was used for iron and steel production since the beginning of the 20th century. Steel-making operations were discontinued by the end of 1983, and, by the mid-1990s, most of the steel-making facilities on the west side of Hamburg Turnpike (NYS Route 5) had been demolished. In September 2001, BSC's coke oven operation was terminated leaving only a galvanized products mill operating by BSC at the Site. Galvanizing operations were acquired by ISG Lackawanna, LLC pursuant to the asset purchase agreement that was approved by the Bankruptcy Court in April 2003. ISG, Inc. merged with

Mittal Steel Inc. in July 2005 to become Mittal Steel USA, Inc. In June 2007, Mittal Steel merged with Arcelor Steel, with Mittal Steel USA, Inc. and Tecumseh Redevelopment, Inc. respectively becoming ArcelorMittal USA, Inc. and ArcelorMittal Tecumseh Redevelopment, Inc.

1.2 Environmental Conditions

A RCRA Facility Investigation (RFI) of the entire former Bethlehem Steel Lackawanna Works was initiated by BSC under an Administrative Order issued by the United States Environmental Protection Agency (USEPA) in 1990. Under terms of the 1990 USEPA Order, BSC agreed to perform the RFI to identify the nature and extent of any release(s) of hazardous constituents from 104 Solid Waste Management Units (SWMUs). The potential impacts on water and sediment quality in six surface water bodies (watercourses) located on or adjacent to the former BSC-Lackawanna Facility were also to be addressed in the RFI. As the RFI Report was incomplete when Tecumseh acquired (most of) the former BSC-Lackawanna Facility in 2003, Tecumseh immediately initiated efforts to expeditiously complete the RFI. The Final RCRA Facilities Investigation Report submitted to USEPA in January 2005 recommended 38 SWMUs and three watercourses (i.e. Smokes Creek, Blasdell Creek, and the South Return Water Trench) for further evaluation with a Corrective Measures Study (CMS). In a letter dated May 17, 2006, USEPA identified five additional SWMUs and two additional watercourses for further evaluation in the CMS. All of the other SWMUs identified by USEPA in the 1990 Order were determined by USEPA to require no further assessment as they do not pose a significant potential risk to human health or the environment. Later, in September 2006, USEPA deemed the provisions of the 1990 Order to be satisfied and Tecumseh's obligations under the Order terminated.

Tecumseh is presently negotiating an Order on Consent with the NYSDEC to undertake corrective measures at certain SWMUs primarily on the western slag fill and coke manufacturing portion of the property. The CMS Areas on the Tecumseh property were formerly used to house portions of BSC's steel making operations. The slag and other industrial fill materials contain highly variable and sometimes elevated concentrations of metals, as well as semi-volatile and volatile organic compounds (SVOCs and VOCs). In addition, groundwater in contact with the soil/fill materials described above may exhibit elevated concentrations of corresponding soluble COPCs (e.g., BTEX) in groundwater. The CMS Areas are defined as follows:

- Slag Fill Area (SFA) – Zones 2, 3, 4, and 5 (approx. 230 acres, excluding Steel Winds I and IA)
- Coal, Coke, and Ore Handling and Storage Area (approx. 137 acres)
- Former Petroleum Bulk Storage (Tank Farm) Area (approx. 68 acres)
- Former Coke Plant and By-Products Facilities (approx. 45 acres)
- Watercourses (approx. 11 acres)

1.3 QAPP Preparation Guidelines

All QA/QC procedures described herein are structured in accordance with applicable technical standards, and NYSDEC's requirements, regulations, guidance, and technical standards. Specifically, this QAPP has been prepared in accordance with:

- *USEPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA QA/R-5, October 1998)
- *Region II CERCLA Quality Assurance Manual*, Revision I, EPA Region II, dated October 1989.
- *NYSDEC Technical Assistance and Guidance Memorandum (TAGM) 3014 – Quality Assurance Project Plan,* dated 1991.
- *NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation*, dated December 2002.

1.4 Scope of the QAPP

This QAPP was prepared to provide quality assurance (QA) guidelines to be implemented during the investigation activities. This document may be modified for subsequent phases of investigative work, as necessary. The QAPP provides:

- A means to communicate to the persons executing the various activities exactly what is to be done, by whom, and when.
- A culmination to the planning process that ensures that the program includes provisions for obtaining quality data (e.g., suitable methods of field operations).

- A historical record that documents the investigation in terms of the methods used, calibration standards and frequencies planned, and auditing planned.
- A document that can be used by the Prime Consultant Project Manager and QA Officer to assess if the activities planned are being implemented and their importance for accomplishing the goal of quality data.
- A plan to document and track project data and results.
- Detailed descriptions of the data documentation materials and procedures, project files, and tabular and graphical reports.

The QAPP is primarily concerned with the quality assurance and quality control aspects of the procedures involved in the collection, preservation, packaging, and transportation of samples; field testing; record keeping; data management; chain-of-custody procedures; laboratory analyses; and other necessary matters to assure that the investigation activities, once completed, will yield data whose integrity can be defended.

QA refers to the conduct of all planned and systematic actions necessary to perform satisfactorily all task-specific activities and to provide information and data confidence as a result of such activities. The QA for task-specific activities includes the development of procedures, auditing, monitoring and surveillance of the performance.

QC refers to the activity performed to determine if the work activities conform to the requirements. This includes activities such as inspections of the work activities in the field (e.g., verification that the items and materials installed conform with applicable codes and design specifications). QA is an overview monitoring of the performance of QC activities through audits rather than first time inspections.

1.5 Project Description

1.5.1 Project Objectives

The fundamental objectives of the Corrective Measures Study are to identify and evaluate feasible alternative remedies and to recommend a combination of corrective or remedial measures for the multiple SWMUs and water bodies that collectively will be protective of public health and the environment. Due to the massive size of the Tecumseh CMS Site, multiple SWMUs, and the diverse mix of waste materials and associated constituents of interest that vary by SWMU, water body and environmental media (i.e., soil/fill, sediment, groundwater, and surface water), corrective measure objectives may be defined by individual SWMUs; group(s) of SWMUs (in the circumstance they contain similar wastes and constituents or are spatially proximate); site- or area-wide (as in the case of groundwater); or by environmental media (as each media has different standards, regulations, guidelines and remedial methods). The corrective measure objectives are discussed further in the CMS Work Plan.

1.5.2 Project Overview

The CMS Areas on the Tecumseh property were formerly used to house portions of BSC's steel making operations or as solid waste disposal areas for wastes generated from both the steel making and coke oven operations. The slag and other industrial fill materials contain highly variable and sometimes elevated concentrations of metals, as well as semi-volatile and volatile organic compounds (SVOCs and VOCs). In addition, groundwater in contact with the soil/fill materials described above may exhibit elevated concentrations of corresponding soluble COPCs (e.g., BTEX) in groundwater.

The CMS Work Plan will be appended to and become a part of an Order on Consent to be entered into by Tecumseh Redevelopment, Inc. and the NYSDEC for the performance of a RCRA Corrective Measures Study consistent with applicable Federal and New York State hazardous waste regulations.

1.6 Site-Specific Soil/Slag/Fill Management Objectives

Practically the entire Tecumseh CMS Site is situated on Land Patent parcels that were reclaimed from Lake Erie by placement of dredge spoils by the United States Army Corps of Engineers (USACE) and subsequent deposition of steel-making slag and historical fill from former Bethlehem Steel iron-making, steel-making, steel-forming, steel-finishing, and coke-making operations, building demolition as well as materials dredged from Smokes Creek. The total quantity of (primarily slag) fill material contained in the CMS Site is estimated to be approximately 20 million cubic yards. The 43 SWMUs that received or may have received solid wastes containing hazardous substances from BSC's former steel-making operations SWMUs and identified by the USEPA as requiring further assessment in the CMS represent a small fraction of the approximately 518-acre CMS Area. While the RFI coupled with the previous RFA has determined that these 43 SWMUs represent the known areas where solid and hazardous wastes were disposed or handled on the CMS Site, it is reasonable to expect based upon the vast size and scope of former manufacturing operations and decades of unregulated waste management that some solid waste and/or petroleum constituents may be intermittently dispersed in the vast soil/slag/fill mass outside the boundaries of these SWMUs. Recent practical experience during subsurface construction related to the Steel Winds wind energy project in SFA Zones 3 and 4 validate those expectations.

A SFMP (see Appendix A of the CMS Work Plan) was developed with the purpose of addressing potentially contaminated soil/slag/fill, if and when encountered on the CMS Site during future redevelopment or slag reclamation activities, outside the known or defined boundaries of the SWMUs requiring further assessment in the CMS. Potentially contaminated soil/slag/fill identified by field screening would be sampled and analyzed to verify concentrations of constituents of interest. Contaminated soil/slag/fill found to exceed site-specific action levels (SSALs) would then be appropriately handled and/or disposed on-site or off-site.

1.7 Groundwater Objectives

Groundwater impacts within, under, and adjacent to individual SWMUs or SWMU groups are identified in Section 3.0, and the development and assessment of SWMU-specific alternative corrective measures are presented in Section 4.0 of the CMS Work Plan. Broader groundwater objectives for the entire CMS Site are addressed in the Long-Term Groundwater Monitoring (LTGWM) Plan presented in Section 6.3 of the CMS Work Plan. The objective of the LTGWM Plan is to monitor downgradient groundwater quality discharged from the entire CMS Area to adjacent surface water bodies Lake Erie, Smokes Creek, and the Ship Canal. CMS groundwater quality will be compared to the NYSDEC Class GA Groundwater Quality Standards/Guidance Values (GWQSs/GVs).

Groundwater quality and flow monitoring on or adjacent to portions of the CMS Site is already in progress at the Hazardous Waste Management Units (HWMUs) 1A, 1B, and 2 (SWMUs S-13, S-16, and S-03, respectively), the Steel Winds I Brownfield Cleanup Program Area, and the Benzol Plant ICM (SWMU P-11) in accordance with their respective post-closure requirements. Data and monitoring requirements from these three areas will be incorporated into the CMS Area LTGWM program and will continue to be monitored for groundwater quality and flow direction, satisfying both the post-closure requirements of those SWMUs as well as the LTGWM requirements. The LTGWM Plan will also be implemented to monitor the efficacy of each planned Interim Corrective Measure (ICM) and post-closure corrective action described in this CMS Work Plan as they are completed.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The principal organizations involved in verifying achievement of CMS goals for the Tecumseh Site include: the NYSDEC, ArcelorMittal Tecumseh Redevelopment, TurnKey, the drilling subcontractor, the independent environmental laboratory, and the independent third-party data validator. Roles, responsibilities and required qualifications of these organizations are discussed in the following subsections.

2.1 Management Responsibilities

2.1.1 NYSDEC and NYSDOH

It is the responsibility of the NYSDEC, in conjunction with the New York State Department of Health (NYSDOH), to review the CMS Work Plan and supporting documents, including this QAPP, for completeness and conformance with the site-specific cleanup objectives and to make a decision to accept or reject these documents based on this review. The NYSDEC also has the responsibility and authority to review and approve all QA documentation collected during remedial activities and to confirm that the QA Plan was followed.

- *NYSDEC Representative:* *Stanley Radon, Project Manager*
- *NYSDOH Representative:* *Cameron O'Conner, Project Manager*

2.1.2 ArcelorMittal Tecumseh Redevelopment, Inc.

Tecumseh will be responsible for complying with the QA requirements as specified herein and for monitoring and controlling the quality of the remedial design activities directly or through their designated environmental consultant and/or legal counsel. The designated Tecumseh Project Coordinator is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements. The Tecumseh Project Coordinator will provide the major point of contact and control for all matters concerning the project.

- *Tecumseh Project Coordinator:* *Keith Nagel, Managing Director*

2.1.3 TurnKey Environmental Restoration, LLC

TurnKey Environmental Restoration, LLC (TurnKey) is the prime consultant on this project and is responsible for the performance of all services required to implement each phase of the CMS Work Plan (hereafter referred to as the Work Plan), including, but not limited to, field operations, laboratory testing, data management, data analysis, and reporting. Any one member of TurnKey's staff may fill more than one of the identified project positions (e.g., field team leader and site safety and health officer). The various quality assurance, field, laboratory and management responsibilities of key project personnel are defined below.

- *TurnKey Project Manager (PM):* *Patrick T. Martin, P.E.*

  The TurnKey PM has the responsibility for ensuring that the project meets the Work Plan objectives. The PM will report directly to the BQ Energy Project Coordinator and the NYSDEC/NYSDOH Project Coordinators and is responsible for technical and project oversight. The PM will:

  - Define project objectives and develop a detailed work plan schedule.
  - Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
  - Acquire and apply technical and corporate resources as needed to assure performance within budget and schedule constraints.
  - Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
  - Review the work performed on each task to assure its quality, responsiveness, and timeliness.
  - Review and analyze overall task performance with respect to planned requirements and authorizations.
  - Review and approve all deliverables before their submission to NYSDEC.
  - Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
  - Ultimately be responsible for the preparation and quality of interim and final reports.
  - Represent the project team at meetings.

- *FTL/SSHO:* *Bryan C. Hann*

  The Field Team Leader (FTL) has the responsibility for implementation of specific project tasks identified at the Site, and is responsible for the supervision of project field personnel, subconsultants, and subcontractors. The FTL reports directly to the Project Manager. The FTL will:

  - Define daily develop work activities.
  - Orient field staff concerning the project's special considerations.
  - Monitor and direct subcontractor personnel.
  - Review the work performed on each task to ensure its quality, responsiveness, and timeliness.
  - Assure that field activities, including sample collection and handling, are carried out in accordance with this QAPP.

  For this project, the FTL will also serve as the Site Safety and Health Officer (SSHO). As such, he is responsible for implementing the procedures and required components of the Site Health and Safety Plan (HASP), determining levels of protection needed during field tasks, controlling site entry/exit, briefing the field team and subcontractors on site-specific health and safety issues, and all other responsibilities as identified in the HASP (see Attachment 2 of the Work Plan).

2.2 Quality Assurance (QA) Responsibilities

The QA Officer will have direct access to corporate executive staff as necessary, to resolve any QA dispute. She is responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations and TurnKey policies, and NYSDEC requirements. The QA Officer has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA issues.

- *Project QA Officer:* *Lori E. Riker, P.E.*

  Specific function and duties include:

  - Performing QA audits on various phases of the field operations (see Section 10).
  - Reviewing and approving QA plans and procedures.

- Providing QA technical assistance to project staff.
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the Project Manager for technical operations.
- Responsible for assuring third party data review of all sample results from the analytical laboratory.

2.3 Field Responsibilities

TurnKey field personnel for this project are drawn from a pool of qualified resources. The Project Manager will use the staff to gather and analyze data, and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

2.4 Laboratory Responsibilities

TestAmerica Laboratories, Inc. (TestAmerica), the environmental laboratory retained by TurnKey located at 10 Hazelwood Drive, Amherst, New York 14228, is an independent, NYSDOH Environmental Laboratory Approval Program (ELAP)-certified facility approved to perform the analyses prescribed herein. TestAmerica will report directly to the QA Officer, and will be responsible for immediately notifying the QA Officer of any problems with sample receipt, analysis or quality control.

- *TestAmerica Client Services Manager:* *C. James Stellrecht*

  The client services manager is responsible for the Client Services Department and will report directly to the Project Manager. The client services manager provides a complete interface with clients from initial project specification to final deliverables.

- *TestAmerica Laboratory Director:* *Chris Spencer*

  The Laboratory Director is a technical advisor and is responsible for summarizing and reporting overall unit performance. Responsibilities of the TestAmerica Laboratory Director include:

  - Provide technical, operational, and administrative leadership.
  - Allocation and management of personnel and equipment resources.
  - Quality performance of the facility.
  - Certification and accreditation activities.
  - Blind and reference sample analysis.

- *TestAmerica Quality Assurance Manager (QA Manager):* *Verl Preston*

  The TestAmerica QA Director has the overall responsibility for data after it leaves the laboratory. The TestAmerica QA Director will be independent of the laboratory but will communicate data issues through the TestAmerica Laboratory Director. In addition, the TestAmerica QA Director will:

  - Oversee laboratory QA.
  - Oversee QA/QC documentation.
  - Conduct detailed data review.
  - Determine whether to implement laboratory corrective actions, if required.
  - Define appropriate laboratory QA procedures.
  - Prepare laboratory SOPs.

  Independent QA review will be provided by the TestAmerica Laboratory Director and QA Director prior to release of all data to TurnKey.

- *TestAmerica Sample Management Office:* *Ken Kinecki*

  The TestAmerica Sample Management Office will report to the TestAmerica Laboratory Director. Responsibilities of the TestAmerica Sample Management Office will include:

  - Receiving and inspecting the incoming sample containers.
  - Recording the condition of the incoming sample containers.
  - Signing appropriate documents.
  - Verifying chain-of-custody.
  - Notifying laboratory manager and laboratory supervisor of sample receipt and inspection.

  - Assigning a unique identification number and customer number, and entering each into the sample-receiving log.
  - With the help of the laboratory manager, initiating transfer of the samples to appropriate lab sections.
  - Controlling and monitoring access/storage of samples and extracts.

- *TestAmerica Technical Staff (TS):*

The TestAmerica TS will be responsible for sample analyses and identification of corrective actions. The staff will report directly to the TestAmerica Laboratory Director.

2.5 Other Subcontractor Personnel

2.5.1 Independent Third Party Data Validator

Data Validation Services, Inc., the third party data validator retained by TurnKey, will perform an independent data usability evaluation as recommended under NYSDEC's draft DER-10 guidance. The data usability evaluation will involve review of pertinent internal and external QC data as reported by the laboratory. QC parameters that will be evaluated in reference to compliance with the analytical methods, protocols and deliverables requirements will include those items necessary to satisfy NYSDEC's requirements for preparation of a Data Usability Summary Report (DUSR). The specific data usability evaluation performed by the following key project personnel is defined below:

- *Data Usability:* *Judy Harry*

  The data validator has the responsibility for evaluating the data usability by examining the following:

  - Completeness of the data package.
  - Compliance with required holding times.
  - Sample chain-of-custody forms
  - QC analysis data, including blanks, instrument tunings, calibrations, spikes, surrogate recoveries, duplicates, laboratory controls and sample data.

- Agreement between laboratory raw data and data summary sheets, with verification that correct data qualifiers were used where appropriate.

The data usability summary will present the review findings with a discussion of any data deficiencies, analytical protocol deviations, and quality control problems encountered. Data deficiencies, analytical method protocol deviations and quality control problems will be described and their effect on the data presented. Recommendations for resampling/reanalysis will be made where deemed necessary. Data qualifications will be documented for each parameter following the USEPA National Functional and Regional Data Validation Guidelines (most recent updates).

2.6 Project Organization

Resumes for key management and QA personnel are included in Appendix C.

2.7 Special Training Requirements and Certifications

The purpose of this section is to address any specialized or non-routine training requirements necessary for completion of the CMS activities. Sufficient information shall be provided to ensure that special training skills can be verified, documented and updated as necessary.

2.7.1 Training

Requirements for specialized training for non-routine field sampling techniques, field analyses, laboratory analyses, and data validation are specified below.

Non-routine field sampling techniques: Currently there are no non-routine field sampling techniques that require specialized training.

Non-routine field analyses: Currently there are no non-routine field analysis that require specialized training.

Non-routine laboratory analyses: Currently there are no non-routine laboratory analyses techniques that require specialized training.

Data validation: Selected analyses to be validated for all matrices sampled will be validated by Ms. Judy Harry of Data Validation Services. Data validation will be performed using the USEPA National Functional and Regional Data Validation Guidelines (most recent updates).

2.7.2 Data Validator Certification

Ms. Harry has already attained certifications required for implementing this plan for Data Validation Services. The data validator resume is presented in Appendix C.

2.8 Contacts

The names, addresses, and telephone numbers of key project personnel are as follows:

Keith Nagel:
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NYSDEC Project Manager
NYSDEC
Department of Environmental Remediation
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(716) 851-7220

Mr. Cameron O'Connor:
NYSDOH Project Manager
NYSDOH
Western Regional Office
584 Delaware Ave.
Buffalo, NY 14202
(716) 847-4502

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall objectives and criteria for assuring quality for this effort are discussed below. This QAPP addresses how the acquisition and handling of samples and the review and reporting of data will be documented. The objectives of this QAPP are to address the following:

- The procedures to be used to collect, preserve, package, and transport soil samples.
- Field data collection.
- Record keeping.
- Data management.
- Chain-of-custody procedures.
- Precision, accuracy, completeness, representativeness, decision rules, comparability and level of quality control effort conformance for sample analysis and data management by TestAmerica under USEPA SW-846 analytical methods.

Analytical methods and detection/reporting limits for possible chemical parameters to be analyzed during CMS activities for soil and water are listed in Tables 1 and 2. The goals for precision, accuracy, and completeness intended for use on this project are discussed in Sections 3.1 through 3.3 of this QAPP. Laboratory quality assurance objectives are presented in the analytical laboratory's QA/QC Plan, which is located in Appendix B. TestAmerica is the analytical laboratory selected to analyze environmental samples for this CMS. All data will be reported completely. No data will be omitted unless an error occurred in the analyses or the run was invalidated because of QC sample recovery or poor precision.

3.1 Precision

Precision is a measurement of the degree to which two or more measurements are in agreement, which is quantitatively assessed based on the standard deviation. Precision in the laboratory is assessed through the calculation of relative percent difference (RPD) and relative calculation of relative standard deviations (RSD) for three or more replicate samples. The equations to be used to verify precision for are found in Section 12.1 of this QAPP.

Laboratory precision will be assessed through the analysis of matrix spike/matrix spike duplicate (MS/MSD) and field duplicate samples for organic parameters. For inorganic parameters, precision will be assessed through the analysis of matrix spike/

duplicates field duplicate pairs. Precision control limits for the laboratory are given in Table 3.

3.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference of true value. Accuracy in the field is assessed through the use of field blanks and trip blanks and through the adherence to all sample handling, preservation and holding times. Laboratory accuracy is assessed through the analysis of a matrix spike/matrix spike duplicate (MS/MSD) (1 per 20 samples), standard reference materials (SRM), laboratory control samples (LCS), and surrogate compounds, and the determination of percent recoveries. The equation to be used for accuracy for this investigation is found in Section 12.1 of this QAPP. Accuracy control limits for the laboratory are given in Table 3.

3.3 Completeness

Data completeness is a measure of the amount of valid data obtained from a prescribed measurement system as compared with that expected and required to meet the project goals. Laboratory and field completeness will be addressed by applying data quality checks and assessments described in Section 3.1 and 3.2 and Section 9.0 to ensure that the data collected are valid and significant.

As shown on Table 3, the laboratory completeness objectives will be 90 percent or greater. A third party data validator will follow procedures described in Section 9.2 to assess the completeness and validity of laboratory data deliverables. For this investigation, 100 percent of all laboratory analytical results will undergo third party data review. The completeness of an analysis will be documented by including in the report sufficient information to allow the data validator to assess the quality of the results. A Category B deliverables package as described in the 2005 NYSDEC Analytical Services Protocol (ASP) will be required in support of third-party data review. A copy of the full Category B data package will be provided to the NYSDEC in PDF format on a CD.

3.4 Data Representativeness

Data representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. All proposed field-testing and measurement procedures were selected to maximize the degree to which the field data will represent the conditions at the Site, and the matrix being sampled or analyzed.

As described in Section 10.0, Performance System Audits and the proper execution of field activities are the main mechanism for ensuring data representativeness. Representativeness in the laboratory is ensured through the use of the proper analytical procedures, appropriate methods, meeting sample holding times, and analyzing and assessing field duplicate samples.

3.5 Comparability

Data comparability expresses the confidence with which one data set can be compared to another data set. Procedures for field measurements, contained in Appendix A, will assure that tests performed at various locations across the Site are conducted using accepted procedures, in a consistent manner between locations and over time, and including appropriate QA/QC procedures to ensure the validity of the data. Sampling procedures for environmental matrices are provided in Section 4.0 to ensure that samples are collected using accepted field techniques.

Analytical data will be comparable when similar sampling and analytical methods are used as documented in the QAPP. Comparability is also dependent on similar QA objectives. The field and laboratory parameter units to be used for this investigation are listed in Table 5.

3.6 Level of QC Effort for Sample Parameters

Field blank, method blank, field duplicate, laboratory duplicate, laboratory control, standard reference materials (SRM) and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs. QC samples are discussed below.

- Field (equipment) blank samples are analyzed to check for potential cross-contamination if improperly cleaned/non-dedicated sampling equipment is used.
- Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures.
- Duplicate samples are analyzed to check for sampling and analytical reproducibility.
- MS/MSD and MS/Duplicate samples provide information about the effect of the sample matrix on the digestion and measurement methodology. Depending on site-specific circumstances, one MS/MSD or MS/Duplicate should be collected for every 20 or fewer investigative samples to be analyzed for organic and inorganic chemicals of a given matrix.

The general level of QC effort will be one field (blind) duplicate and one field blank (when non-dedicated equipment is used) for every 20 or fewer investigative samples of a given matrix. Additional sample volume will also be provided to the laboratory to allow one site-specific MS/MSD or MS/Duplicate for every 20 or fewer investigative samples of a given matrix. One trip blank consisting of distilled, deionized water will be included along with each sample delivery group of aqueous VOC samples.

4.0 SAMPLING AND ANALYSIS PLAN

The selection and rationale for the CMS investigative activities is discussed in the CMS Work Plan. Methods and protocol to be used to collect environmental samples are described in the TurnKey Field Operating Procedures (FOPs) presented in Appendix A of this QAPP. A summary of the FOPs to be used is presented in Table 6.

The types of environmental samples to be collected, parameter lists, required detection limits, and sample container requirements for each matrix (i.e., soil and water) are summarized in Tables 1, 2, and 7. The specific number and location of samples is not presented in the QAPP. Upon NYSDEC approval of the CMS Work Plan, TurnKey proposes to submit for NYSDEC approval a detailed SWMU-specific sampling and analysis plan for those SWMUs described in Section 3.0 of the CMS Work Plan as requiring further assessment and noted below.

In general, the samples collected from these supplemental assessments will be analyzed primarily for toxicity characteristic leaching procedure (TCLP) SVOCs and RCRA metals; some samples may be analyzed for TCLP VOCs in order to assess waste characteristics for determination of placement within the hazardous or non-hazardous CAMUs. Analysis of samples for total VOCs, SVOCs, and RCRA metals may be included for some low-level waste matrices if it is determined that the material may be left in place in accordance with NYSDEC Part 375 soil cleanup objectives (SCOs).

Section 3.0 of the CMS Work Plan presents recommended additional characterization to be performed as part of the CMS. These recommendations are summarized below by SWMU:

- **SWMU S-14:** A boring or test pit program will be implemented to characterize the waste materials and the lateral and vertical limits of the waste.
- **SWMU S-16:** A supplemental waste characterization of the fill materials will be implemented via borings or test pits to confirm the hazardous characterization of the material within this closed in-place HWMU.
- **SWMU S-23:** A planned subsurface investigation (e.g., borings or test pits) will be implemented to characterize the waste materials and delineate the lateral and vertical extent of impact within this waste fill area.
- **SWMU S-26:** A planned perimeter test pitting program will be implemented to delineate the lateral and vertical extent of impact as well as to confirm waste characterization data within this SWMU.

- **SWMU P-75, P-74, and P-8:** A planned subsurface investigation (e.g., borings or test pits) will be implemented to delineate the lateral and vertical extent of impact within these units.
- **SWMUs P-6, P-7, P-9, and P-10:** A planned subsurface investigation (e.g., monitoring wells or piezometers) of SWMUs P-6, P-7, P-9, and P-10 will be implemented to further characterize the groundwater impacts from these SWMUs.
- **SWMU P-18:** A planned sediment sampling investigation to characterize the residuals in the wells will be implemented to determine the hazardous characteristic per TCLP of this unit.
- **SRWT:** A planned sampling investigation will be implemented to determine the quality of sediment and surface water within the SRWT.

Since the RFI data collected from the ATP SWMUs was deemed insufficient for the lateral and vertical extent of the SWMUs for purpose of remedy design and preparation of remedial cost estimates, a perimeter test pitting and boring program was implemented at the Agitator Sludge and ATPs SWMUs, respectively, to more adequately delineate the lateral and vertical extent of fill as well as to confirm the presence and depth to the confining soil unit beneath these SWMUs as identified during the RFI.

The ATP SWMU investigation boring program included the advancement of 14 perimeter borings in May 2008 around the combined perimeter of SWMUS S-11 and S-22. In general, the depth to the lower confining unit ranged from approximately 38 to 52 feet below ground surface.

The Agitator Sludge SWMU test pit investigation included the excavation of 13 test pits in April 2008 to delineate the lateral and vertical extent of waste material within SWMU S-24 as well as to confirm the depth to the confining soil unit identified during the RFI. Upon visual confirmation of this material (i.e., black with elevated photoionization detector readings), each test pit was extended outward until the waste fill was no longer observed. Periodically during lateral advancement of each test pit, the confining layer described in the RFI was confirmed and an average waste/fill material vertical thickness was determined. With these more accurate measurements in hand, it was calculated that approximately 23,000 CY of waste/fill material exists within the Agitator Sludge SWMU.

5.0 CUSTODY PROCEDURES

Sample custody is controlled and maintained through the chain-of-custody procedures. Chain of custody is the means by which the possession and handling of samples will be tracked from the source (field) to their final disposition, the laboratory. A sample is considered to be in a person's custody if it is in the person's possession or it is in the person's view after being in his or her possession or it was in that person's possession and that person has locked it in a vehicle or room. Sample containers will be cleaned and preserved at the laboratory before shipment to the Site. The following section and FOPs for Sampling, Labeling, Storage, and Shipment, located in Appendix A, describe procedures for maintaining sample custody from the time samples are collected to the time they are received by the analytical laboratory. TestAmerica's laboratory chain-of-custody procedures are discussed in the TestAmerica Quality Assurance Manual located in Appendix B.

5.1 Field Custody Procedures

Field logbooks will provide the means of recording data collecting activities performed during the investigation. As such, entries will be described in as much detail as possible so that persons going to the facility could reconstruct a particular situation without reliance on memory. Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- Person to whom the logbook is assigned.
- Logbook number.
- Project name.
- Project start date.
- End date

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection equipment being used, and the signature of the person making the entry will be entered. The names of visitors to the Site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in permanent ink, signed, and dated and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark that is signed and dated by the sampler. Whenever a sample location is surveyed, which includes compass and distance measurements or, latitude and longitude information (e.g., obtained by using a global positioning system) the location information shall be recorded. In the event that photographs are taken to document field activities, the number and brief description of the photographs taken will also be recorded. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in Section 4.0 of this QAPP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive a separate sample identification number, will be noted under sample description.

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain-of-custody intact. The protocol for specific sample numbering and other sample designations are included in an FOP provided in Appendix A of this QAPP. Examples of field custody documents and instructions for completion are also presented in Appendix A of this QAPP.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. Field procedures have been designed such that as few people as possible will handle the samples.
- All bottles will be identified by the use of sample tags with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented in the FOP.
- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample label because the ballpoint pen would not function in freezing weather.
- Samples will be accompanied by a properly completed chain-of-custody form (see FOP). The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and

receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

Samples will be properly packaged and cooled to 4° C (soil samples) for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by the field team leader. The cooler will be strapped shut with strapping tape in at least two locations.

5.2 Laboratory Custody Procedures

Laboratory custody procedures for sample receiving and log-in; sample storage and numbering; tracking during sample preparation and analysis; and storage of data are described in Appendix B, the Laboratory QA Manual.

5.2.1 Sample Receipt

A sample custodian is responsible for receiving samples, completing chain-of-custody records, determining and documenting the condition of samples received through the Cooler Receipt and Preservation Form (CRPF, see laboratory QA Manual, Appendix B), logging samples into the LIMS system based upon the order of log-in, and storing samples in appropriate limited-access storage areas. Chain-of-custody documentation is also maintained for the transfer of samples between TestAmerica, and for shipment of samples to subcontracted laboratories.

Upon sample receipt, an inventory of shipment contents is compared with the chain-of-custody record, and any discrepancies, including broken containers, inappropriate container materials or preservatives, headspace in volatile organic samples, and incorrect or unclear sample identification, are documented and communicated to the appropriate project manager.

Each sample is given a unique laboratory code and an analytical request form is generated. The analytical request contains pertinent information for each sample, including:

- Client name
- Project number
- Task number
- Purchase order number
- Air bill number
- Chain-of-custody number
- Number of samples
- Sample descriptions
- Sample matrix type
- Date and time of sampling
- Analysis due dates
- Date and time of receipt by lab
- Client sample identification
- Any comments regarding special instructions or discrepancies

5.2.2 Sample Storage

Samples are stored in secure limited-access areas. Walk-in coolers or refrigerators are maintained at 4°C, ± 2°C, or as required by the applicable regulatory program. The temperatures of all refrigerated storage areas are monitored and recorded a minimum of once per day. Deviations of temperature from the applicable range require corrective action, including moving samples to another storage location if necessary.

5.2.3 Sample Custody

Sample custody is defined by this document as when any of the following occur:

- It is in someone's actual possession.
- It is in someone's view after being in his or her physical possession.
- It was in someone's possession and then locked, sealed, or secured in a manner that prevents unsuspected tampering.
- It is placed in a designated and secured area.

Samples are removed from storage areas by the sample custodian or analysts and transported to secure laboratory areas for analysis. Access to the laboratory and sample storage areas is restricted to laboratory personnel and escorted visitors only; all areas of the laboratory are therefore considered secure. If required by the applicable regulatory program, internal chain-of-custody is documented in a log by the person moving the samples between laboratory and storage areas.

Laboratory documentation used to establish COC and sample identification may include the following:

- Field COC forms or other paperwork that arrives with the sample.
- The laboratory COC.
- Sample labels or tags are attached to each sample container.
- Sample custody seals.
- Sample preparation logs (i.e., extraction and digestion information) recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist.
- Sample analysis logs (e.g., metals, GC/MS, etc.) information recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist.
- Sample storage log (same as the laboratory COC).
- Sample disposition log, which documents sample disposal by a contracted waste disposal company.

5.2.4 Sample Tracking

All samples are maintained in the appropriate coolers prior to and after analysis. The analysts remove and return their samples as needed. Samples that require internal COC are relinquished to the analysts by the sample custodians. The analyst and sample custodian must sign the original COC relinquishing custody of the samples from the sample custodian to the analyst. When the samples are returned, the analyst will sign the original COC returning sample custody to the sample custodian. Sample extracts are relinquished to the instrumentation analysts by the preparatory analysts. Each preparation department tracks internal COC through their logbooks/spreadsheets.

Any change in the sample during the time of custody will be noted on the COC (e.g., sample breakage or depletion).

5.2.5 Sample Disposal

A minimum of 30 days following completion of the project, or after a period of time specified by any applicable project requirements, sample disposal is performed in compliance with federal, state, and local regulations. Alternatively, samples may be returned to the client by mutual agreement. All available data for each sample, including laboratory analysis results and any information provided by the client, are reviewed before sample disposal.

All samples are characterized according to hazardous/non-hazardous waste criteria and are segregated accordingly. All hazardous waste samples are disposed of according to formal procedures outlined in TestAmerica's Standard Operating Procedure (SOP). It should be noted that all waste produced at the laboratory, including the laboratory's own various hazardous waste streams, is treated in accordance with all applicable local and Federal laws.

Complete Internal Chain of Custody documentation is maintained for some samples from initial receipt through final disposal. This ensures that an accurate history of the sample from "cradle to grave" is generated. Internal Chain Documentation through disposal is in place at TestAmerica.

5.3 Project File

The project file will be the central repository for all documents, which constitute evidence relevant to sampling and analysis activities as described in this QAPP. TurnKey is the custodian of the evidence file and maintains the contents of evidence files for the investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports and data reviews in a secured, limited access area and under custody of the TurnKey project manager. Information generated during this study by will be retained by TurnKey in the project file. The project file will include at a minimum:

- Field logbooks
- Field data and data deliverables
- Photographs
- Drawings
- Soil boring logs
- Laboratory data deliverables
- Data validation and assessment reports
- Progress reports, QA reports, interim project reports, etc.
- All custody documentation (tags, forms, air bills, etc.).

6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

6.1 Field Instrument Calibration

Quantitative field data to be obtained during soil sampling includes screening for the presence of volatile organic vapors with a calibrated Photovac 2020 PID equipped with a 10.6 eV lamp (or equivalent).

FOPs located in Appendix A describe the field instruments used to monitor for these parameters and the calibration methods, standards, and frequency requirements for each instrument. Calibration results will be recorded in the Project Field Book.

6.2 Laboratory Instrument Calibration

All equipment and instruments used at TestAmerica are operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files. The frequency of calibration and concentration of calibration standards are determined by the manufacturer's guidelines, the analytical method, or the requirements of special contracts. Generally, purchased standards have a shelf life of 12-36 months and prepared standards have a shelf life of 1-12 months. Recalibration is required at anytime the instrument is not operating correctly or functioning at the proper sensitivity. Brief descriptions of the calibration procedures for major laboratory equipment and instruments are described in TestAmerica's QA Manual (Appendix B).

7.0 ANALYTICAL PROCEDURES

Samples collected during the CMS activities will be analyzed by TestAmerica Laboratories, Inc. (TestAmerica), 10 Hazelwood Drive, Amherst, New York 14228, (716) 691-2600.

7.1 Field Analytical Procedures

Field procedures for collecting and preserving soil samples are described in FOPs located in Appendix A.

7.2 Laboratory Analytical Procedures

This section describes the analytical procedures to be followed in the laboratory. Laboratory analytical procedures will follow USEPA SW-846 methodology. Analytical methods, method detection limits, and reporting limits selected for use are listed in Tables 1 and 2. Sample container, preservation, and holding time requirements are presented in Table 7. TestAmerica will provide analytical services; however, other laboratories may be used if necessary depending on project requirements. If a subcontract laboratory is required, the subcontracted laboratory's QA manual and copies of the State or Federal Certifications will be submitted to the NYSDEC prior to sample analysis for this project. General laboratory analytical procedures and sample handling procedures are presented in TestAmerica's QA Manual in Appendix B.

7.2.1 Sample Preparation and Analytical Methods

The laboratory named above will implement the method SOPs. The laboratory SOPs for sample preparation, cleanup and analysis are based on USEPA procedures. These SOPs provide sufficient details specific to the methods identified for this project.

7.2.2 Confirmation Analysis Methods

The laboratory SOPs presented in Appendix B identify the confirmatory analysis appropriate for this project. The basis for these SOPs is USEPA procedures. These protocols include second column confirmation for the gas chromatography methods.

In addition, confirmatory analysis may be performed by the evaluation of field duplicates and/or analytical results for split samples with the agency. Although analyte concentrations between duplicate analyses and split samples may vary, the target analytes present should be the same. This can be considered confirmation analysis.

7.2.3 Method Validation

In order to demonstrate that the laboratory is capable of detecting and quantifying analytes at specific levels required by regulatory agencies or clients, each laboratory establishes method detection limits (MDLs), instrument detection limits (IDLs), and practical quantitation limits (PQLs), as required by the specific method protocols. These limits, along with other related detection or quantitation limits, are defined as follows:

- *Method Detection Limit* (MDL) - the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is a theoretical, statistically-derived value determined by preparing at least seven replicates of a low-level spiked matrix, which are taken through the entire sample preparation and analysis procedure; the standard deviation of the results is multiplied by the appropriate student's t value at the 99% confidence level to obtain the MDL. TestAmerica analytical laboratories perform MDL studies using the procedure defined in 40 CFR Part 136, Appendix B, *Definition and Procedure for the Determination of the Method Detection Limit* - Revision 1.11. MDLs are determined for each method and instrument annually, at a minimum, or when significant modifications to the procedure or instrumentation have been made, as determined by laboratory manager.
- *Instrument Detection Limit* (IDL) - an estimate of the lowest concentration of a substance that can be reliably detected above background noise on an instrument. The IDL is a theoretical, statistically derived value, which is determined by analyzing seven replicates of a low-level standard on each of three non-consecutive days; the standard deviation of the results is multiplied by three (3) to obtain the IDL.
- *Practical or Estimated Quantitation Limit* (PQL or EQL) - an estimate of the lowest concentration of a substance that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operations. Typically, the PQL (EQL) is a nominal value selected at a level between 3 and 10 times the MDL.

- *Contract Required Quantitation Limit* (CRQL) – an estimate of the lowest concentration of a substance that can be reliably achieved as specified in the method. Typically, the CRQL is higher than PQL.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Field Quality Control Checks

Assessment of field sampling precision and bias will be made by collecting field duplicates and field blanks for laboratory analysis. Collection of the samples will be in accordance with the applicable FOPs described in Section 4.0 of this QAPP at the frequency indicated in Section 3.0 of this QAPP.

Blind duplicate soil samples will be collected to allow determination of analytical precision. One duplicate soil sample will be collected for every 20 samples or per sampling event if less than 20 samples are collected. Duplicate sample aliquots for soil will be collected sequentially as grab samples after collection of the initial sample aliquot. The sample location will not be disclosed to the analytical laboratory.

One equipment blank will be collected for each day of sampling activity if non-dedicated sampling equipment is used. These equipment blank samples will be used as a QC check of the decontamination procedures for sampling equipment.

8.2 Laboratory Quality Control Checks

The internal QC checks for laboratory analyses of soil samples that will be collected during this investigation are covered in the laboratory's QA Manual located in Appendix B. Laboratory analytical internal QA/QC will be conducted in accordance with USEPA methodology. The checks include internal QC methods covering surrogate spikes, duplicates, preparation blanks, calibration, lab quality control samples and reagent checks. A site-specific matrix spike/matrix spike duplicate (MS/MSD) sample will be analyzed as a further QC check. The matrix spike samples will be analyzed at the same frequency as the duplicate samples. The matrix spike samples will allow accuracy to be determined by using the percent recovery of the spiked compounds. The purpose of the MS/MSD samples is to monitor any possible matrix effects specific to samples collected from the Site. The specific sample location that will be used for matrix spikes may be chosen by the Project Manager or Project QA Officer.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

All data generated through field activities, or by the laboratory operation shall be reduced and validated prior to reporting. The laboratory shall disseminate no data until it has been subjected to the procedures summarized below.

9.1 Data Reduction

9.1.1 Field Data Reduction Procedures

Field measurements of volatile organic vapor content (via the PID) are read directly in the units of final use, as discussed in Section 3.0 of this QAPP and listed in Table 4. Field personnel are responsible for monitoring the collection and reporting of field data. Field personnel will review field measurements at the time of measurement and will re-measure a parameter as necessary to assure quality and accuracy is maintained.

Field data will be recorded on appropriate field data record forms as they are collected and will be maintained in TurnKey's office project file. The Project QA Officer will review field procedures and compare field data to previous measurements to assess comparability and accuracy of the field data measurements.

9.1.2 Laboratory Data Reduction Procedures

Results of laboratory analyses will be reported in units of final use, as discussed in Section 3.0 and listed in Table 5. Laboratory calculations will be performed as prescribed for a given analytical method or in conformance with acceptable laboratory standards at the time the calculation is performed.

The laboratory will retain quality assurance/quality control records for at least five years. Original laboratory reports will be stored in the TurnKey project files. Copies of raw data will be available for review at the laboratory. Copies of raw data also may be requested as part of the QA/QC review. For this project, TurnKey has requested a complete validatable data package (Category B deliverables). The data package includes the following information:

- Transmittal letter.

- Sample number or numbers; matrix; date and time collected; date and time extracted/digested; date and time analyzed; chain of custody information; sample receipt information (e.g., container seals, cooler temperature); and field sampling log.
- Parameter requested.
- Results, including sample analytical results; duplicates; blanks; MS/MSDs; blank spikes; surrogate recoveries (if applicable); standard reference materials results; and low level matrix spike recoveries to confirm method detection limit.
- Surrogate recovery results for appropriate organic methods, including associated NYSDEC or TestAmerica acceptance criteria.
- Chain of Custody documents.
- Case narrative.
- Supporting QA/QC. This includes sample preparation, analysis and cleanup methods, sample preparation and cleanup logs; analysis run logs; MDLs, IDLs and methods used to determine MDL in the matrix; calibration data; percent solids for non-water samples; example calculations; data validation procedures, results and checklists; and documentation illustrating how blank water is determined to be analyte free.

The Project Manager, Project QA Officer, or appropriate personnel assigned by the Project Manager will review the laboratory data. Section 12.0 outlines the procedures for evaluating the accuracy and precision of data. If comparison of data to previous measurements or known conditions at the Site indicates anomalies, the laboratory will be instructed to review the submitted data while TurnKey reviews the methods used to obtain the data. If anomalies remain, the laboratory may be asked to re-analyze selected samples provided that holding times have not been exceeded.

9.2 Data Usability Evaluation

Data usability evaluation procedures shall be performed for both field and laboratory operations as described below.

9.2.1 Procedures Used to Evaluate Field Data Usability

Procedures to validate field data for this project will be facilitated by adherence to the FOPs identified in Appendix A. The performance of all field activities, calibration checks on all field instruments at the beginning of each day of use, manual checks of field calculations, checking for transcription errors and review of field log books is the responsibility of the Field Team Leader.

9.2.2 Procedures Used to Evaluate Laboratory Data Usability

Data evaluation will be performed by the third party data validator using the most current methods and quality control criteria from the USEPA's Contract Laboratory Program, (CLP) *National Functional Guidelines for Organic Data Review,* and *Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review*, as well as corresponding USEPA Region 2 guidance. Also, results of blanks, surrogate spikes, MS/MSDs, and laboratory control samples will be reviewed/evaluated by the data validator. All sample analytical data for each sample matrix shall be evaluated. The third party data validation expert will also evaluate the overall completeness of the data package. Completeness checks will be administered on all data to determine whether deliverables specified in Section 9.1.2 of this QAPP are present. The reviewer will determine whether all required items are present and request copies of missing deliverables. The data review will be presented in a Data Usability Summary Report (DUSR), prepared in accordance with Appendix 2B of NYSDEC's draft DER-10 guidance. Appropriate data qualifiers will be added to the data summary tables and analytical report Form 1. Any data that would be rejected under USEPA Region 2 Data Validation Guidelines will also be rejected in the DUSR.

9.3 Data Reporting

Data reporting procedures shall be carried out for field and laboratory operations as indicated below.

9.3.1 Field Data Reporting

All investigation field documents will be accounted for when they are completed. Accountable documents include items such as field notebooks, sample logs, field data records, photographs, data packages, computer disks, and reports.

9.3.2 Laboratory Data Reporting

Analytical data will be summarized in tabular format with such information as sample identification, sample matrix description, parameters analyzed and their corresponding detected concentrations, and the detection limit. Analytical results will be incorporated into reports as data tables, maps showing sampling locations and analytical results, and supporting text.

10.0 PERFORMANCE SYSTEM AUDITS AND FREQUENCY

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FOPs and this QAPP. The audits of field and laboratory activities include two independent parts, internal and external.

10.1 Field Performance and System Audits

10.1.1 Internal Field Audits

The QA Officer will conduct internal audits of field activities including sampling and field measurements. These audits will verify that all established procedures are being followed. Internal field audits will be conducted at least once at the beginning of the Site sample collection activities. Project duration may warrant subsequent audits on a monthly basis.

The audit program consists of the following:

- Observation of field activities to confirm that procedures are performed in accordance with project protocols and standard accepted methods, as detailed in the FOPs located in Appendix A.
- Review daily field records, monitoring well sampling records, and any other data collection sheets during and after field measurements.

10.1.2 External Field Audits

The NYSDEC Site Project Coordinator may conduct external field audits. External field audits may be conducted any time during the field operations. These audits may or may not be announced and are at the discretion of the NYSDEC. External field audits will be conducted according to the field activity information presented in this QAPP.

10.2 Laboratory System Audits

The adequacy and implementation of TestAmerica's Quality Assurance (QA) Plan are assessed on a continual basis through systems and performance audits. Systems audits evaluate practice against established quality system objectives and requirements. Performance audits measure the comparability and accuracy of laboratory data through the analysis of reference materials for which the true value is unknown to the analyst. Audits may be performed by TestAmerica (internal), or by clients, regulatory agencies, or accreditation bodies (external).

10.2.1 Internal Laboratory Audits

The TestAmerica QA Coordinator schedules internal systems audits such that the laboratory's quality system and range of test capabilities are audited annually. The audits are conducted to determine the following:

- Whether the procedures defined in the quality system are being followed;
- Whether the objectives defined in the quality system are being achieved; and
- Identify opportunities for improvement.

The TestAmerica QA Coordinator will conduct the laboratory audit. The QA Coordinator prepares an audit plan for each audit, which defines the scope of the audit, requirements that the audit will be conducted against, and the audit technique(s) to be used (observation, record review, interview). The internal system audits are scheduled as two auditing events and follow the audit plan.

The results of each audit are reported to the Laboratory Director and Supervisors for review and comment. Any deficiencies noted by the auditor are summarized in an audit report and corrective action is taken within a specified length of time to correct each deficiency. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification if not already provided.

10.2.2 External Laboratory Audits

Upon client, regulatory agency, or accreditation body notification of intent to audit, the quality assurance officer notifies laboratory personnel and corporate quality assurance. During the audit, the quality assurance coordinator, or a designee, provides escort for the auditors, and participates in the pre-audit and post-audit conferences. Additional laboratory personnel are called upon as necessary during the course of the audit. An external audit will be conducted upon request by appropriate NYSDEC QA staff. These audits may or may not be announced and are at the discretion of the NYSDEC.

External audits may include any or all of the following:

- Review of laboratory analytical procedures.
- Laboratory on-site visits (see below).
- Submission of performance evaluation samples to the laboratory for analysis.

Failure of any or all audit procedures chosen can lead to laboratory disqualification and the requirement that another suitable laboratory be chosen.

An external on-site review may consist of:

- Sample receipt procedures
- Custody and sample security and log in procedures,
- Calibration records,
- Instrument logs and statistics (number and type),
- Review of QA procedures,
- Review of logbooks,
- Review of sample preparation procedures,
- Sample analytical SOP review,
- Instrument (normal or extends quantitation report) reviews,
- Personnel interviews,
- Review of deadlines and glassware prep, and
- A close out to offer potential corrective action.

It is common practice when conducting an external laboratory audit to review one or more data packages from sample lots recently analyzed by the laboratory. This review will most likely include but not be limited to:

- Comparison of resulting data to the laboratory SOP or method, including coding for deviations.
- Verification of initial and continuing calibrations within control limits.
- Verification of surrogate recoveries and instrument tuning results where applicable.
- Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable.
- Recoveries on control standard runs.
- Review of run logs with run times, ensuring proper order of runs,
- Review of spike recoveries/QC sample data.
- Review of suspected manually integrated GC data and its cause (where applicable).

- Assurance that samples are run within holding times.

All data will be reviewed while on the premises of TestAmerica, so that any questionable data can be discussed with the staff.

Following the audit, the quality assurance officer provides a written summary of the audit to the laboratory manager, department supervisors, and corporate quality assurance. The summary includes the areas reviewed, and strengths and deficiencies identified during the audit.

The quality assurance coordinator initiates the corrective action process for each finding and is responsible for ensuring timely corrective action. The quality assurance coordinator prepares the audit report response, and prepares any follow-up responses as corrective actions are completed. The audit report and laboratory responses are copied to corporate quality assurance.

10.3 Laboratory Performance Audits

10.3.1 Internal Performance Audit

Internal performance audit samples are submitted at the discretion of the local quality assurance director as a supplement to the quality control checks run on a daily basis. The QA Director maintains a log of blind sample preparation in which the reference material used, preparation, and true value(s) are documented. The reference materials submitted should be independent of the laboratory's initial calibration standards.

Acceptance criteria for internal performance audit sample results are those provided with the reference material. If no criteria are provided, performance criteria listed in the reference method are used. Internal performance audit results are scored and corrective action is initiated in the same manner as external samples. The laboratory director is responsible for ensuring timely corrective action.

10.3.2 External Performance Audit

External performance audit samples are run at the frequency required to obtain and maintain desired certifications, accreditations, and approvals. Additional studies may be run at the discretion of corporate quality assurance or the local laboratory manager.

The quality assurance director initiates the corrective action process for each performance audit result scored as "fail." The laboratory director is responsible for ensuring timely corrective action. The audit report and laboratory responses are copied to corporate quality assurance.

11.0 PREVENTATIVE MAINTENANCE

11.1 Field Instrument Preventative Maintenance

Each piece of field equipment is checked according to its routine maintenance schedule and before field activities begin. Field equipment planned for use during this investigation includes:

- Photoionization detector (PID)
- Water quality meters (includes pH, turbidity, temperature and specific conductance)
- Electric water level indicator

Field personnel will report all equipment maintenance and/or replacement needs to the Project QA Officer and will record the information on the daily field record. Calibration and Maintenance FOPs are provided in Appendix A.

11.2 Laboratory Instrument Preventative Maintenance

As part of the QA Program Plan, a routine preventative maintenance program is conducted by TestAmerica to minimize the occurrence of instrument failure and other system malfunctions. The analysts regularly perform routine instrument maintenance tasks (or coordinate with the vendor). All maintenance that is performed is in accordance with the manufacturer's specifications and is documented in the laboratory's maintenance logbooks. The maintenance logbooks used at TestAmerica contain extensive information about the instruments used at the laboratory.

Preventative maintenance procedures, frequencies, and other pertinent information are available for each instrument used at TestAmerica through SOPs for routine and in the operating or maintenance manuals provided with the equipment. Responsibility for ensuring that routine maintenance is performed lies with the section supervisors. Each laboratory section maintains a critical parts inventory. The parts inventories include the items needed to perform the preventative maintenance procedures presented in TestAmerica's QA Manual provided in Appendix B of this QAPP.

11.3 Inspection/Acceptance Requirements for Supplies and Consumables

11.3.1 Field Supplies and Consumables

For this investigation, TurnKey will track critical supplies in the following manner.

Item	Date Received	Condition	Responsible Individual
Tyvek suits			
Disposable bailers			
Pump tubing			
Latex gloves			
Respirator cartridges			
Sample containers			
Decon materials			
Alconox detergent			
pH buffer solutions			
Calibration gases			

Labels indicating the following information on receipt and testing are to be used for critical supplies and consumables.

- Unique identification number (if not clearly shown).
- Date received.
- Date opened.
- Date tested (if performed).
- Date to be retested (if applicable).
- Expiration date.

11.3.2 Laboratory Supplies and Consumables

Supplies and consumables used in the analytical process shall have traceable documentation (e.g., labels or logbooks) for date received, date opened, and date expired. Inspection, testing and acceptance criteria for critical supplies and consumables are identified below.

Critical Supplies & Consumables	Inspection/ Acceptance Testing Requirements	Acceptance Criteria	Testing Method	Frequency	Responsible Individual	Handling/ Storage Conditions
Standards	Refer to the Manufacturer's Certificate of Analysis.					
Acids	< RL's for common lab contaminants	< RL's all elements	SW-846	Each Lot	Receiving / Laboratory Personnel	Vented Acid Cabinets
Solvents	< RL's for common lab contaminants	< RL's for common lab contaminants	SW-846	Each Lot	Receiving / Laboratory Personnel	Vented Solvent Cabinets

12.0 DATA PRECISION, ACCURACY, AND COMPLETENESS EVALUATION

The purpose of this section is to indicate the methods by which it will be assured that the data collected for this investigation is in accordance with the data quality objectives (DQOs) for the Site. After the DQOs have been determined, the sample locations, parameters, and reporting limits will be selected. Factors considered as part of this assessment of data collection methods include:

- The chemical constituents known and/or suspected to be of concern, as they relate to the data quality level parameters chosen.
- The choice of analytical and sample preparation methods with method detection limits that meet the data quality level concentrations for chemical constituents of concern.
- The risk-based preliminary remediation goal parameters chosen based on conditions and possible receptors associated with the site (e.g., human health data quality levels, soil screening guidance, etc.).

In addition, the data will be reviewed for indications of interferences to results caused by sample matrices, cross contamination during sampling, cross contamination in the laboratory, and sample preservation and storage anomalies (i.e., samples holding time or analytical instrument problems).

As discussed in Section 3.0 of this QAPP, the validity of data will be evaluated in terms of precision, accuracy, and completeness. Described below are ways in which these three parameters will be evaluated. Evaluations will be performed upon completion of investigation field activities.

12.1 Accuracy Assessment

Data accuracy, which is assessed for laboratory data only, is based on recoveries, expressed as the percentage of the true (known) concentration, from laboratory-spiked samples and QA/QC samples generated by the analytical laboratory.

Percent recovery (%R) for MS/MSD results is determined according to the following equation:

$$R\% = \underline{(A - B)} \times 100$$

T

Where A = measured concentration after spiking
B = background concentration
T = known true value of spike

Percent recovery (%R) for LCS and surrogate compound results is determined according to the following equation:

$$R\% = \frac{\text{Experimental concentration}}{\text{Known amount added}} \times 100$$

This information is reviewed periodically by the Project Manager or Project QA Officer. The goals for the recovery of any constituent in a spiked or QA/QC sample are presented in Table 3.

12.2 Precision Assessment

For data generated by the laboratory, data precision is estimated by comparing analytical results from duplicate samples. The comparison is made by calculating the relative percent difference (RPD) given by:

$$RPD\% = \frac{2(S_1 - S_2)}{S_1 + S_2} \times 100$$

Where S_1 = sample result
S_2 = duplicate result

This information is calculated and reviewed periodically by the Project Manager and/or Project QA Officer. The goals for data precision for duplicate samples are presented in Table 3.

12.3 Completeness Assessment

Data completeness will be evaluated by comparing the objectives of investigation efforts with the data obtained and determining whether there are any shortcomings in required information. A series of protocols, described below, will be used to evaluate data completeness. The purpose is to accomplish the following:

- Rigorously assess the quality and adequacy of data collected during the investigation.
- Review data collected during the investigation to evaluate if the study's objectives are being addressed and met.
- Ensure that the data collected are valid by applying the quality checks described in this and other sections of the QAPP.

Data generated during the sampling program will be evaluated for completeness; that is, the amount of data meeting project QA/QC goals. If data generated during field operations or during analytical procedures appear to deviate significantly from previous trends, the Project Manager or Project QA Officer will review field or laboratory procedures with the appropriate personnel to evaluate the cause of such deviations. Where data anomalies cannot be explained, resampling may be performed. Completeness is defined as the percentage of valid results according to the equation below:

$$\%\ \text{completeness} = \frac{A}{B} \times 100$$

Where: A = number of valid results;
B = total number of possible results

The goals for data completeness for laboratory measurements were presented previously in Table 3.

12.4 Assessment of Data

To assess the integrity of the data generated during this investigation, the Project Manager and QA Officer will review the laboratory analytical data and field data in accordance with procedures and protocols outlined in this QAPP. An assessment will be made to determine if the project objectives described in Section 1.0 have been achieved.

Corrective Action described in Section 13.0 will be implemented, if necessary, to meet objectives for data integrity.

13.0 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out of quality control performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. All corrective action proposed and implemented should be documented in the regular quality assurance reports to management. Corrective action should be implemented only after approval by the Project Manager, or his/her designee. If immediate corrective action is required, approvals secured by telephone from the Project Manager should be documented in an additional memorandum.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. In the field, the person who identifies the problem is responsible for notifying the Field Team Leader, who will notify the Project Manager, who in turn will notify the Tecumseh Project Coordinator and the NYSDEC Project Coordinator. If the problem is analytical in nature, information will be promptly communicated to the NYSDEC Project Coordinator via fax or telephone during that same day or the next business day. Implementation of corrective action will be confirmed in writing through the same channels. If noncompliance is observed in the laboratory or during data validation, the analyst or data validator will notify the Project Manager and communication will continue in the same manner as described above.

13.1 Field Corrective Action

If errors in field procedures are discovered during the observation or review of field activities by the Project QA Officer or his/her designee, corrective action will be initiated. Nonconformance to the QA/QC requirements of the field operating procedures (FOPs) will be identified by field audits or immediately by project staff who know or suspect that a procedure is not being performed in accordance with the requirements. The Project QA Officer or his designee will be informed immediately upon discovery of all deficiencies. Timely action will be taken if corrective action is necessary.

Corrective action in the field may be needed when the sample network is changed (i.e., more/fewer samples, sampling locations other than those specified in the Work Plan, etc.) or when sampling procedures and/or field analytical procedures require modification due to unexpected conditions. In general, the Project Manager and QA Officer may identify the need for corrective action. The Project Manager will approve the corrective measure that will be implemented by the field team. It will be the responsibility of the Project Manager to ensure that corrective action has been implemented.

If the corrective action will supplement the existing sampling plan (e.g., additional soil borings) using existing and approved procedures in the QAPP, corrective action approved by the Project Manager will be documented. If the corrective actions result in fewer samples (or analytical fractions), alternate locations, etc., which may result in non-achievement of project QA objectives, it will be necessary that all levels of project management, including the NYSDEC Project Coordinator, concur with the proposed action.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. The QA Officer will identify deficiencies and recommend corrective action to the Project Manager. The Project Manager and field team will implement corrective actions. Corrective action will be documented in QA reports to the entire project management.

Corrective actions will be implemented and documented in the project field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by the NYSDEC Project Coordinator.

If at any time a corrective action issue is identified which directly impacts project DQOs, the NYSDEC Project Coordinator will be notified immediately.

13.2 Laboratory Corrective Action

Corrective actions may be initiated if the quality assurance goals are not achieved. The initial step in a corrective action is to instruct the analytical laboratory to examine its procedures to assess whether analytical or computational errors caused the anomalous result. If no error in laboratory procedures or sample collection and handling procedures can be identified, then the Project Manager will assess whether reanalysis or resampling is required or whether any protocol should be modified for future sampling events.

13.3 Data Validation & Assessment Corrective Action

The need for corrective action may be identified during the data validation or assessment processes. Potential types of corrective action may include resampling by the field team, or reinjection/reanalysis of samples by the laboratory.

These actions are dependent upon the ability to mobilize the field team, whether the data to be collected is necessary to meet the QA objectives (e.g., the holding time for samples is not exceeded, etc.). If the data validator identifies a corrective action situation, the Project Manager will be responsible for approving the corrective action implementation. All required corrective actions will be documented by the laboratory QA Coordinator.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The deliverables associated with the tasks identified in the Work Plan and monthly progress reports will contain separate QA sections in which data quality information collected during the reporting period is summarized. Those reports will be the responsibility of the Project Manager and will include the QA Officers input on the accuracy, precision, and completeness of the data, as well as the results of the performance and system audits, and any corrective action needed or taken during the project.

14.1 Contents of Project QA Reports

The progress reports will contain, on a routine basis, a QA section describing all results of field and laboratory audits, all information generated during the past month reflecting on the achievement of specific DQOs, and a summary of corrective action that was implemented, and its immediate results on the project. The status of the project with respect to the Project Schedule included in this QAPP will be determined. Whenever necessary, updates on training provided, changes in key personnel, anticipated problems in the field or laboratory for the coming month that could bear on data quality along with proposed solutions, will be reported. Detailed references to QAPP modifications will also be highlighted. All QA reports will be prepared in written, final format by the project manager or his designee. To the extent possible, assessment of the project should also be performed on the basis of available QC data and overall results in relation to originally targeted objectives.

In the event of an emergency, or in case it is essential to implement corrective action immediately, QA reports can be made by telephone to the appropriate individuals, as identified in the Project Organization and Corrective Action sections of this QAPP. However, these events, and their resolution will be addressed thoroughly in the next monthly progress report.

14.2 Frequency and Distribution of QA Reports

The QA reports will be completed for all months during which sample collection and/or analysis occurs and will be presented as part of the monthly progress report.

14.3 Individuals Receiving/Reviewing QA Reports

The QA reports will be delivered to all progress report recipients, which shall include all individuals identified in the Project Organization chart and other individuals identified by NYSDEC.

15.0 REFERENCES

1. New York State Department of Environmental Conservation, December 2002. *Draft DER-10; Technical Guidance for Site Investigation and Remediation*.

2. United States Department of Agriculture, Soil Conservation Service, 1978. *Soil Survey of Erie County, New York*.

3. U.S. Environmental Protection Agency. Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5), October 1998.

4. U.S. Environmental Protection Agency. National Functional Guidelines for Organic Data Review (EPA-540/R-94-012), 1994a.

5. U.S. Environmental Protection Agency. National Functional Guidelines for Inorganic Data Review (EPA-540/R-94-013), 1994b.

6. U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846, Third Edition (Updates I, II and III). 1991.

7. U.S. Environmental Protection Agency, Region II, CERCLA Quality Assurance Manual, Revision I, October 1989.

8. U.S. Environmental Protection Agency, Methods for Chemical Analysis of Water and Wastes, EPA 600/4-70-020. 1983b.

TABLES

TABLE 1

CONSTITUENTS OF PRIMARY CONCERN (COPCs)
FOR SOIL/FILL MATRICES

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

Analyte[1]	*CAS Number*	Analytical Method [2]	PQL	MDL
TCL Volatile Organic Compounds (full list): (57 compounds) (ug/L) ***[includes STARS VOCs in blue]***				
Acetone	*67-64-1*	8260B	25	1.10
Benzene	*71-43-2*	8260B	5	0.55
Bromoform	*75-25-2*	8260B	5	0.46
Bromodichloromethane	*75-27-4*	8260B	5	0.26
Bromomethane (Methyl bromide)	*74-83-9*	8260B	5	0.46
2-Butanone (MEK)	*78-93-3*	8260B	25	6.80
n-Butylbenzene	*104-51-8*	8260B	5	0.43
sec-Butylbenzene	*135-98-8*	8260B	5	0.43
tert-Butylbenzene	*98-06-6*	8260B	5	0.52
Carbon disulfide	*75-15-0*	8260B	5	0.43
Carbon tetrachloride	*56-23-5*	8260B	5	0.68
Chlorobenzene	*108-90-7*	8260B	5	0.51
Chloroethane	*75-00-3*	8260B	5	0.81
Chloroform	*67-66-3*	8260B	5	0.31
Chloromethane (Methyl chloride)	*74-87-3*	8260B	5	0.30
Cyclohexane	*110-82-7*	8260B	5	0.23
p-Cymene (p-isopropyltoluene)	*99-87-6*	8260B	5	0.40
1,2-Dibromo-3-chloropropane	*96-12-8*	8260B	5	1.00
1,2-Dibromoethane (EDB)	*106-93-4*	8260B	5	0.19
Dibromochloromethane	*124-48-1*	8260B	5	0.28
Dichlorodifluoromethane (Freon-12)	*75-71-8*	8260B	5	0.41
1,2-Dichlorobenzene	*95-50-1*	8260B	5	0.75
1,3-Dichlorobenzene	*541-73-1*	8260B	5	0.71
1,4-Dichlorobenzene	*106-46-7*	8260B	5	0.70
1,1-Dichloroethane	*75-34-3*	8260B	5	0.58
1,2-Dichloroethane (EDC)	*107-06-2*	8260B	5	0.25
1,1-Dichloroethylene (1,1-DCE)	*75-35-4*	8260B	5	0.61
trans-1,2-Dichloroethylene	*156-60-5*	8260B	5	0.52
cis-1,2-Dichloroethylene	*156-59-2*	8260B	5	0.25
cis-1,3-Dichloropropene	*10061-01-5*	8260B	5	0.29
trans-1,3-Dichloropropene	*10061-02-6*	8260B	5	0.64
1,2-Dichloropropane	*78-87-5*	8260B	5	0.26
Ethylbenzene	*100-41-4*	8260B	5	0.35
2-Hexanone	*591-78-6*	8260B	25	6.25
Isopropylbenzene (Cumene)	*98-82-8*	8260B	5	0.33

TABLE 1

CONSTITUENTS OF PRIMARY CONCERN (COPCs) FOR SOIL/FILL MATRICES

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

Analyte[1]	*CAS Number*	Analytical Method [2]	PQL	MDL
TCL Volatile Organic Compounds (full list): (57 compounds) (ug/L) ***[includes STARS VOCs in blue]***				
Methyl acetate	*79-20-9*	8260B	5	1.00
Methylene chloride	*75-09-2*	8260B	5	2.20
Methylcyclohexane	*108-87-2*	8260B	5	0.32
4-methyl-2-pentanone (MIBK)	*108-10-1*	8260B	25	6.25
Methyl tert butyl ether (MTBE)	*1634-04-4*	8260B	5	0.49
n-Propylbenzene	*103-65-1*	8260B	5	0.38
Styrene	*100-42-5*	8260B	5	0.25
1,1,1,2-Tetrachloroethane	*630-20-6*	8260B	5	0.31
Tetrachloroethylene (PCE)	*127-18-4*	8260B	5	0.67
Toluene	*108-88-3*	8260B	5	0.85
1,2,4-Trichlorobenzene	*120-82-1*	8260B	5	0.30
1,1,1-Trichloroethane	*71-55-6*	8260B	5	0.36
1,1,2-Trichloroethane	*79-00-5*	8260B	5	0.25
Trichloroethylene (TCE)	*79-01-6*	8260B	5	0.35
Trichlorofluoromethane (Freon-11)	*75-69-4*	8260B	5	1.56
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon	*76-13-1*	8260B	5	0.53
1,2,4-Trimethylbenzene	*95-63-6*	8260B	5	0.36
1,3,5-Trimethylbenzene	*108-67-8*	8260B	5	0.32
Vinyl chloride	*75-01-4*	8260B	10	0.20
o-Xylene	*95-47-6*	8260B	5	0.25
p-Xylene (combined)	*106-42-3*	8260B	10	0.43
m-Xylene (combined)	*108-38-3*	8260B	10	0.43
TCL Semi-Volatile Organic Compounds (full list): (64 compounds) (ug/kg) ***[includes Base-Neutrals (black) and Acid Extractables (blue)]***				
Acenaphthene	*83-32-9*	8270C	170	2.00
Acenaphthylene	*208-96-8*	8270C	170	1.40
Anthracene	*120-12-7*	8270C	170	4.30
Benzo(a)anthracene	*56-55-3*	8270C	170	2.90
Benzo(a)pyrene	*50-32-8*	8270C	170	4.10
Benzo(b)fluoranthene	*205-99-2*	8270C	170	3.30
Benzo(g,h,i)perylene	*191-24-2*	8270C	170	2.00
Benzo(k)fluoranthene	*207-08-9*	8270C	170	1.90
Benzyl alcohol	*100-51-6*	8270C	330	8.10
bis(2-Chloroethoxy)methane	*111-91-1*	8270C	170	9.20
bis(2-Chloroethyl)ether	*111-44-4*	8270C	170	15.00

TABLE 1

CONSTITUENTS OF PRIMARY CONCERN (COPCs)
FOR SOIL/FILL MATRICES

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

Analyte[1]	*CAS Number*	Analytical Method [2]	PQL	MDL
TCL Semi-Volatile Organic Compounds (full list): (64 compounds) (ug/kg) ***[includes Base-Neutrals (black) and Acid Extractables (blue)]***				
2,2'-oxybis(1-chloropropane); bis(2-chloroisopropyl)ether	*108-60-1*	8270C	170	15.00
bis(2-Ethylhexyl)phthalate	*117-81-7*	8270C	170	54.00
Butyl benzyl phthalate	*85-68-7*	8270C	170	45.00
4-Bromophenyl phenyl ether	*101-55-3*	8270C	170	54.00
4-Chloroaniline	*106-47-8*	8270C	170	50.00
4-Chloro-3-methylphenol	*59-50-7*	8270C	170	6.90
2-Chloronaphthalene	*91-58-7*	8270C	170	11.00
2-Chlorophenol	*95-57-8*	8270C	170	8.60
4-Chlorophenyl-phenylether	*7005-72-3*	8270C	170	3.60
Chrysene	*218-01-9*	8270C	170	1.70
Dibenzo(a,h)anthracene	*53-70-3*	8270C	170	2.00
Dibenzofuran	*132-64-9*	8270C	170	1.80
3,3'-Dichlorobenzidine	*91-94-1*	8270C	170	150.00
2,4-Dichlorophenol	*120-83-2*	8270C	170	8.80
1,2-Dichlorobenzene	*95-50-1*	8270C	330	3.20
1,3-Dichlorobenzene	*541-73-1*	8270C	330	3.00
1,4-Dichlorobenzene	*106-46-7*	8270C	330	2.20
Diethyl phthalate	*84-66-2*	8270C	170	5.10
2,4-Dimethylphenol	*105-67-9*	8270C	170	46.00
Dimethyl phthalate	*131-11-3*	8270C	170	4.40
Di-n-butyl phthalate	*84-74-2*	8270C	170	58.00
Di-n-octyl phthalate	*117-84-0*	8270C	170	3.90
4,6-Dinitro-2-methylphenol	*534-52-1*	8270C	330	58.00
2,4-Dinitrophenol	*51-28-5*	8270C	330	59.00
2,4-Dinitrotoluene	*121-14-2*	8270C	170	26.00
2,6-Dinitrotoluene	*606-20-2*	8270C	170	41.00
Fluoranthene	*206-44-0*	8270C	170	2.40
Fluorene	*86-73-7*	8270C	170	3.90
Hexachlorobenzene	*118-74-1*	8270C	170	8.40
Hexachlorobutadiene	*87-68-3*	8270C	170	8.60
Hexachlorocyclopentadiene	*77-47-4*	8270C	170	51.00
Hexachloroethane	*67-72-1*	8270C	170	13.00
Indeno(1,2,3-cd)pyrene	*193-39-5*	8270C	170	4.70
Isophorone	*78-59-1*	8270C	170	8.40
2-Methylnaphthalene	*91-57-6*	8270C	170	2.00

TABLE 1

CONSTITUENTS OF PRIMARY CONCERN (COPCs) FOR SOIL/FILL MATRICES

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

Analyte[1]	***CAS Number***	**Analytical Method [2]**	**PQL**	**MDL**
TCL Semi-Volatile Organic Compounds (full list): (64 compounds) (ug/kg) ***[includes Base-Neutrals (black) and Acid Extractables (blue)]***				
2-Methylphenol (o-Cresol)	*95-48-7*	8270C	170	5.20
4-Methylphenol (p-Cresol)	*106-44-5*	8270C	170	9.40
Naphthalene	*91-20-3*	8270C	170	2.80
2-Nitroaniline	*88-74-4*	8270C	330	54.00
3-Nitroaniline	*99-09-2*	8270C	330	39.00
4-Nitroaniline	*100-01-6*	8270C	330	19.00
Nitrobenzene	*98-95-3*	8270C	170	7.50
2-Nitrophenol	*88-75-5*	8270C	170	7.70
4-Nitrophenol	*100-02-7*	8270C	330	41.00
N-Nitrosodiphenylamine	*86-30-6*	8270C	170	9.20
N-Nitroso-di-n-propylamine	*621-64-7*	8270C	170	13.00
Pentachlorophenol	*87-86-5*	8270C	330	58.00
Phenanthrene	*85-01-8*	8270C	170	3.50
Phenol	*108-95-2*	8270C	170	18.00
Pyrene	*129-00-0*	8270C	170	1.10
1,2,4-Trichlorobenzene	*120-82-1*	8270C	330	4.80
2,4,5-Trichlorophenol	*95-95-4*	8270C	170	37.00
2,4,6-Trichlorophenol	*88-06-2*	8270C	170	11.00
RCRA Metals: (8 compounds) (mg/kg)				
Arsenic	*7440-38-2*	6010B	2	0.22
Barium	*7440-39-3*	6010B	0.5	0.05
Cadmium	*7440-43-9*	6010B	0.2	0.04
Chromium	*7440-47-3*	6010B	0.5	0.09
Lead	*7439-92-1*	6010B	1	0.12
Mercury	*7439-97-6*	7471A	0.02	0.0081
Selenium	*7782-49-2*	6010B	4	0.59
Silver	*7440-22-4*	6010B	0.5	0.07

Notes:

1. Analytes as per NYSDEC and USEPA list of parameters.
2. Analytical methods per USEPA publication, SW-846, "Test Methods for Evaluating Solid Waste", Third Edition. Samples for TCLP analysis will be prepared using USEPA Method 1311.

Acronyms/Abbreviations:

CAS = Chemical Abstracts Service registry number.
MDL = Method Detection Limit provided by STL
PQL = Practical Quantitation Limit
mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram

TABLE 2

CONSTITUENTS OF PRIMARY CONCERN (COPCs)
FOR WATER MATRICES

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

Analyte[1]	*CAS Number*	Analytical Method [2]	PQL	MDL
TCL Volatile Organic Compounds (full list): (57 compounds) (ug/L) ***[includes STARS VOCs in blue]***				
Acetone	*67-64-1*	8260B	5	1.35
Benzene	*71-43-2*	8260B	1	0.16
Bromoform	*75-25-2*	8260B	1	0.26
Bromodichloromethane	*75-27-4*	8260B	1	0.39
Bromomethane (Methyl bromide)	*74-83-9*	8260B	1	0.28
2-Butanone (MEK)	*78-93-3*	8260B	5	1.32
n-Butylbenzene	*104-51-8*	8260B	1	0.28
sec-Butylbenzene	*135-98-8*	8260B	1	0.30
tert-Butylbenzene	*98-06-6*	8260B	1	0.30
Carbon disulfide	*75-15-0*	8260B	1	0.19
Carbon tetrachloride	*56-23-5*	8260B	1	0.27
Chlorobenzene	*108-90-7*	8260B	1	0.32
Chloroethane	*75-00-3*	8260B	1	0.32
Chloroform	*67-66-3*	8260B	1	0.34
Chloromethane (Methyl chloride)	*74-87-3*	8260B	1	0.35
Cyclohexane	*110-82-7*	8260B	1	0.53
p-Cymene (p-isopropyltoluene)	*99-87-6*	8260B	1	0.31
1,2-Dibromo-3-chloropropane	*96-12-8*	8260B	1	1.00
1,2-Dibromoethane (EDB)	*106-93-4*	8260B	1	0.17
Dibromochloromethane	*124-48-1*	8260B	1	0.32
Dichlorodifluoromethane (Freon-12)	*75-71-8*	8260B	1	0.29
1,2-Dichlorobenzene	*95-50-1*	8260B	1	0.20
1,3-Dichlorobenzene	*541-73-1*	8260B	1	0.16
1,4-Dichlorobenzene	*106-46-7*	8260B	1	0.16
1,1-Dichloroethane	*75-34-3*	8260B	1	0.75
1,2-Dichloroethane (EDC)	*107-06-2*	8260B	1	0.21
1,1-Dichloroethylene (1,1-DCE)	*75-35-4*	8260B	1	0.29
trans-1,2-Dichloroethylene	*156-60-5*	8260B	1	0.13
cis-1,2-Dichloroethylene	*156-59-2*	8260B	1	0.16
cis-1,3-Dichloropropene	*10061-01-5*	8260B	1	0.36
trans-1,3-Dichloropropene	*10061-02-6*	8260B	1	0.37
1,2-Dichloropropane	*78-87-5*	8260B	1	0.14
Ethylbenzene	*100-41-4*	8260B	1	0.18
2-Hexanone	*591-78-6*	8260B	5	1.24
Isopropylbenzene (Cumene)	*98-82-8*	8260B	1	0.19
Methyl acetate	*79-20-9*	8260B	1	0.17
Methylene chloride	*75-09-2*	8260B	1	0.44
Methylcyclohexane	*108-87-2*	8260B	1	0.50

TABLE 2

CONSTITUENTS OF PRIMARY CONCERN (COPCs)
FOR WATER MATRICES

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

Analyte[1]	*CAS Number*	Analytical Method [2]	PQL	MDL
TCL Volatile Organic Compounds (full list): (57 compounds) (ug/L) ***[includes STARS VOCs in blue]***				
4-methyl-2-pentanone (MIBK)	*108-10-1*	8260B	5	0.91
Methyl tert butyl ether (MTBE)	*1634-04-4*	8260B	1	0.16
n-Propylbenzene	*103-65-1*	8260B	1	0.18
Styrene	*100-42-5*	8260B	1	0.18
1,1,1,2-Tetrachloroethane	*630-20-6*	8260B	1	0.35
Tetrachloroethylene (PCE)	*127-18-4*	8260B	1	0.36
Toluene	*108-88-3*	8260B	1	0.51
1,2,4-Trichlorobenzene	*120-82-1*	8260B	1	0.41
1,1,1-Trichloroethane	*71-55-6*	8260B	1	0.26
1,1,2-Trichloroethane	*79-00-5*	8260B	1	0.23
Trichloroethylene (TCE)	*79-01-6*	8260B	1	0.18
Trichlorofluoromethane (Freon-11)	*75-69-4*	8260B	1	0.15
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon	*76-13-1*	8260B	1	0.31
1,2,4-Trimethylbenzene	*95-63-6*	8260B	1	0.33
1,3,5-Trimethylbenzene	*108-67-8*	8260B	1	0.22
Vinyl chloride	*75-01-4*	8260B	1	0.24
o-Xylene	*95-47-6*	8260B	1	0.14
p-Xylene (combined)	*106-42-3*	8260B	2	0.66
m-Xylene (combined)	*108-38-3*	8260B	2	0.66
TCL Semi-Volatile Organic Compounds (full list): (64 compounds) (ug/L) ***[includes Base-Neutrals (black) and Acid Extractables (blue)]***				
Acenaphthene	*83-32-9*	8270C	5	0.11
Acenaphthylene	*208-96-8*	8270C	5	0.05
Anthracene	*120-12-7*	8270C	5	0.06
Benzo(a)anthracene	*56-55-3*	8270C	5	0.06
Benzo(a)pyrene	*50-32-8*	8270C	5	0.09
Benzo(b)fluoranthene	*205-99-2*	8270C	5	0.06
Benzo(g,h,i)perylene	*191-24-2*	8270C	5	0.08
Benzo(k)fluoranthene	*207-08-9*	8270C	5	0.07
Benzyl alcohol	*100-51-6*	8270C	20	0.29
bis(2-Chloroethoxy)methane	*111-91-1*	8270C	5	0.38
bis(2-Chloroethyl)ether	*111-44-4*	8270C	5	0.18
2,2'-oxybis(1-chloropropane); bis(2-chloroisopropyl)ether	*108-60-1*	8270C	5	0.42
bis(2-Ethylhexyl)phthalate	*117-81-7*	8270C	5	4.76
Butyl benzyl phthalate	*85-68-7*	8270C	5	1.74
4-Bromophenyl phenyl ether	*101-55-3*	8270C	5	0.90
4-Chloroaniline	*106-47-8*	8270C	5	0.33
4-Chloro-3-methylphenol	*59-50-7*	8270C	5	0.60

TABLE 2

CONSTITUENTS OF PRIMARY CONCERN (COPCs) FOR WATER MATRICES

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

Analyte[1]	*CAS Number*	Analytical Method [2]	PQL	MDL
TCL Semi-Volatile Organic Compounds (full list): (64 compounds) (ug/L) ***[includes Base-Neutrals (black) and Acid Extractables (blue)]***				
2-Chloronaphthalene	*91-58-7*	8270C	5	0.08
2-Chlorophenol	*95-57-8*	8270C	5	0.51
4-Chlorophenyl-phenylether	*7005-72-3*	8270C	5	0.17
Chrysene	*218-01-9*	8270C	5	0.27
Dibenzo(a,h)anthracene	*53-70-3*	8270C	5	0.20
Dibenzofuran	*132-64-9*	8270C	5	0.10
3,3'-Dichlorobenzidine	*91-94-1*	8270C	5	0.37
2,4-Dichlorophenol	*120-83-2*	8270C	5	0.79
1,2-Dichlorobenzene	*95-50-1*	8270C	10	0.15
1,3-Dichlorobenzene	*541-73-1*	8270C	10	0.14
1,4-Dichlorobenzene	*106-46-7*	8270C	10	0.16
Diethyl phthalate	*84-66-2*	8270C	5	0.11
2,4-Dimethylphenol	*105-67-9*	8270C	5	0.96
Dimethyl phthalate	*131-11-3*	8270C	5	0.30
Di-n-butyl phthalate	*84-74-2*	8270C	5	0.30
Di-n-octyl phthalate	*117-84-0*	8270C	5	0.24
4,6-Dinitro-2-methylphenol	*534-52-1*	8270C	10	2.27
2,4-Dinitrophenol	*51-28-5*	8270C	10	2.22
2,4-Dinitrotoluene	*121-14-2*	8270C	5	0.45
2,6-Dinitrotoluene	*606-20-2*	8270C	5	0.51
Fluoranthene	*206-44-0*	8270C	5	0.10
Fluorene	*86-73-7*	8270C	5	0.07
Hexachlorobenzene	*118-74-1*	8270C	5	0.45
Hexachlorobutadiene	*87-68-3*	8270C	5	2.60
Hexachlorocyclopentadiene	*77-47-4*	8270C	5	2.50
Hexachloroethane	*67-72-1*	8270C	5	2.82
Indeno(1,2,3-cd)pyrene	*193-39-5*	8270C	5	0.15
Isophorone	*78-59-1*	8270C	5	0.32
2-Methylnaphthalene	*91-57-6*	8270C	5	0.08
2-Methylphenol (o-Cresol)	*95-48-7*	8270C	5	0.23
4-Methylphenol (p-Cresol)	*106-44-5*	8270C	5	0.35
Naphthalene	*91-20-3*	8270C	5	0.12
2-Nitroaniline	*88-74-4*	8270C	10	0.50
3-Nitroaniline	*99-09-2*	8270C	10	1.55
4-Nitroaniline	*100-01-6*	8270C	10	0.46
Nitrobenzene	*98-95-3*	8270C	5	0.54
2-Nitrophenol	*88-75-5*	8270C	5	0.60
4-Nitrophenol	*100-02-7*	8270C	10	1.53
N-Nitrosodiphenylamine	*86-30-6*	8270C	5	0.26

TABLE 2

CONSTITUENTS OF PRIMARY CONCERN (COPCs)
FOR WATER MATRICES

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

Analyte[1]	*CAS Number*	Analytical Method [2]	PQL	MDL
TCL Semi-Volatile Organic Compounds (full list): (64 compounds) (ug/L) ***[includes Base-Neutrals (black) and Acid Extractables (blue)]***				
N-Nitroso-di-n-propylamine	*621-64-7*	8270C	5	0.45
Pentachlorophenol	*87-86-5*	8270C	10	5.14
Phenanthrene	*85-01-8*	8270C	5	0.11
Phenol	*108-95-2*	8270C	5	0.45
Pyrene	*129-00-0*	8270C	5	0.07
1,2,4-Trichlorobenzene	*120-82-1*	8270C	10	0.11
2,4,5-Trichlorophenol	*95-95-4*	8270C	5	0.99
2,4,6-Trichlorophenol	*88-06-2*	8270C	5	0.99
RCRA Metals: (8 compounds) (mg/L)				
Arsenic	*7440-38-2*	6010B	0.01	0.0037
Barium	*7440-39-3*	6010B	0.002	0.00028
Cadmium	*7440-43-9*	6010B	0.001	0.00033
Chromium	*7440-47-3*	6010B	0.004	0.00088
Lead	*7439-92-1*	6010B	0.005	0.0029
Mercury	*7439-97-6*	7470A	0.0002	0.00012
Selenium	*7782-49-2*	6010B	0.015	0.0061
Silver	*7440-22-4*	6010B	0.003	0.00127
Field Parameters: (5 compounds) (units as identified below)				
pH (units)	*NA*	field	NA	NA
Temperature (^{o}C)	*NA*	field	NA	NA
Specific Conductance (uS/mS)	*NA*	field	NA	NA
Turbidity (NTU)	*NA*	field	NA	NA
Dissolved Oxygen	*NA*	field	NA	NA

Notes:

1. Analytes as per NYSDEC and USEPA list of parameters.
2. Analytical methods per USEPA publication, SW-846, "Test Methods for Evaluating Solid Waste", Third Edition.

Acronyms/Abbreviations:

CAS = Chemical Abstracts Service registry number.
MDL = Method Detection Limit provided by STL
mg/L = milligrams per liter
mS = milli-Siemans
ug/L = micrograms per liter
uS = micro-Siemans
NA = not applicable
NTU = nephelometric turbidity unit
PQL = Practical Quantitation Limit

Table 3 - Precision and Accuracy Goals for VOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

8260 in Water (8260B)

Preservation: HCl to pH<2; zero headspace, cool at 4°C

Container: VOA Vial HCl **Amount Required:** 5 **Hold Time:** 14 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
1,1,1,2-Tetrachloroethane	0.35	1.0 ug/L		20	76 - 122	20	76 - 122	20
1,1,1-Trichloroethane	0.26	1.0 ug/L		15	73 - 126	15	73 - 126	15
1,1,2,2-Tetrachloroethane	0.21	1.0 ug/L		15	70 - 126	15	70 - 126	15
1,1,2-Trichloroethane	0.23	1.0 ug/L		15	76 - 122	15	76 - 122	15
1,1,2-Trichlorotrifluoroethane	0.31	1.0 ug/L		20	60 - 140	20	60 - 140	20
1,1-Dichloroethane	0.75	1.0 ug/L		20	71 - 129	20	71 - 129	20
1,1-Dichloroethene	0.29	1.0 ug/L		16	65 - 138	16	65 - 138	16
1,1-Dichloropropene	0.18	1.0 ug/L		20	72 - 122	20	72 - 122	20
1,1-Dimethoxyethane	3.3	5.0 ug/L						
1,2,3-Trichlorobenzene	0.39	1.0 ug/L		20	64 - 121	20	64 - 121	20
1,2,3-Trichloropropane	0.16	1.0 ug/L		14	68 - 131	14	68 - 131	14
1,2,3-Trimethylbenzene	0.47	1.0 ug/L						
1,2,4-Trichlorobenzene	0.41	1.0 ug/L		20	70 - 122	20	70 - 122	20
1,2,4-Trimethylbenzene	0.33	1.0 ug/L		20	76 - 121	20	76 - 121	20
1,2-Dibromo-3-chloropropane	1.0	1.0 ug/L		15	56 - 134	15	56 - 134	15
1,2-Dibromoethane (EDB)	0.17	1.0 ug/L		15	77 - 120	15	77 - 120	15
1,2-Dichlorobenzene	0.20	1.0 ug/L		20	77 - 120	20	77 - 120	20
1,2-Dichloroethane	0.21	1.0 ug/L		20	75 - 127	20	75 - 127	20
1,2-Dichloroethene, Total	0.70	2.0 ug/L		20	72 - 124	20	72 - 124	20
1,2-Dichloropropane	0.14	1.0 ug/L		20	76 - 120	20	76 - 120	20
1,3,5-Trichlorobenzene	0.45	1.0 ug/L						
1,3,5-Trimethylbenzene	0.22	1.0 ug/L		20	77 - 121	20	77 - 121	20
1,3-Dichlorobenzene	0.16	1.0 ug/L		20	77 - 120	20	77 - 120	20
1,3-Dichloropropane	0.21	1.0 ug/L		20	75 - 120	20	75 - 120	20
1,3-Dichloropropene, Total	0.72	2.0 ug/L						
1,4-Dichlorobenzene	0.16	1.0 ug/L		20	75 - 120	20	75 - 120	20
1,4-Dioxane	22	40 ug/L						
2,2-Dichloropropane	0.75	1.0 ug/L		20	63 - 136	20	63 - 136	20
2-Butanone (MEK)	1.3	5.0 ug/L		20	57 - 140	20	57 - 140	20
2-Chloroethyl vinyl ether	0.96	5.0 ug/L						
2-Chlorotoluene	0.20	1.0 ug/L		20	76 - 121	20	76 - 121	20
2-Hexanone	1.2	5.0 ug/L		15	65 - 127	15	65 - 127	15
2-Methylthiophene	0.44	1.0 ug/L						
3-Chlorotoluene	0.45	1.0 ug/L						
3-Methylthiophene	0.53	1.0 ug/L						
4-Chlorotoluene	0.37	1.0 ug/L		15	77 - 121	15	77 - 121	15
4-Isopropyltoluene	0.31	1.0 ug/L		20	73 - 120	20	73 - 120	20
4-Methyl-2-pentanone (MIBK)	0.91	5.0 ug/L		35	71 - 125	35	71 - 125	35
Acetone	1.3	5.0 ug/L		15	56 - 142	15	56 - 142	15
Acetonitrile	6.5	40 ug/L		20	60 - 140	20	60 - 140	20
Acrolein	5.5	20 ug/L		20	60 - 140	20	60 - 140	20
Acrylonitrile	0.83	5.0 ug/L		20	63 - 138	20	63 - 138	20
Allyl chloride	0.17	1.0 ug/L		20	60 - 140	20	60 - 140	20
Benzene	0.16	1.0 ug/L		13	71 - 124	13	71 - 124	13
Bromobenzene	0.17	1.0 ug/L		15	78 - 120	15	78 - 120	15
Bromochloromethane	0.12	1.0 ug/L		15	72 - 130	15	72 - 130	15

Table 3 - Precision and Accuracy Goals for VOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
Bromodichloromethane	0.39	1.0 ug/L		15	80 - 122	15	80 - 122	15
Bromoform	0.26	1.0 ug/L		15	66 - 128	15	66 - 128	15
Bromomethane	0.28	1.0 ug/L		15	36 - 150	15	36 - 150	15
Carbon disulfide	0.19	1.0 ug/L		15	59 - 134	15	59 - 134	15
Carbon Tetrachloride	0.27	1.0 ug/L		15	72 - 134	15	72 - 134	15
Chlorobenzene	0.32	1.0 ug/L		25	72 - 120	25	72 - 120	25
Chlorodibromomethane	0.32	1.0 ug/L		15	75 - 125	15	75 - 125	15
Chlorodifluoromethane	0.26	1.0 ug/L						
Chloroethane	0.32	1.0 ug/L		15	69 - 136	15	69 - 136	15
Chloroform	0.34	1.0 ug/L		20	73 - 127	20	73 - 127	20
Chloromethane	0.35	1.0 ug/L		15	49 - 142	15	49 - 142	15
Chloroprene	0.18	1.0 ug/L		20	60 - 140	20	60 - 140	20
cis-1,2-Dichloroethene	0.16	1.0 ug/L		15	74 - 124	15	74 - 124	15
cis-1,3-Dichloropropene	0.36	1.0 ug/L		15	74 - 124	15	74 - 124	15
Cyclohexane	0.53	1.0 ug/L		20	70 - 130	20	70 - 130	20
Cyclohexanone	0.83	10 ug/L						
Dibromomethane	0.41	1.0 ug/L		15	76 - 127	15	76 - 127	15
Dichlorodifluoromethane	0.29	1.0 ug/L		20	33 - 157	20	33 - 157	20
Dichlorofluoromethane	0.54	1.0 ug/L						
Dicyclopentadiene	0.44	1.0 ug/L						
Diethyl ether	0.13	5.0 ug/L						
Epichlorohydrin	2.8	20 ug/L						
Ethyl Acetate	0.16	1.0 ug/L						
Ethyl Methacrylate	0.26	1.0 ug/L		20	60 - 140	20	60 - 140	20
Ethyl tert-Butyl Ether	0.60	1.0 ug/L		15	75 - 125	15	75 - 125	15
Ethylbenzene	0.18	1.0 ug/L		15	77 - 123	15	77 - 123	15
Heptane	0.15	20 ug/L						
Hexachlorobutadiene	0.28	1.0 ug/L		20	62 - 124	20	62 - 124	20
Hexane	0.62	10 ug/L						
Iodomethane	0.75	1.0 ug/L		20	52 - 151	20	52 - 151	20
Isobutanol	4.4	40 ug/L		20	60 - 140	20	60 - 140	20
Isopropyl alcohol	6.7	20 ug/L						
Isopropyl ether	0.17	1.0 ug/L		15	75 - 125	15	75 - 125	15
Isopropylbenzene	0.19	1.0 ug/L		20	77 - 122	20	77 - 122	20
Methacrylonitrile	0.12	5.0 ug/L		20	60 - 140	20	60 - 140	20
Methyl Acetate	0.17	1.0 ug/L		20	60 - 140	20	60 - 140	20
Methyl Methacrylate	0.14	1.0 ug/L		20	60 - 140	20	60 - 140	20
Methyl tert-Butyl Ether	0.16	1.0 ug/L		37	64 - 127	37	64 - 127	37
Methylcyclohexane	0.50	1.0 ug/L		20	60 - 140	20	60 - 140	20
Methylene Chloride	0.44	1.0 ug/L		15	57 - 132	15	57 - 132	15
m-Monochlorobenzotrifluoride	0.49	1.0 ug/L						
m-Xylene & p-Xylene	0.66	2.0 ug/L		16	76 - 122	16	76 - 122	16
Naphthalene	0.43	1.0 ug/L		20	54 - 140	20	54 - 140	20
n-Butanol	16	40 ug/L						
n-Butylbenzene	0.28	1.0 ug/L		15	71 - 128	15	71 - 128	15
n-Propylbenzene	0.18	1.0 ug/L		15	77 - 120	15	77 - 120	15
o-Monochlorobenzotrifluoride	0.50	1.0 ug/L						
o-Xylene	0.14	1.0 ug/L		16	76 - 122	16	76 - 122	16
Pentachloroethane	0.11	1.0 ug/L						
p-Monochlorobenzotrifluoride	0.48	1.0 ug/L						

Table 3 - Precision and Accuracy Goals for VOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
Propionitrile	1.9	10 ug/L		20	60 - 140	20	60 - 140	20
Propylene Oxide	0.60	5.0 ug/L						
sec-Butylbenzene	0.30	1.0 ug/L		15	74 - 127	15	74 - 127	15
Styrene	0.18	1.0 ug/L		20	70 - 130	20	70 - 130	20
t-Amyl alcohol	1.0	1.0 ug/L		15	75 - 125	15	75 - 125	15
t-Butanol	3.6	20 ug/L		15	75 - 125	15	75 - 125	15
Tert-Amyl Methyl Ether	0.53	1.0 ug/L		15	75 - 125	15	75 - 125	15
tert-Butylbenzene	0.30	1.0 ug/L		15	75 - 123	15	75 - 123	15
Tetrachloroethene	0.36	1.0 ug/L		20	74 - 122	20	74 - 122	20
Tetrahydrofuran	1.3	5.0 ug/L						
Toluene	0.51	1.0 ug/L		15	70 - 122	15	70 - 122	15
trans-1,2-Dichloroethene	0.13	1.0 ug/L		20	73 - 127	20	73 - 127	20
trans-1,3-Dichloropropene	0.37	1.0 ug/L		15	72 - 123	15	72 - 123	15
trans-1,4-Dichloro-2-butene	2.1	5.0 ug/L		20	38 - 155	20	38 - 155	20
Trichloroethene	0.18	1.0 ug/L		16	74 - 123	16	74 - 123	16
Trichlorofluoromethane	0.15	1.0 ug/L		20	62 - 152	20	62 - 152	20
Vinyl acetate	0.85	5.0 ug/L		23	50 - 144	23	50 - 144	23
Vinyl chloride	0.24	1.0 ug/L		15	65 - 133	15	65 - 133	15
Xylenes, total	0.93	3.0 ug/L		16	76 - 122	16	76 - 122	16
2-Nitropropane	0.74	5.0 ug/L						
surr: 1,2-Dichloroethane-d4			66 - 137					
surr: 4-Bromofluorobenzene	0.0		73 - 120					
surr: Dibromofluoromethane			70 - 130					
surr: Toluene-d8			71 - 126					
Total BTEX								
1,4-Dichlorobenzene-d4								
1,4-Difluorobenzene								
Chlorobenzene-d5								

Table 3 - Precision and Accuracy Goals for VOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

8260 in Solid (8260B)

Preservation: Glass jar w/PTFE seal; minimal headspace, Cool 4°C

Container: 2 oz. Glass Jar **Amount Required:** 5 **Hold Time:** 14 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
1,1,1,2-Tetrachloroethane	0.31	5.0 ug/kg		20	74 - 127	20	74 - 127	20
1,1,1-Trichloroethane	0.36	5.0 ug/kg		20	77 - 121	20	77 - 121	20
1,1,2,2-Tetrachloroethane	0.81	5.0 ug/kg		20	80 - 120	20	80 - 120	20
1,1,2-Trichloroethane	0.25	5.0 ug/kg		20	78 - 122	20	78 - 122	20
1,1,2-Trichlorotrifluoroethane	0.53	5.0 ug/kg		20	60 - 140	20	60 - 140	20
1,1-Dichloroethane	0.58	5.0 ug/kg		20	79 - 126	20	79 - 126	20
1,1-Dichloroethene	0.61	5.0 ug/kg		22	65 - 153	22	65 - 153	22
1,1-Dichloropropene	0.29	5.0 ug/kg		20	72 - 128	20	72 - 128	20
1,1-Dimethoxyethane	2.0	25 ug/kg						
1,2,3-Trichlorobenzene	0.53	5.0 ug/kg		20	60 - 120	20	60 - 120	20
1,2,3-Trichloropropane	0.51	5.0 ug/kg		20	73 - 128	20	73 - 128	20
1,2,3-Trimethylbenzene	0.27	5.0 ug/kg						
1,2,4-Trichlorobenzene	0.30	5.0 ug/kg		20	64 - 120	20	64 - 120	20
1,2,4-Trimethylbenzene	0.36	5.0 ug/kg		20	74 - 120	20	74 - 120	20
1,2-Dibromo-3-chloropropane	1.0	5.0 ug/kg		20	63 - 124	20	63 - 124	20
1,2-Dibromoethane (EDB)	0.19	5.0 ug/kg		20	78 - 120	20	78 - 120	20
1,2-Dichlorobenzene	0.75	5.0 ug/kg		20	75 - 120	20	75 - 120	20
1,2-Dichloroethane	0.25	5.0 ug/kg		20	77 - 122	20	77 - 122	20
1,2-Dichloroethene, Total	2.6	10 ug/kg		20	82 - 120	20	82 - 120	20
1,2-Dichloropropane	0.26	5.0 ug/kg		20	75 - 124	20	75 - 124	20
1,3,5-Trimethylbenzene	0.32	5.0 ug/kg		20	74 - 120	20	74 - 120	20
1,3-Dichlorobenzene	0.71	5.0 ug/kg		20	74 - 120	20	74 - 120	20
1,3-Dichloropropane	0.30	5.0 ug/kg		20	72 - 127	20	72 - 127	20
1,4-Dichlorobenzene	0.70	5.0 ug/kg		20	73 - 120	20	73 - 120	20
1,4-Dioxane	53	200 ug/kg						
2,2-Dichloropropane	0.34	5.0 ug/kg		20		20		20
2-Butanone (MEK)	6.8	25 ug/kg		20	70 - 134	20	70 - 134	20
2-Chloroethyl vinyl ether	6.2	25 ug/kg						
2-Chlorotoluene	0.78	5.0 ug/kg		20		20		20
2-Hexanone	6.2	25 ug/kg		20	59 - 130	20	59 - 130	20
3-Chlorotoluene	0.29	5.0 ug/kg						
4-Chlorotoluene	0.75	5.0 ug/kg		20		20		20
4-Isopropyltoluene	0.40	5.0 ug/kg		20	74 - 120	20	74 - 120	20
4-Methyl-2-pentanone (MIBK)	6.2	25 ug/kg		20	65 - 133	20	65 - 133	20
Acetone	1.1	25 ug/kg		15	61 - 137	15	61 - 137	15
Acetonitrile	50	200 ug/kg						
Acrolein	2.7	100 ug/kg						
Acrylonitrile	2.1	100 ug/kg		20	65 - 134	20	65 - 134	20
Allyl chloride	0.42	5.0 ug/kg						
Benzene	0.55	5.0 ug/kg		20	79 - 127	20	79 - 127	20
Bromobenzene	0.78	5.0 ug/kg		20		20		20
Bromochloromethane	0.36	5.0 ug/kg		20	75 - 134	20	75 - 134	20
Bromodichloromethane	0.26	5.0 ug/kg		20	80 - 122	20	80 - 122	20
Bromoform	0.46	5.0 ug/kg		20	68 - 126	20	68 - 126	20
Bromomethane	0.46	5.0 ug/kg		20	43 - 151	20	43 - 151	20
Carbon disulfide	0.43	5.0 ug/kg		20	64 - 131	20	64 - 131	20

Table 3 - Precision and Accuracy Goals for VOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
Carbon Tetrachloride	0.68	5.0 ug/kg		20	75 - 123	20	75 - 123	20
Chlorobenzene	0.51	5.0 ug/kg		25	79 - 118	25	79 - 118	25
Chlorodibromomethane	0.28	5.0 ug/kg		20	76 - 125	20	76 - 125	20
Chloroethane	0.81	5.0 ug/kg		20	69 - 135	20	69 - 135	20
Chloroform	0.31	5.0 ug/kg		20	80 - 118	20	80 - 118	20
Chloromethane	0.30	5.0 ug/kg		20	63 - 127	20	63 - 127	20
Chloroprene	0.33	5.0 ug/kg						
cis-1,2-Dichloroethene	0.25	5.0 ug/kg		20	81 - 117	20	81 - 117	20
cis-1,3-Dichloropropene	0.29	5.0 ug/kg		20	82 - 120	20	82 - 120	20
Cyclohexane	0.23	5.0 ug/kg		20	70 - 130	20	70 - 130	20
Cyclohexanone	3.8	50 ug/kg						
Dibromomethane	0.52	5.0 ug/kg		20	73 - 130	20	73 - 130	20
Dichlorodifluoromethane	0.41	5.0 ug/kg		20	57 - 142	20	57 - 142	20
Dicyclopentadiene	0.26	5.0 ug/kg						
Diethyl ether	0.55	25 ug/kg						
Epichlorohydrin	1.8	100 ug/kg						
Ethyl Acetate	1.9	5.0 ug/kg						
Ethyl Methacrylate	0.27	5.0 ug/kg						
Ethyl tert-Butyl Ether	0.20	5.0 ug/kg						
Ethylbenzene	0.35	5.0 ug/kg		20	80 - 120	20	80 - 120	20
Heptane	1.2	100 ug/kg						
Hexachlorobutadiene	0.59	5.0 ug/kg		20		20		20
Hexane	0.50	50 ug/kg						
Iodomethane	0.61	5.0 ug/kg		20	59 - 149	20	59 - 149	20
Isobutanol	8.8	200 ug/kg						
Isopropyl ether	0.28	5.0 ug/kg						
Isopropylbenzene	0.33	5.0 ug/kg		20	72 - 120	20	72 - 120	20
Methacrylonitrile	0.30	25 ug/kg						
Methyl Acetate	1.0	5.0 ug/kg		20	60 - 140	20	60 - 140	20
Methyl Methacrylate	0.54	5.0 ug/kg						
Methyl tert-Butyl Ether	0.49	5.0 ug/kg		20	63 - 125	20	63 - 125	20
Methylcyclohexane	0.32	5.0 ug/kg		20	60 - 140	20	60 - 140	20
Methylene Chloride	2.2	5.0 ug/kg		15	61 - 127	15	61 - 127	15
m-Xylene & p-Xylene	0.43	10 ug/kg		20	70 - 130	20	70 - 130	20
Naphthalene	0.68	5.0 ug/kg		20	38 - 137	20	38 - 137	20
n-Butanol	12	200 ug/kg						
n-Butylbenzene	0.43	5.0 ug/kg		20	70 - 120	20	70 - 120	20
n-Propylbenzene	0.38	5.0 ug/kg		20	70 - 130	20	70 - 130	20
o-Xylene	0.25	5.0 ug/kg		20	70 - 130	20	70 - 130	20
Propionitrile	2.6	50 ug/kg						
Propylene Oxide	0.73	25 ug/kg						
sec-Butylbenzene	0.43	5.0 ug/kg		20	74 - 120	20	74 - 120	20
Styrene	0.25	5.0 ug/kg		20	80 - 120	20	80 - 120	20
t-Butanol	13	100 ug/kg						
Tert-Amyl Methyl Ether	0.15	5.0 ug/kg						
tert-Butylbenzene	0.52	5.0 ug/kg		20	73 - 120	20	73 - 120	20
Tetrachloroethene	0.67	5.0 ug/kg		20	74 - 122	20	74 - 122	20
Tetrahydrofuran	0.64	25 ug/kg						
Toluene	0.85	5.0 ug/kg		20	74 - 128	20	74 - 128	20
trans-1,2-Dichloroethene	0.52	5.0 ug/kg		20	78 - 126	20	78 - 126	20

Table 3 - Precision and Accuracy Goals for VOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	**MDL**	**Reporting Limit**	**Surrogate %R**	**Duplicate RPD**	**Matrix Spike**		**Blank Spike / LCS**	
					%R	**RPD**	**%R**	**RPD**
trans-1,3-Dichloropropene	0.64	5.0 ug/kg		20	73 - 123	20	73 - 123	20
trans-1,4-Dichloro-2-butene	0.36	25 ug/kg		20	38 - 155	20	38 - 155	20
Trichloroethene	0.35	5.0 ug/kg		24	77 - 129	24	77 - 129	24
Trichlorofluoromethane	1.6	5.0 ug/kg		20	65 - 146	20	65 - 146	20
Vinyl acetate	6.2	25 ug/kg		20	53 - 134	20	53 - 134	20
Vinyl chloride	0.20	10 ug/kg		20	61 - 133	20	61 - 133	20
Xylenes, total	2.9	15 ug/kg		20	80 - 120	20	80 - 120	20
2-Nitropropane	2.7	25 ug/kg						
surr: 1,2-Dichloroethane-d4			64 - 126					
surr: 4-Bromofluorobenzene	0.0		72 - 126					
surr: Toluene-d8			71 - 125					
1,4-Dichlorobenzene-d4								
1,4-Difluorobenzene								
Chlorobenzene-d5								

Table 3 - Precision and Accuracy Goals for SVOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD

8270 in Water (8270C)

Preservation: Store cool at 4°C

Container: 1 L Amber Glass Unpreserved **Amount Required:** 1000 **Hold Time:** 7 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
1,2,4,5-Tetrachlorobenzene	0.82	5.0 ug/L		30	40 - 160	30	40 - 160	30
1,2,4-Trichlorobenzene	0.11	10 ug/L		30	40 - 120	30	40 - 120	30
1,2-Dichlorobenzene	0.14	10 ug/L		29	33 - 120	29	33 - 120	29
1,2-Diphenylhydrazine	0.30	10 ug/L						
1,3,5-Trinitrobenzene	0.41	10 ug/L		30	40 - 160	30	40 - 160	30
1,3-Dichlorobenzene	0.14	10 ug/L		37	28 - 120	37	28 - 120	37
1,3-Dinitrobenzene	0.33	20 ug/L		30	40 - 160	30	40 - 160	30
1,4-Dichlorobenzene	0.16	10 ug/L		36	32 - 120	36	32 - 120	36
1,4-Dinitrobenzene	0.56	10 ug/L						
1,4-Dioxane	0.63	10 ug/L		50	11 - 120	50	11 - 120	50
1,4-Naphthoquinone	0.24	10 ug/L		30	40 - 160	30	40 - 160	30
1-Naphthylamine	2.3	10 ug/L		30	40 - 160	30	40 - 160	30
2,3,4,6-Tetrachlorophenol	2.1	5.0 ug/L		30	40 - 160	30	40 - 160	30
2,4,5-Trichlorophenol	0.99	5.0 ug/L		18	65 - 126	18	65 - 126	18
2,4,6-Trichlorophenol	0.99	5.0 ug/L		19	64 - 120	19	64 - 120	19
2,4-Dichlorophenol	0.79	5.0 ug/L		19	64 - 120	19	64 - 120	19
2,4-Dimethylphenol	0.96	5.0 ug/L		42	57 - 120	42	57 - 120	42
2,4-Dinitrophenol	2.2	10 ug/L		22	42 - 153	22	42 - 153	22
2,4-Dinitrotoluene	0.45	5.0 ug/L		20	59 - 125	20	59 - 125	20
2,6-Dichlorophenol	0.69	10 ug/L		30	40 - 160	30	40 - 160	30
2,6-Dichloropyridine	2.6	10 ug/L			53 - 120		53 - 120	
2,6-Dinitrotoluene	0.51	5.0 ug/L		15	74 - 134	15	74 - 134	15
2-Acetylaminofluorene	0.58	10 ug/L		30	40 - 160	30	40 - 160	30
2-Chloronaphthalene	0.084	5.0 ug/L		21	48 - 120	21	48 - 120	21
2-Chlorophenol	0.51	5.0 ug/L		25	48 - 120	25	48 - 120	25
2-Chloropyridine	2.2	10 ug/L		0	51 - 120	0	51 - 120	0
2-Methylnaphthalene	0.082	5.0 ug/L		21	48 - 120	21	48 - 120	21
2-Methylphenol	0.23	5.0 ug/L		27	39 - 120	27	39 - 120	27
2-Naphthylamine	0.66	10 ug/L		30	40 - 160	30	40 - 160	30
2-Nitroaniline	0.50	10 ug/L		15	67 - 136	15	67 - 136	15
2-Nitrophenol	0.60	5.0 ug/L		18	59 - 120	18	59 - 120	18
2-Picoline	0.45	80 ug/L						
2-Toluidine	1.5	10 ug/L		30	40 - 160	30	40 - 160	30
3 & 4 Methylphenol	0.93	20 ug/L		30	39 - 120	30	39 - 120	30
3,3'-Dichlorobenzidine	0.37	5.0 ug/L		25	33 - 140	25	33 - 140	25
3,3'-Dimethylbenzidine	1.2	40 ug/L		30	40 - 160	30	40 - 160	30
3-Chloropyridine	1.4	10 ug/L			48 - 120		48 - 120	
3-Methylcholanthrene	0.90	10 ug/L		30	40 - 160	30	40 - 160	30
3-Methylphenol	0.58	10 ug/L		22	41 - 120	22	41 - 120	22
3-Nitroaniline	1.5	10 ug/L		19	69 - 129	19	69 - 129	19
4,6-Dinitro-2-methylphenol	2.3	10 ug/L		15	64 - 159	15	64 - 159	15
4-Aminobiphenyl	0.48	10 ug/L		30	40 - 160	30	40 - 160	30
4-Bromophenyl phenyl ether	0.90	5.0 ug/L		15	71 - 126	15	71 - 126	15
4-Chloro-3-methylphenol	0.60	5.0 ug/L		27	64 - 120	27	64 - 120	27
4-Chloroaniline	0.33	5.0 ug/L		22	60 - 124	22	60 - 124	22
4-Chlorophenyl phenyl ether	0.17	5.0 ug/L		16	71 - 122	16	71 - 122	16

Table 3 - Precision and Accuracy Goals for SVOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
4-Chloropyridine	1.2	10 ug/L						
4-Methylphenol	0.35	5.0 ug/L		24	36 - 120	24	36 - 120	24
4-Nitroaniline	0.46	10 ug/L		24	64 - 135	24	64 - 135	24
4-Nitrophenol	1.5	10 ug/L		48	16 - 120	48	16 - 120	48
4-Nitroquinoline-1-oxide	0.58	10 ug/L						
7,12-Dimethylbenz[a]anthracene	0.52	10 ug/L		30	40 - 160	30	40 - 160	30
a,a-Dimethylphenethylamine	0.49	100 ug/L						
Acenaphthene	0.11	5.0 ug/L		24	60 - 120	24	60 - 120	24
Acenaphthylene	0.047	5.0 ug/L		18	63 - 120	18	63 - 120	18
Acetophenone	1.0	5.0 ug/L		20	45 - 120	20	45 - 120	20
Alachlor	0.63	10 ug/L						
Alpha-Terpineol	1.4	10 ug/L						
Aniline	0.70	10 ug/L		30	37 - 120	30	37 - 120	30
Anthracene	0.056	5.0 ug/L		15	69 - 131	15	69 - 131	15
Aramite	0.57	20 ug/L						
Atrazine	1.1	5.0 ug/L		20	70 - 129	20	70 - 129	20
Benzaldehyde	0.27	5.0 ug/L		20	30 - 140	20	30 - 140	20
Benzidine	2.2	80 ug/L		20	30 - 131	20	30 - 131	20
Benzo[a]anthracene	0.064	5.0 ug/L		15	73 - 138	15	73 - 138	15
Benzo[a]pyrene	0.091	5.0 ug/L		15	74 - 126	15	74 - 126	15
Benzo[b]fluoranthene	0.063	5.0 ug/L		15	75 - 133	15	75 - 133	15
Benzo[g,h,i]perylene	0.078	5.0 ug/L		15	66 - 152	15	66 - 152	15
Benzo[k]fluoranthene	0.066	5.0 ug/L		22	66 - 134	22	66 - 134	22
Benzoic acid	100	150 ug/L		50	10 - 120	50	10 - 120	50
Benzyl alcohol	0.29	20 ug/L		34	49 - 120	34	49 - 120	34
Biphenyl	0.065	5.0 ug/L		20	30 - 140	20	30 - 140	20
Bis(2-chloroethoxy)methane	0.38	5.0 ug/L		17	62 - 120	17	62 - 120	17
Bis(2-chloroethyl)ether	0.18	5.0 ug/L		21	51 - 120	21	51 - 120	21
Bis(2-chloroisopropyl) ether	0.42	5.0 ug/L		24	47 - 120	24	47 - 120	24
Bis(2-ethylhexyl) phthalate	4.8	5.0 ug/L		15	69 - 136	15	69 - 136	15
Butyl benzyl phthalate	1.7	5.0 ug/L		16	62 - 149	16	62 - 149	16
Caprolactam	4.6	5.0 ug/L		20	30 - 140	20	30 - 140	20
Carbazole	0.089	5.0 ug/L		20	68 - 133	20	68 - 133	20
Chlorobenzilate	0.51	20 ug/L		30	40 - 160	30	40 - 160	30
Chrysene	0.27	5.0 ug/L		15	69 - 140	15	69 - 140	15
Cresol(s)	1.2	20 ug/L						
Diallate	0.26	10 ug/L		30	40 - 160	30	40 - 160	30
Dibenz[a,h]anthracene	0.20	5.0 ug/L		15	67 - 144	15	67 - 144	15
Dibenzo[a,e]pyrene	3.0	10 ug/L						
Dibenzofuran	0.098	5.0 ug/L		15	66 - 120	15	66 - 120	15
Diethyl phthalate	0.11	5.0 ug/L		15	78 - 128	15	78 - 128	15
Dimethoate	0.34	10 ug/L		30	40 - 160	30	40 - 160	30
Dimethyl phthalate	0.30	5.0 ug/L		15	73 - 127	15	73 - 127	15
Di-n-butyl phthalate	0.30	5.0 ug/L		15	67 - 132	15	67 - 132	15
Di-n-octyl phthalate	0.24	5.0 ug/L		16	72 - 145	16	72 - 145	16
Dinoseb	2.9	10 ug/L						
Diphenylamine	0.52	10 ug/L		30	40 - 160	30	40 - 160	30
Disulfoton	0.37	10 ug/L		30	40 - 160	30	40 - 160	30
Ethyl Methanesulfonate	1.4	10 ug/L		30	40 - 160	30	40 - 160	30
Famphur	0.93	40 ug/L		30	40 - 160	30	40 - 160	30

Table 3 - Precision and Accuracy Goals for SVOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

		Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
Analyte	**MDL**				**%R**	**RPD**	**%R**	**RPD**
Fluoranthene	0.098	5.0 ug/L		15	67 - 133	15	67 - 133	15
Fluorene	0.074	5.0 ug/L		15	66 - 129	15	66 - 129	15
Hexachlorobenzene	0.45	5.0 ug/L		15	38 - 131	15	38 - 131	15
Hexachlorobutadiene	2.6	5.0 ug/L		44	30 - 120	44	30 - 120	44
Hexachlorocyclopentadiene	2.5	5.0 ug/L		49	23 - 120	49	23 - 120	49
Hexachloroethane	2.8	5.0 ug/L		46	25 - 120	46	25 - 120	46
Hexachlorophene	130	310 ug/L						
Hexachloropropene	0.58	10 ug/L		30	40 - 160	30	40 - 160	30
Indeno[1,2,3-cd]pyrene	0.15	5.0 ug/L		15	69 - 146	15	69 - 146	15
Isodrin	0.93	10 ug/L		30	40 - 160	30	40 - 160	30
Isophorone	0.32	5.0 ug/L		17	64 - 120	17	64 - 120	17
Isosafrole	0.81	10 ug/L		30	40 - 160	30	40 - 160	30
Kepone	1.5	50 ug/L		30	40 - 160	30	40 - 160	30
Methapyrilene	33	50 ug/L		30	40 - 160	30	40 - 160	30
Methyl Methanesulfonate	3.1	10 ug/L		30	40 - 160	30	40 - 160	30
N,N-Dimethyl Formamide	1.7	20 ug/L						
Naphthalene	0.12	5.0 ug/L		29	48 - 120	29	48 - 120	29
Nitrobenzene	0.54	5.0 ug/L		24	52 - 120	24	52 - 120	24
N-Nitro-o-toluidine	0.66	10 ug/L		30	40 - 160	30	40 - 160	30
N-Nitrosodiethylamine	0.95	10 ug/L		30	40 - 160	30	40 - 160	30
N-Nitrosodimethylamine	1.0	10 ug/L		30	40 - 160	30	40 - 160	30
N-Nitrosodi-n-butylamine	0.76	10 ug/L		30	40 - 160	30	40 - 160	30
N-Nitrosodi-n-propylamine	0.45	5.0 ug/L		31	56 - 120	31	56 - 120	31
N-Nitrosodiphenylamine	0.26	5.0 ug/L		15	25 - 125	15	25 - 125	15
N-Nitrosomethylethylamine	0.95	10 ug/L		30	40 - 160	30	40 - 160	30
N-Nitrosomorpholine	0.83	10 ug/L						
N-Nitrosopiperidine	1.4	10 ug/L		30	40 - 160	30	40 - 160	30
N-Nitrosopyrrolidine	0.74	10 ug/L		30	40 - 160	30	40 - 160	30
O,O,O-Triethyl phosphorothioate	0.34	10 ug/L		30	40 - 160	30	40 - 160	30
Parathion-ethyl	0.28	10 ug/L		30	40 - 160	30	40 - 160	30
Parathion-methyl	0.37	10 ug/L		30	40 - 160	30	40 - 160	30
p-Dimethylamino azobenzene	1.0	10 ug/L		30	40 - 160	30	40 - 160	30
Pentachlorobenzene	1.2	10 ug/L		30	40 - 160	30	40 - 160	30
Pentachloroethane	2.9	10 ug/L						
Pentachloronitrobenzene	1.0	10 ug/L		30	40 - 160	30	40 - 160	30
Pentachlorophenol	5.1	10 ug/L		37	39 - 136	37	39 - 136	37
p-Fluoroaniline	0.84	10 ug/L			51 - 120		51 - 120	
Phenacetin	0.83	10 ug/L		30	40 - 160	30	40 - 160	30
Phenanthrene	0.11	5.0 ug/L		15	67 - 130	15	67 - 130	15
Phenol	0.45	5.0 ug/L		39	17 - 120	39	17 - 120	39
Phorate	2.0	10 ug/L		30	40 - 160	30	40 - 160	30
Phthalic anhydride	56	500 ug/L						
p-Phenylene diamine	200	800 ug/L		30	40 - 160	30	40 - 160	30
Pronamide	0.23	10 ug/L		30	40 - 160	30	40 - 160	30
Pyrene	0.068	5.0 ug/L		25	58 - 136	25	58 - 136	25
Pyridine	1.6	25 ug/L		49	10 - 120	49	10 - 120	49
Quinoline	1.7	10 ug/L						
Safrole	0.55	10 ug/L		30	40 - 160	30	40 - 160	30
Simazine	0.68	10 ug/L						
Sulfotepp	0.35	10 ug/L						

Table 3 - Precision and Accuracy Goals for SVOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Tetraethyl lead	2.0	10 ug/L		35	10 - 120	35	10 - 120	35
Thionazin	0.30	10 ug/L		30	40 - 160	30	40 - 160	30
Tributyl phosphate	0.34	10 ug/L						
Tricresylphosphate	1.8	10 ug/L						
surr: 1,2-Dichlorobenzene-d4								
surr: 2-Chlorophenol-d4								
surr: 2,4,6-Tribromophenol			52 - 132					
surr: 2-Fluorobiphenyl			48 - 120					
surr: 2-Fluorophenol			20 - 120					
surr: Nitrobenzene-d5			46 - 120					
surr: Phenol-d5			16 - 120					
surr: p-Terphenyl-d14			24 - 136					
1,4-Dichlorobenzene-d4								
Naphthalene-d8								
Acenaphthene-d10								
Phenanthrene-d10								
Chrysene-d12								
Perylene-d12								

Table 3 - Precision and Accuracy Goals for SVOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

8270 in Solid (8270C)

Preservation: Store cool at 4°C

Container: 4 oz. Glass Jar **Amount Required:** 30 **Hold Time:** 14 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
1,2,4,5-Tetrachlorobenzene	15	170 ug/kg						
1,2,4-Trichlorobenzene	4.8	330 ug/kg		30	39 - 120	30	39 - 120	30
1,2-Dichlorobenzene	3.2	330 ug/kg		29				
1,2-Diphenylhydrazine	40	330 ug/kg						
1,3,5-Trinitrobenzene	14	330 ug/kg						
1,3-Dichlorobenzene	3.0	330 ug/kg		37	14 - 120	37	14 - 120	37
1,3-Dinitrobenzene	11	330 ug/kg						
1,4-Dichlorobenzene	2.2	330 ug/kg		36	25 - 120	35	25 - 120	35
1,4-Dinitrobenzene	330	330 ug/kg						
1,4-Dioxane	38	330 ug/kg						
1,4-Naphthoquinone	8.1	330 ug/kg						
1-Naphthylamine	200	330 ug/kg						
2,3,4,6-Tetrachlorophenol	170	170 ug/kg						
1,4-Dihydroxyanthraquinone	110	660 ug/kg						
2,4,5-Trichlorophenol	37	170 ug/kg		18	59 - 126	18	59 - 126	18
2,4,6-Trichlorophenol	11	170 ug/kg		19	59 - 123	19	59 - 123	19
2,4-Dichlorophenol	8.8	170 ug/kg		19				
2,4-Dimethylphenol	46	170 ug/kg		42				
2,4-Dinitrophenol	59	330 ug/kg		22	35 - 146	22	35 - 146	22
2,4-Dinitrotoluene	26	170 ug/kg		20	55 - 125	20	55 - 125	20
1-Hydroxyanthraquinone	250	660 ug/kg						
2,6-Dichlorophenol	330	330 ug/kg						
2,6-Dinitrotoluene	41	170 ug/kg		15	66 - 128	15	66 - 128	15
2-Acetylaminofluorene	20	330 ug/kg						
2-Chloronaphthalene	11	170 ug/kg		21				
2-Chlorophenol	8.6	170 ug/kg		25	38 - 120	25	38 - 120	25
2-Methylnaphthalene	2.0	170 ug/kg		21				
2-Methylphenol	5.2	170 ug/kg		27				
2-Naphthylamine	22	330 ug/kg						
2-Nitroaniline	54	330 ug/kg		15	61 - 130	15	61 - 130	15
2-Nitrophenol	7.7	170 ug/kg		18	50 - 120	18	50 - 120	18
2-Picoline	330	330 ug/kg						
2-Toluidine	69	330 ug/kg						
3 & 4 Methylphenol	9.4	660 ug/kg						
3,3'-Dichlorobenzidine	150	170 ug/kg		25	48 - 126	25	48 - 126	25
3,3'-Dimethylbenzidine	41	330 ug/kg						
2-Chloroaniline	30	330 ug/kg						
3-Methylcholanthrene	30	330 ug/kg						
3-Methylphenol	9.4	330 ug/kg						
3-Nitroaniline	39	330 ug/kg		19	61 - 127	19	61 - 127	19
4,6-Dinitro-2-methylphenol	58	330 ug/kg		15	49 - 155	15	49 - 155	15
4-Aminobiphenyl	16	330 ug/kg						
4-Bromophenyl phenyl ether	54	170 ug/kg		15	58 - 131	15	58 - 131	15
4-Chloro-3-methylphenol	6.9	170 ug/kg		27	49 - 125	27	49 - 125	27
4-Chloroaniline	50	170 ug/kg		22	49 - 120	22	49 - 120	22
4-Chlorophenyl phenyl ether	3.6	170 ug/kg		16	63 - 124	16	63 - 124	16

Table 3 - Precision and Accuracy Goals for SVOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
4-Methylphenol	9.4	170 ug/kg		24				
4-Nitroaniline	19	330 ug/kg		24	63 - 128	24	63 - 128	24
4-Nitrophenol	41	330 ug/kg		25	43 - 137	25	43 - 137	25
4-Nitroquinoline-1-oxide	660	660 ug/kg						
7,12-Dimethylbenz[a]anthracene	17	330 ug/kg						
a,a-Dimethylphenethylamine	330	330 ug/kg						
Acenaphthene	2.0	170 ug/kg		24	60 - 120	35	60 - 120	35
Acenaphthylene	1.4	170 ug/kg		18				
Acetophenone	8.7	170 ug/kg		20	66 - 120	20	66 - 120	20
Aniline	92	330 ug/kg		30	45 - 120	30	45 - 120	30
Anthracene	4.3	170 ug/kg		15				
Aramite	330	330 ug/kg						
Atrazine	7.5	170 ug/kg		20				
Benzaldehyde	19	170 ug/kg		20	21 - 120	20	21 - 120	20
Benzidine	2100	5000 ug/kg		15	20 - 120	15	20 - 120	15
Benzo[a]anthracene	2.9	170 ug/kg		15				
Benzo[a]pyrene	4.1	170 ug/kg		15				
Benzo[b]fluoranthene	3.3	170 ug/kg		15				
Benzo[g,h,i]perylene	2.0	170 ug/kg		15				
Benzo[k]fluoranthene	1.9	170 ug/kg		22				
Benzoic acid	240	4800 ug/kg		50	62 - 120	50	62 - 120	50
Benzyl alcohol	8.1	330 ug/kg		34	15 - 145	34	15 - 145	34
Biphenyl	11	170 ug/kg		20	71 - 120	20	71 - 120	20
Bis(2-chloroethoxy)methane	9.2	170 ug/kg		17	61 - 133	17	61 - 133	17
Bis(2-chloroethyl)ether	15	170 ug/kg		21	45 - 120	21	45 - 120	21
Bis(2-chloroisopropyl) ether	18	170 ug/kg		24				
9-Octadecenamide	820	3300 ug/kg						
Bis(2-ethylhexyl) phthalate	54	170 ug/kg		15				
Butyl benzyl phthalate	45	170 ug/kg		16				
Caprolactam	73	170 ug/kg		20	54 - 133	20	54 - 133	20
Carbazole	2.0	170 ug/kg		20	59 - 129	20	59 - 129	20
Chlorobenzilate	17	330 ug/kg						
Chrysene	1.7	170 ug/kg		15				
Diallate	8.9	330 ug/kg						
Dibenz[a,h]anthracene	2.0	170 ug/kg		15				
Anthraquinone	150	330 ug/kg						
Dibenzo[a,e]pyrene	330	330 ug/kg						
Dibenzofuran	1.8	170 ug/kg		15	56 - 120	15	56 - 120	15
Diethyl phthalate	5.1	170 ug/kg		15				
Dimethoate	11	330 ug/kg						
Dimethyl phthalate	4.4	170 ug/kg		15				
Di-n-butyl phthalate	58	170 ug/kg		15				
Di-n-octyl phthalate	3.9	170 ug/kg		16				
Dinoseb	330	330 ug/kg						
Diphenylamine	330	330 ug/kg						
Disulfoton	12	330 ug/kg						
Ethyl Methanesulfonate	46	330 ug/kg						
Famphur	31	660 ug/kg						
Fluoranthene	2.4	170 ug/kg		15				
Fluorene	3.9	170 ug/kg		15				

Table 3 - Precision and Accuracy Goals for SVOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Hexachlorobenzene	8.4	170 ug/kg		15				
Hexachlorobutadiene	8.6	170 ug/kg		44				
Hexachlorocyclopentadiene	51	170 ug/kg		49				
Hexachloroethane	13	170 ug/kg		46	41 - 120	46	41 - 120	46
Hexachlorophene	3300	3300 ug/kg						
Hexachloropropene	19	330 ug/kg						
Indeno[1,2,3-cd]pyrene	4.7	170 ug/kg		15				
Isodrin	31	330 ug/kg						
Isophorone	8.4	170 ug/kg		17				
Isosafrole	27	330 ug/kg						
Kepone	49	660 ug/kg						
Methapyrilene	1000	1500 ug/kg						
Methyl Methanesulfonate	100	330 ug/kg						
N,N-Dimethyl Formamide	210	660 ug/kg						
Naphthalene	2.8	170 ug/kg		29				
Nitrobenzene	7.5	170 ug/kg		24	42 - 131	24	42 - 131	24
N-Nitro-o-toluidine	22	330 ug/kg						
N-Nitrosodiethylamine	32	330 ug/kg						
N-Nitrosodimethylamine	12	330 ug/kg						
N-Nitrosodi-n-butylamine	25	330 ug/kg						
N-Nitrosodi-n-propylamine	13	170 ug/kg		31	46 - 120	31	46 - 120	31
N-Nitrosodiphenylamine	9.2	170 ug/kg		15	20 - 119	15	20 - 119	15
N-Nitrosomethylethylamine	32	330 ug/kg						
N-Nitrosomorpholine	330	330 ug/kg						
N-Nitrosopiperidine	46	330 ug/kg						
N-Nitrosopyrrolidine	25	330 ug/kg						
O,O,O-Triethyl phosphorothioate	11	330 ug/kg						
Parathion-ethyl	9.2	330 ug/kg						
Parathion-methyl	12	330 ug/kg						
p-Dimethylamino azobenzene	34	330 ug/kg						
Pentachlorobenzene	39	330 ug/kg						
Pentachloronitrobenzene	34	330 ug/kg						
Pentachlorophenol	58	330 ug/kg		37	39 - 136	35	39 - 136	35
Phenacetin	28	330 ug/kg						
Phenanthrene	3.5	170 ug/kg		15				
Phenol	18	170 ug/kg		34	17 - 120	35	17 - 120	35
Phorate	66	330 ug/kg						
Phthalic anhydride	770	10000 ug/kg						
p-Phenylene diamine	200	800 ug/kg						
Pronamide	7.7	330 ug/kg						
Pyrene	1.1	170 ug/kg		25	58 - 136	35	58 - 136	35
Pyridine	95	330 ug/kg		49	8 - 120	49	8 - 120	49
Quinoline	54	330 ug/kg						
Safrole	18	330 ug/kg						
Sulfotepp	330	330 ug/kg						
Tetraethyl lead	160	1000 ug/kg		30	40 - 160	30	40 - 160	30
Thionazin	10	330 ug/kg						
surr: 2,4,6-Tribromophenol	0.0		39 - 146					
surr: 2-Fluorobiphenyl			37 - 120					
surr: 2-Fluorophenol			18 - 120					

Table 3 - Precision and Accuracy Goals for SVOCs

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
surr: Nitrobenzene-d5			34 - 132					
surr: Phenol-d5			11 - 120					
surr: p-Terphenyl-d14			58 - 147					
p-Toluidine	160	330 ug/kg						
1,4-Dichlorobenzene-d4								
Naphthalene-d8								
Acenaphthene-d10								
Phenanthrene-d10								
Chrysene-d12								
Perylene-d12								

Table 3 - Precision and Accuracy Goals for Metals

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

6010B Tot - Aluminum in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Aluminum	0.0236	0.200 mg/L		20	75 - 125	20	80 - 120	20

6010B Tot - Antimony in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Antimony	0.00548	0.0200 mg/L		20	75 - 125	20	80 - 120	20

6010B Tot - Arsenic in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Arsenic	0.00370	0.0100 mg/L		20	75 - 125	20	80 - 120	20

6010B Tot - Barium in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Barium	0.000280	0.00200 mg/L		20	75 - 125	20	80 - 120	20

6010B Tot - Beryllium in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Beryllium	0.000330	0.00200 mg/L		20	75 - 125	20	80 - 120	20

6010B Tot - Cadmium in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Cadmium	0.000330	0.00100 mg/L		20	75 - 125	20	80 - 120	20

6010B Tot - Calcium in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Calcium	0.100	0.500 mg/L		20	75 - 125	20	80 - 120	20

6010B Tot - Chromium in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Chromium	0.000880	0.00400 mg/L		20	75 - 125	20	80 - 120	20

6010B Tot - Cobalt in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Cobalt	0.00106	0.00400 mg/L		20	75 - 125	20	80 - 120	20

6010B Tot - Copper in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Copper	0.00126	0.0100 mg/L		20	75 - 125	20	80 - 120	20

6010B Tot - Iron in Water (6010B)

Preservation: Add HNO3 to pH<2

Container: 250 mL Plastic HNO3 **Amount Required:** 50 **Hold Time:** 180 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Iron	0.0193	0.0500 mg/L		20	75 - 125	20	80 - 120	20

Table 3 - Precision and Accuracy Goals for Metals

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
6010B Tot - Lead in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Lead	0.00290	0.00500 mg/L		20	75 - 125	20	80 - 120	20
6010B Tot - Magnesium in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Magnesium	0.0423	0.200 mg/L		20	75 - 125	20	80 - 120	20
6010B Tot - Manganese in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Manganese	0.000240	0.00300 mg/L		20	75 - 125	20	80 - 120	20
6010B Tot - Nickel in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Nickel	0.00103	0.0100 mg/L		20	75 - 125	20	80 - 120	20
6010B Tot - Potassium in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Potassium	0.0500	0.500 mg/L		20	75 - 125	20	80 - 120	20
6010B Tot - Selenium in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Selenium	0.00610	0.0150 mg/L		20	75 - 125	20	80 - 120	20
6010B Tot - Silver in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Silver	0.00127	0.00300 mg/L		20	75 - 125	20	80 - 120	20
6010B Tot - Sodium in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Sodium	0.339	1.00 mg/L		20	75 - 125	20	80 - 120	20
6010B Tot - Thallium in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Thallium	0.00588	0.0200 mg/L		20	75 - 125	20	80 - 120	20
6010B Tot - Vanadium in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Vanadium	0.000980	0.00500 mg/L		20	75 - 125	20	80 - 120	20
6010B Tot - Zinc in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 mL Plastic HNO3			**Amount Required:** 50			**Hold Time:** 180 days		
Zinc	0.00360	0.0100 mg/L		20	75 - 125	20	80 - 120	20

Table 3 - Precision and Accuracy Goals for Metals

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
7470 Tot - Mercury in Water (7470A)								
Preservation: Add HNO3 to pH<2								
Container: 250 ml Plastic HNO3		**Amount Required:** 30				**Hold Time:** 28 days		
Mercury	0.000120	0.000200		20	80 - 120	20	80 - 120	20
Metals TAL in Water (6010B)								
Preservation: Add HNO3 to pH<2								
Container: 250 ml Plastic HNO3		**Amount Required:** 50				**Hold Time:** 180 days		
6010B Tot - Aluminum in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar		**Amount Required:** 0.5				**Hold Time:** 180 days		
Aluminum	0.0236	10.0 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Antimony in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar		**Amount Required:** 0.5				**Hold Time:** 180 days		
Antimony	0.00548	15.0 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Arsenic in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar		**Amount Required:** 0.5				**Hold Time:** 180 days		
Arsenic	0.00370	2.00 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Barium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar		**Amount Required:** 0.5				**Hold Time:** 180 days		
Barium	0.000280	0.500 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Beryllium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar		**Amount Required:** 0.5				**Hold Time:** 180 days		
Beryllium	0.000330	0.200 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Cadmium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar		**Amount Required:** 0.5				**Hold Time:** 180 days		
Cadmium	0.000330	0.200 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Calcium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar		**Amount Required:** 0.5				**Hold Time:** 180 days		
Calcium	0.100	50.0 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Chromium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar		**Amount Required:** 0.5				**Hold Time:** 180 days		
Chromium	0.000880	0.500 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Cobalt in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar		**Amount Required:** 0.5				**Hold Time:** 180 days		
Cobalt	0.00106	0.500 mg/kg		20	75 - 125	20	80 - 120	20

Table 3 - Precision and Accuracy Goals for Metals

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
					%R	RPD	%R	RPD
6010B Tot - Copper in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Copper	0.00126	1.00 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Iron in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Iron	0.0193	10.0 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Lead in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Lead	0.00290	1.00 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Magnesium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Magnesium	0.0423	20.0 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Manganese in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Manganese	0.000240	0.200 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Nickel in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Nickel	0.00103	0.500 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Potassium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Potassium	0.0500	30.0 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Selenium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Selenium	0.00610	4.00 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Silver in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Silver	0.00127	0.500 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Sodium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Sodium	0.339	140 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Thallium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Thallium	0.00588	6.00 mg/kg		20	75 - 125	20	80 - 120	20

Table 3 - Precision and Accuracy Goals for Metals

Analytical Method Information (1/28/2009 - TestAmerica Buffalo)

		Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike		Blank Spike / LCS	
Analyte	**MDL**				**%R**	**RPD**	**%R**	**RPD**
6010B Tot - Vanadium in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Vanadium	0.000980	0.500 mg/kg		20	75 - 125	20	80 - 120	20
6010B Tot - Zinc in Solid (6010B)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		
Zinc	0.00360	2.00 mg/kg		20	75 - 125	20	80 - 120	20
7470 Tot - Mercury in Solid (7470A)								
Preservation: *** DEFAULT PRESERVATION ***								
Container: *** DEFAULT CONTAINER ***			**Amount Required:**			**Hold Time:** 28 days		
7471 Tot - Mercury in Solid (7471A)								
Preservation: Cool 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.6			**Hold Time:** 26 days		
Mercury	0.00810	0.0200 mg/kg		20	80 - 120	20	80 - 120	20
Metals TAL in Solid (6010B)								
Preservation: Store cool at 4°C								
Container: 4 oz. Glass Jar			**Amount Required:** 0.5			**Hold Time:** 180 days		

TABLE 4

PROJECT GOALS FOR PRECISION, ACCURACY & COMPLETENESS FOR FIELD MEASUREMENTS

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

Measurement	Units	Precision Goal	Accuracy Goal	Completeness Goal
pH	pH units	± 0.2 unit	± 0.2 unit	90%
Eh	milli-volts (mV)	± 1.0 mV	± 1.0 mV	90%
Temperature	degrees Celsius (^{o}C)	± 0.2 deg. C	± 0.4 deg. C	90%
Turbidity	NTU	± 0.05 NTU	± 0.05 NTU	90%
Specific Conductance	mS/cm at 25^{o}C mS/cm at 25oC	± 100 uS/cm ± 0.1 mS/cm	± 100 uS/cm ± 0.1 mS/cm	90%
Dissolved Oxygen	ppm	± 0.3 ppm	± 0.3 ppm	90%
Water Level	fbTOR	± 0.01 unit	± 0.01 unit	90%

Acronyms/Abbreviations:

fbTOR = feet below top of riser
mS = milli-Siemans
NTU = nephelometric turbidity unit
ug/L = micrograms per liter

TABLE 5

DATA MEASUREMENT UNITS FOR FIELD & LABORATORY PARAMETERS

CORRECTIVE MEASURES STUDY QAPP

Tecumseh Redevelopment Site
Lackawanna, New York

Parameter	Units
Water Level	feet below top of riser (fbTOR)
pH	pH units
Eh	milli-volts (mV)
Temperature	degrees Celsius (°C)
Turbidity	Nephelometric Turbidity Unit (NTU)
Specific Conductance	microsiemens per centimeter at 25°C (mS/cm) millisiemens per centimeter at 25°C (mS/cm)
Dissolved Oxygen (DO)	parts per million (ppm)
Concentration of parameter in soil sample	micrograms per kilogram (mg/kg) organic milligrams per kilogram (mg/kg) inorganic
Concentration of parameter in groundwater sample	micrograms per liter (mg/L) organic milligrams per liter (mg/L) inorganic
Hydraulic Conductivity	centimeters per second (cm/sec)
Photoionization Detector (PID)	parts per million by volume (ppmv)

TABLE 6

SUMMARY OF FIELD OPERATING PROCEDURES

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

QAPP FOP No.	BM FOP No.	Procedure
1	001.0	Abandonment of Borehole Procedures
2	007.0	Calibration and Maintenance of Portable Dissolved Oxygen Meter
3	008.0	Calibration and Maintenance of Portable Field pH/Eh Meter
4	009.0	Calibration and Maintenance of Portable Field Turbidity Meter
5	011.0	Calibration and Maintenance of Portable Photoionization Detector (PID)
6	012.0	Calibration and Maintenance of Portable Specific Conductance Meter
7	015.0	Documentation Requirements for Drilling and Well Installation
8	017.0	Drill Site Selection Procedure
9	018.0	Drilling and Excavation Equipment Decontamination Procedures
10	021.0	Establishing Horizontal and Vertical Control
11	022.0	Groundwater Level Measurement
12	023.0	Groundwater Purging Procedures Prior to Sample Collection
13	024.0	Groundwater Sample Collection Procedures
14	026.0	Hollow Stem Auger (HSA) Drilling Procedures
15	031.0	Low Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedure
16	032.0	Management of Investigative-Derived Waste
17	033.0	Monitoring Well Construction for Hollow Stem Auger Boreholes
18	036.0	Monitoring Well Development Procedures
19	040.0	Non-Disposable and Non-Dedicated Sampling Equipment Decontamination
20	041.0	Overburden Casing Installation Procedure
21	046.0	Sample Labeling, Storage and Shipment Procedures
22	047.0	Screening of Soil Samples for Organic Vapors During Drilling Activities
23	050.0	Sediment Sample Collection in Shallow Water Procedures
24	054.0	Soil Description Procedures Using the USCS
25	063.1	Surface and Subsurface Soil Sampling Procedures
26	064.0	Surface Water Sampling Procedures
27	070.0	Well/Piezometer Construction Materials and Design
28	073.0	Real-Time Air Monitoring During Intrusive Activities

TABLE 7

SAMPLE CONTAINER, VOLUME, PRESERVATION & HOLDING TIME REQUIREMENTS

CORRECTIVE MEASURES STUDY QAPP

Tecumseh Redevelopment Site
Lackawanna, New York

Matrix	Parameter[1]	Container Type	Minimum Volume	Preservation[2]	Holding Time[2]
Soil/Fill	TCL VOCs	glass (with PTFE seal)	2 oz.	Cool to 4°C, Minimal Headspace	Analyze within 14 days
	TCL SVOCs	glass	4 oz.	Cool to 4°C	Extract within 14 days Analyze within 40 days
	RCRA Metals	glass	4 oz.	Cool to 4°C	Mercury - 26 Days Others - 180 Days
Water	TCL VOCs	glass	VOA Vial	HCl to pH <2, Cool to 4°C, Zero Headspace	Analyze within 14 days
	TCL SVOCs	amber glass	1L	Cool to 4°C	Extract within 7 days Analyze within 40 days
	RCRA Metals	plastic	250 mL	HNO_3 to pH <2	Mercury - 28 Days Others - 180 Days

Notes:

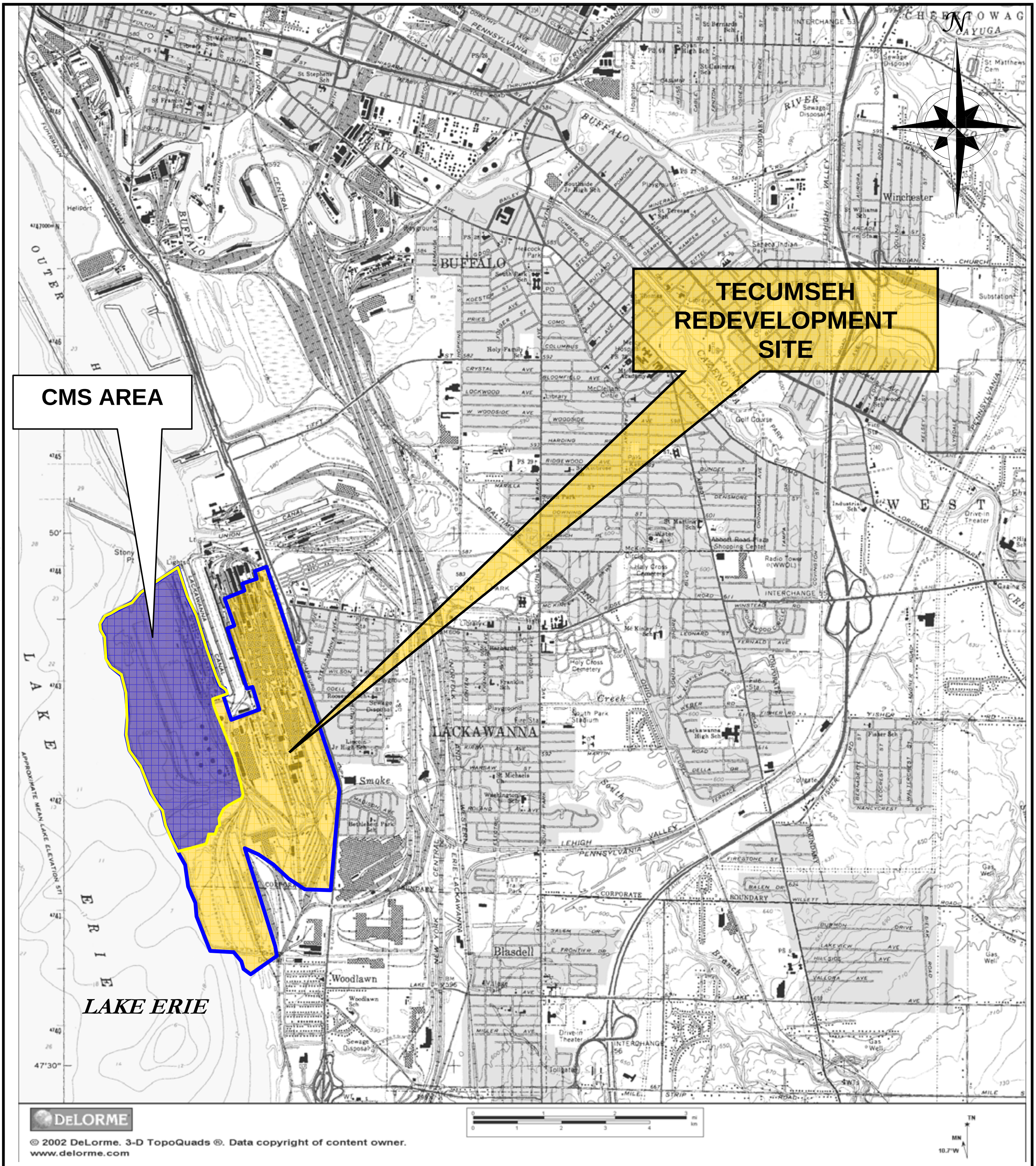
1. USEPA SW-846 methodology. The list of analytes, laboratory method and the method detection limit for each parameter are included in Tables 1 and 2.
2. SW-846 Method 5035 is the preferred method of collecting soil samples for VOC analysis.

Acronyms/Abbreviations:

VOCs = Volatile Organic Compounds
SVOCs = Semi-Volatile Organic Compounds
TAL = Target Analyte List
TCL = Target Compound List
mL = milliliter

FIGURES

FIGURE 1



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TurnKey Environmental Restoration, LLC

726 EXCHANGE STREET
SUITE 624
BUFFALO, NEW YORK 14210
(716) 856-635

PROJECT NO.: 0071-007-110

DATE: DECEMBER 2008

DRAFTED BY: JCT

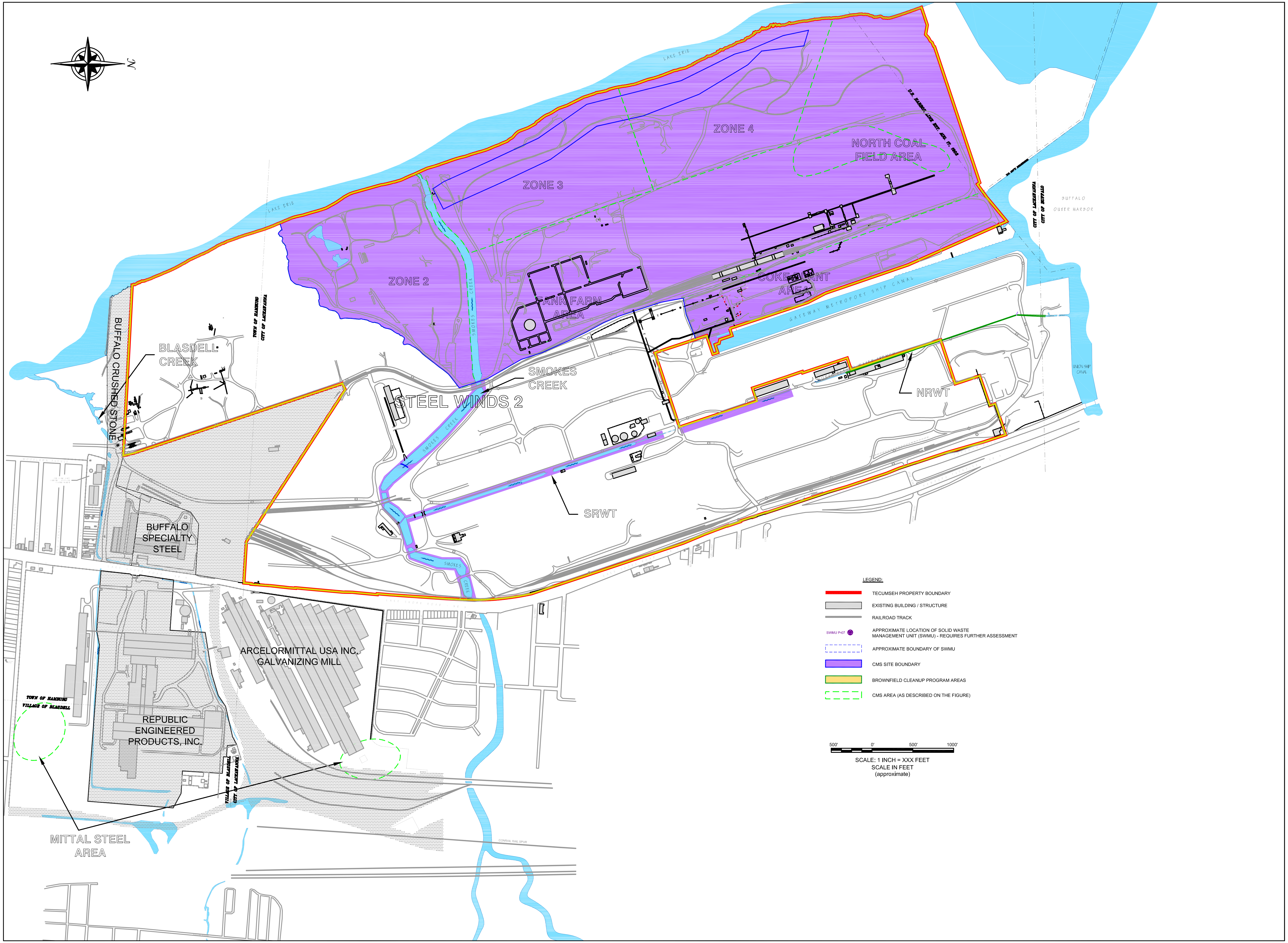
SITE LOCATION AND VICINITY MAP

TECUMSEH REDEVELOPMENT SITE
LACKAWANNA, NEW YORK

PREPARED FOR

ARCELORMITTAL TECUMSEH REDEVELOPMENT, INC.

FILEPATH:F:\CAD\TurnKey\Tecumseh Redevelopment\RFI-CMS ORDER\CMS\CMS Work Plan\CP PLAN\figure 1; site location and vicinity map.dwg



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(716) 856-0635

JOB NO.: 0071-007-110

REVISIONS

NO.	BY	DATE	REMARKS

SEAL

DRAWN BY:	BCH
DATE:	DECEMBER 2008
CHECKED BY:	
APPROVED BY:	

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SITE PLAN

TECUMSEH REDEVELOPMENT SITE
LACKAWANNA, NEW YORK

PREPARED FOR
ARCELORMITTAL TECUMSEH REDEVELOPMENT, INC.

FIGURE 2

APPENDIX A

FIELD OPERATING PROCEDURES (FOPS)

APPENDIX A

SUMMARY OF FIELD OPERATING PROCEDURES

CORRECTIVE MEASURES STUDY QAPP
Tecumseh Redevelopment Site
Lackawanna, New York

QAPP FOP No.	BM FOP No.	Procedure
1	001.0	Abandonment of Borehole Procedures
2	007.0	Calibration and Maintenance of Portable Dissolved Oxygen Meter
3	008.0	Calibration and Maintenance of Portable Field pH/Eh Meter
4	009.0	Calibration and Maintenance of Portable Field Turbidity Meter
5	011.0	Calibration and Maintenance of Portable Photoionization Detector (PID)
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26	064.0	Surface Water Sampling Procedures
27	070.0	Well/Piezometer Construction Materials and Design
28	073.0	Real-Time Air Monitoring During Intrusive Activities

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Abandonment of Borehole Procedures

PURPOSE

Soil borings that are not completed as monitoring wells will be plugged by filling the holes with a cement/bentonite grout. Field staff will calculate the borehole volume and compare it to the final installed volume of grout to evaluate whether bridging or loss to the formation has occurred. These calculations and the actual volume placed will be noted on the Boring Log.

PROCEDURE

1. Determine most suitable seal materials. Grout specifications generally have mixture ratios as follows:

   Grout Slurry Composition (% Weight)

1.5 to 3.0%	-	Bentonite (Quick Gel)
40 to 60 %	-	Cement (Portland Type I)
40 to 60 %	-	Potable Water

2. Calculate the volume of the borehole base on the bit or auger head diameter plus 10% and determine the volume of grout to be emplaced. Generally, the total mixed volume is the borehole volume plus 20%.

3. Identify the equipment to be used for the preparation and mixing of the grout. Ensure the volume of the tanks to be used for mixing has been measured adequately. Document these volumes on the **Field Borehole Log** (sample attached).

4. Identify the source of the water to be used for the grout and determine its suitability for use. In particular, water with high sulfate, or chloride levels or heated water should not be used. These types of waters can cause operational difficulties or modify the set-up for the grout.

5. Identify the equipment to be used for emplacing the grout. Ensure that the pump to be used has adequate pressure to enable complete return to surface.

6. Identify the volumes to be pumped at each stage or in total if only one stage is to be used.

7. Prepare the borehole abandonment plan and discuss the plan and activities with the drilling contractor prior to beginning any mixing activities.

8. Begin mixing the grout to be emplaced.

9. Record the type and amount of materials used during the mixing operation. Ensure the ratios are within specifications tolerance.

10. Begin pumping the grout through the return line bypass system to confirm all pump and surface fittings are secure.

11. Initiate downhole pumping from the bottom of the borehole. Record the times and volumes emplaced on the Field Borehole Log (sample attached).

12. Document the return circulation of grout. This may be facilitated by using a colored dye or other tagging method if a mudded borehole condition exists prior to grout injection.

13. Identify what procedures will be used for grouting in the upper 3 feet. When casing exists in the borehole, decisions are required as to the timing for removal and final disposition of the casing. Generally, it will not be removed prior to grouting because of the potential for difficult access and loss of circulation in the upper soil or rock layers. Accordingly, when cement return is achieved at surface, the casing is commonly removed and the borehole is topped off with grout or soils. If casing removal is not possible or not desired, the casing left in place should be cut off at a depth of 5 feet or greater below ground surface. If casing is not present during grouting, the grout level in the borehole is topped off after the rods or tremie pipe is removed.

14. Clear and clean the surface near the borehole. Level the ground to above the pre-existing grade. Add grout or cement as necessary to the area near the borehole. (Note: On occasion, the grout may settle over several days. If settling occurs, the

natural soils from the immediate vicinity can be used to level to settled area to match the existing grade.

15. A follow-up check at each site should be made within one week to 10 days of completion. Document the visit and describe any action taken on a Field Activity Daily Log.

ATTACHMENTS

Field Borehole Log (sample)

REFERENCES

New York State Department of Environmental Conservation, July 1988, Drilling and Monitoring Well Installation Guidance Manual.

Driscoll, F.G., 1987, Groundwater and Wells, Johnson Division, St. Paul, Minnesota, 1089 p.

TurnKey Environmental Restoration, LLC

FIELD BOREHOLE LOG

PROJECT:		**Log of Boring No.:**		
BORING LOCATION:		ELEVATION AND DATUM:		
DRILLING CONTRACTOR:		DATE STARTED:		DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:		SCREEN INTERVAL:
DRILLING EQUIPMENT:		DEPTH TO WATER:	FIRST: COMPL.:	CASING:
SAMPLING METHOD:		LOGGED BY:		
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:		REG. NO.

Depth (fbgs)	SAMPLES					PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	REMARKS
	Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery			

ABANDONMENT:

Volume of cement/bentonite grout required:	V = pr2 x 7.48 =	gallons	borehole depth =	ft.
Volume of cement/bentonite grout installed:		gallons	borehole diameter =	ft.
Has bridging of grout occurred?	☐ yes ☐ no		borehole radius =	ft.
If yes, explain resolution:				
Method of installation:				

Project No:	**TurnKey Environmental Restoration, LLC**	Figure

SAMPLE

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Calibration & Maintenance of Portable Dissolved Oxygen Meter

FOP 007.0

CALIBRATION AND MAINTENANCE OF PORTABLE DISSOLVED OXYGEN METER

PURPOSE

This guideline describes a method for calibration of a portable dissolved oxygen meter. This meter measures the concentration of dissolved oxygen within a water sample. This parameter is of interest both as a general indicator of water quality, and because of its pertinence to fate and transport of organics and inorganics. This guideline presents a method for calibration of this meter, which is performed to verify instrument accuracy and function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each day that the instrument is in use. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter.

ACCURACY

The calibrated accuracy of the dissolved oxygen meter will be within ± 1% of full-scale over the temperature range of 23° to 113° F (-5° to +45° C).

PROCEDURE

1. Calibrate the dissolved oxygen meter to ambient air based on probe temperature and true local atmospheric pressure conditions (or feet above sea level). Because procedures vary with different brands and models of meters, refer to the manufacturer's recommended calibration procedures.

2. In the event of a failure to adequately calibrate, follow the corrective action directed by the manufacturer.
3. If calibration cannot be achieved or maintained, obtain a replacement instrument (rental instruments) and/or order necessary repairs/adjustment.

4. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample). Information will include, at a minimum:
    - Time, date, and initials of the field team member performing the calibration
    - The unique identifier for the meter, including manufacturer, model, and serial number
    - The brand and expiration dates of calibration solutions
    - The calibration readings
    - The instrument settings (if applicable)
    - The approximate response time
    - The overall adequacy of calibration including the Pass or fail designation in accordance with the accuracy specifications presented above
    - Corrective action taken (see Step 5 above) in the event of failure to adequately calibrate

MAINTENANCE

- When not in use or between measurements, the dissolved oxygen probe will be kept immersed in or moist with deionized water.

- The meter batteries will be checked prior to each meter's use and will be replaced when the meter cannot be redline adjusted.

- The meter response time and stability will be tracked to determine the need for instrument maintenance. When response time becomes greater than two minutes, probe service is indicated.

ATTACHMENTS

Equipment Calibration Log (sample)

EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name: Date:

Project No.:

Client: Instrument Source: ☐ TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	970600014560		< 0.4		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS		Myron L Company Ultra Meter 6P	606987		μS @ 25 °C		
☐ PID	ppm		Photovac 2020 PID	ED [illegible] 301		open air zero		MIBK re factor =
						_____ ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

SAMPLE

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Calibration and Maintenance of Portable Field pH/Eh Meter

FOP 008.0

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD pH/Eh METER

PURPOSE

This guideline describes a method for calibration of a portable pH/Eh meter. The pH/Eh meter measures the hydrogen ion concentration or acidity of a water sample (pH function), and the oxidation/reduction potential of a water sample (Eh function). Calibration is performed to verify instrument accuracy and function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each day that the instrument is in use. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter.

ACCURACY

The calibrated accuracy of the pH/Eh meter will be:

pH	± 0.2 pH unit, over the temperature range of ± 0.2 C.
Eh	± 0.2 millivolts (mV) over the range of ± 399.9 mV, otherwise ± 2 mV.

PROCEDURE

Note: Meters produced by different manufacturers may have different calibration procedures. These instructions will take precedence over the procedure provided herein. This procedure is intended to be used as a general guideline, or in the absence of available manufacturer's instructions.

1. Obtain and active the meter to be used. As stated above, initial calibrations will be performed at the beginning of each sampling day.

2. Immerse the sensing probe in a container of certified pH 7.0 buffer solution traceable to the National Bureau of Standards.

3. Measure the temperature of the buffer solution, and adjust the temperature setting accordingly.

4. Compare the meter reading to the known value of the buffer solution while stirring. If the reading obtained by the meter does not agree with the known value of the buffer solution, recalibrate the meter according to the manufacturer's instructions until the desired reading is obtained. This typically involves accessing and turning a dial or adjustment screw while measuring the pH of the buffer solution. The meter is adjusted until the output agrees with the known solution pH.

5. Repeat Steps 2 through 5 with a pH 4.0 and 10.0 buffer solution to provide a three-point calibration. Standards used to calibrate the pH meter will be of concentrations that bracket the expected values of the samples to be analyzed, especially for two-point calibrations (see note below).

Note: Some pH meters only allow two-point calibrations. Two-point calibrations should be within the suspected range of the groundwater to be analyzed. For example, if the groundwater pH is expected to be approximately 8, the two-point calibration should bracket that value. Buffer solutions of 7 and 10 should then be used for the two-point calibration.

6. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample). Information will include, at a minimum:

    - Time, date, and initials of the field team member performing the calibration
    - The unique identifier for the meter, including manufacturer, model, and serial number
    - The brand and expiration dates of buffer solutions
    - The instrument readings
    - The instrument settings (if applicable)

- Pass or fail designation in accordance with the accuracy specifications presented above
- Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate

MAINTENANCE

- When not in use, or between measurements, keep the pH/Eh probe immersed in or moist with buffer solutions.

- Check the meter batteries at the end of each day and recharge or replace as needed.

- Replace the pH/Eh probe any time that the meter response time becomes greater than two minutes or the meeting system consistently fails to retain its calibrated accuracy for a minimum of ten sample measurements.

- If a replacement of the pH/Eh probe fails to resolve instrument response time and stability problems, obtain a replacement instrument (rental instruments) and/or order necessary repairs/adjustment.

ATTACHMENTS

Equipment Calibration Log (sample)

TurnKey Environmental Restoration, LLC

EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name: ______ Date: ______

Project No.: ______

Client: ______ Instrument Source: ☐ TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	970600014560		< 0.4		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS		Myron L Company Ultra Meter 6P	606987		µS @ 25 °C		
☐ PID	ppm		Photovac 2020 PID			open air zero		MIBK re factor =
						_____ ppm Iso. Gas		
☐ Particulate meter	mg/m³					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

SAMPLE

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Calibration and Maintenance of Portable Field Turbidity Meter

FOP 009.0

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER

PURPOSE

This guideline describes the method for calibration of the HACH 2100P portable field turbidity meter. Turbidity is one water quality parameter measured during purging and development of wells. Turbidity is measured as a function of the samples ability to transmit light, expressed as Nephelometric Turbidity Units (NTUs). The turbidity meter is factory calibrated and must be checked daily prior to using the meter in the field. Calibration is performed to verify instrument accuracy and function. This procedure also documents critical maintenance activities for this meter.

ACCURACY

Accuracy shall be ± 2% of reading below 499 NTU or ± 3% of reading above 500 NTU with resolution to 0.01 NTU in the lowest range. The range key provides for automatic or manual range selection for ranges of 0.00 to 9.99, 0.0 to 99.9 and 0 to 1000 NTU. Another key provides for selecting automatic signal averaging. Pressing the key shall toggle signal averaging on or off.

PROCEDURE

Calibration of the 2100P Turbidimeter is based on formazin, the primary standard for turbidity. The instrument's electronic and optical design provides long-term stability and minimizes the need for frequent calibration. The two-detector ratioing system compensates for most fluctuations in lamp output. **A formazin recalibration should be performed at least once every three months,** more often if experience indicates the need. During calibration, use a primary standard such as StablCal™ Stabilized Standards or formazin standards.

Note: Meters produced by different manufacturers may have different calibration check procedures. These manufacturers' instructions will take precedence over the procedure provided here. This procedure is intended to be used as a general guideline, or in the absence of available manufacturer's instructions.

Note: Because the turbidity meter measures light transmission, it is critical that the meter and standards be cared for as precision optical instruments. Scratches, dirt, dust, etc. can all temporarily or permanently affect the accuracy of meter readings.

Preparing StablCal Stabilized Standards in Sealed Vials

Sealed vials that have been sitting undisturbed for longer than a month must be shaken to break the condensed suspension into its original particle size. Start at *step 1* for these standards. If the standards are used on at least a weekly interval, start at *step 3*.

Note: These instructions do not apply to < 0.1 NTU StablCal Standards; < 0.1 NTU StablCal Standards should not be shaken or inverted.

1. Shake the standard vigorously for 2-3 minutes to re-suspend any particles.
2. Allow the standard to stand undisturbed for 5 minutes.
3. Gently invert the vial of StablCal 5 to 7 times.
4. Prepare the vial for measurement using traditional preparation techniques. This usually consists of oiling the vial (see *Section 2.3.2 on page 11 of the manual*)

and marking the vial to maintain the same orientation in the sample cell compartment (see *Section 2.3.3 on page 12 of the manual*). This step will eliminate any optical variations in the sample vial.

5. Let the vial stand for one minute. The standard is now ready for use in the calibration procedure.

Calibration Procedure

1. Turn the meter on.
2. Shake pre-mixed formazin primary standards in accordance with the above procedure.
3. Wipe the outside of the < 0.1 NTU standard and insert the sample cell in the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment.
4. Close the lid and press **I/O**.
5. Press the **CAL** button. The **CAL** and **S0** icons will be displayed and the 0 will flash. The four-digit display will show the value of the **S0** standard for the previous calibration. If the blank value was forced to 0.0, the display will be blank. Press the right arrow key (→) to get a numerical display.
6. Press **READ**. The instrument will count from 60 to 0, read the blank and use it to calculate a correction factor for the 20 NTU standard measurement. If the dilution water is ≥ 0.5 NTU, E 1 will appear when the calibration is calculated (*see Section 3.6.2.3 on page 31 of the manual*). The display will automatically increment to the next standard. Remove the sample cell from the cell compartment

Note: The turbidity of the dilution water can be "forced" to zero by pressing → rather than reading the dilution water. The display will show "S0 NTU" and the ↑ key must be pressed to continue with the next standard.

7. Repeat steps 1 through 7 for the 20, 100 and 800 standards.

8. Following the 800 NTU standard calibration, the display will increment back to the **S0** display. Remove the sample cell from the cell compartment.

9. Press **CAL** to accept the calibration. The instrument will return to measurement mode automatically.

10. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample). Information will include, at a minimum:
    - Time, date, and initials of the field team member performing the calibration
    - The unique identifier for the meter, including manufacturer, model, and serial number
    - The brand of calibration standards
    - The instrument readings
    - The instrument settings (if applicable)
    - Pass or fail designation in accordance with the accuracy specifications presented above
    - Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate.

Note: Pressing CAL completes the calculation of the calibration coefficients. If calibration errors occurred during calibration, error messages will appear after CAL is pressed. If E 1 or E 2 appear, check the standard preparation and review the calibration; repeat the calibration if necessary. If "CAL?" appears, an error may have

occurred during calibration. If "CAL?" is flashing, the instrument is using the default calibration.

NOTES

- If the **I/O** key is pressed during calibration, the new calibration data is lost and the old calibration will be used for measurements. Once in calibration mode, only the **READ, I/O, ↑** , and →keys function. Signal averaging and range mode must be selected before entering the calibration mode.

- If **E 1** or **E 2** are displayed, an error occurred during calibration. Check the standard preparation and review the calibration; repeat the calibration if necessary. Press **DIAG** to cancel the error message (**E 1** or **E 2)**. To continue without repeating the calibration, press **I/O** twice to restore the previous calibration. If "**CAL?"** is displayed, an error may have occurred during calibration. The previous calibration may not be restored. Either recalibrate or use the calibration as is.

- To review a calibration, press **CAL** and then ↑ to view the calibration standard values. As long as **READ** is never pressed and **CAL** is not flashing, the calibration will not be updated. Press **CAL** again to return to the measurement mode.

MAINTENANCE

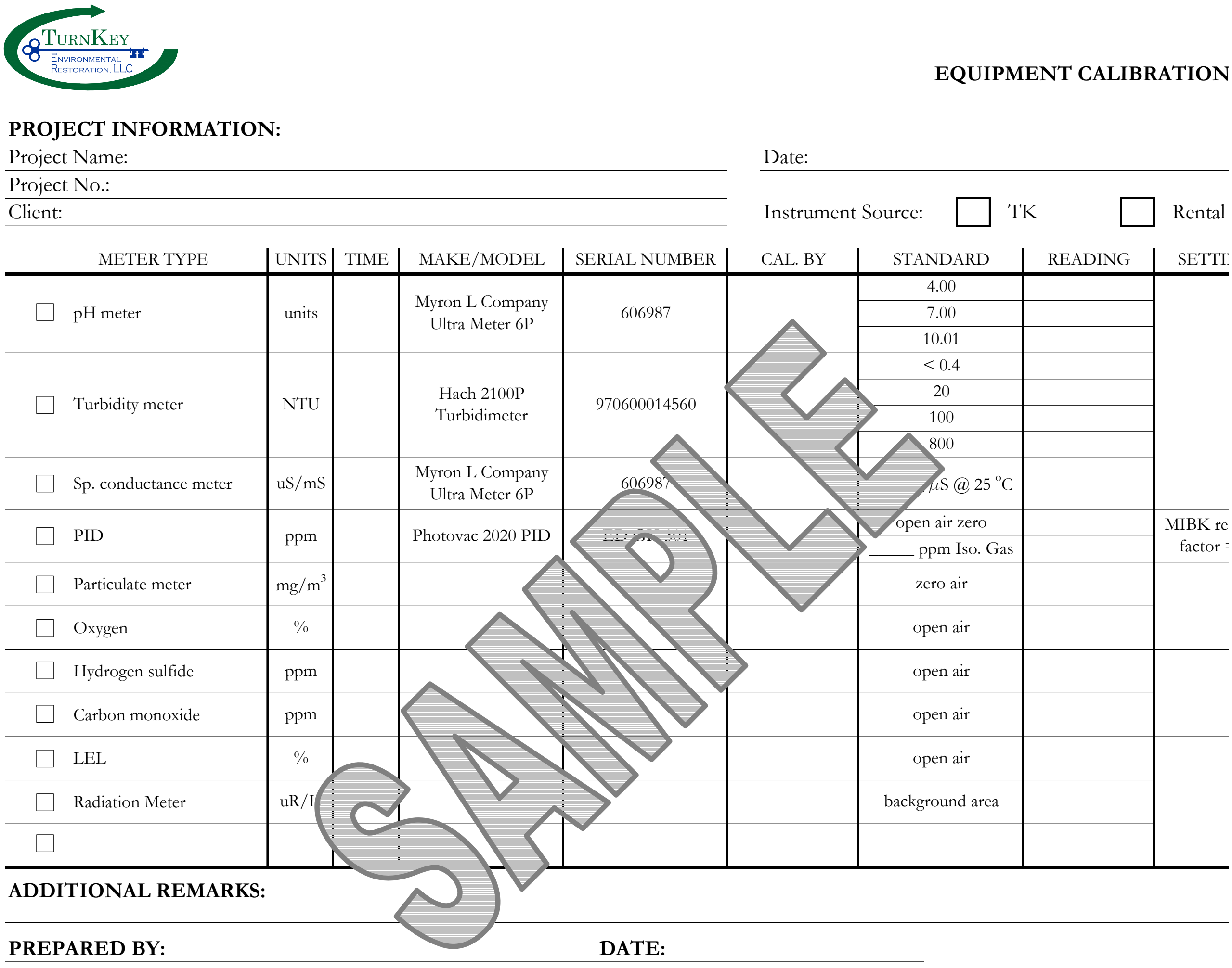
- **Cleaning**: Keep the turbidimeter and accessories as clean as possible and store the instrument in the carrying case when not in use. Avoid prolonged exposure to sunlight and ultraviolet light. Wipe spills up promptly. Wash sample cells with non-abrasive laboratory detergent, rinse with distilled or demineralized water, and air dry. Avoid scratching the cells and wipe all moisture and fingerprints off the cells before inserting them into the instrument. Failure to do so can give inaccurate readings. See *Section 2.3.1 on page 11of the manual* for more information about sample cell care.

- **Battery Replacement**: AA alkaline cells typically last for about 300 tests with the signal-averaging mode off, about 180 tests if signal averaging is used. The "battery" icon flashes when battery replacement is needed. Refer to *Section 1.4.2 on page 5 of the manual* for battery installation instructions. If the batteries are changed within 30 seconds, the instrument retains the latest range and signal average selections. If it takes more than 30 seconds, the instrument uses the default settings. If, after changing batteries, the instrument will not turn off or on and the batteries are good, remove the batteries and reinstall them. If the instrument still won't function, contact Hach Service or the nearest authorized dealer.

- **Lamp Replacement**: The procedure in *Section 4.0 on page 49 of the manual* explains lamp installation and electrical connections. Use a small screwdriver to remove and install the lamp leads in the terminal block. The instrument requires calibration after lamp replacement.

ATTACHMENTS

Equipment Calibration Log (sample)



EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name:

Date:

Project No.:

Client:

Instrument Source: ☐ TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	970600014560		< 0.4		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS		Myron L Company Ultra Meter 6P	606987		μS @ 25 °C		
☐ PID	ppm		Photovac 2020 PID	ED 6TC 301		open air zero		MIBK re factor =
						_____ ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

TurnKey Environmental Restoration, LLC

Field Operating Procedures

Calibration and Maintenance of Portable Photoionization Meter

FOP 011.0

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

PURPOSE

This procedure describes a general method for the calibration and maintenance of a portable photoionization detector (PID). The PID detects and initially quantifies a reading of the volatile organic compound (VOC) concentration in air. The PID is used as a field-screening tool for initial evaluation of soil samples and for ambient air monitoring of compounds with ionization potentials (IP) less than the PID lamp electron voltage (eV) rating. The IP is the amount of energy required to move an electron to an infinite distance from the nucleus thus creating a positive ion plus an electron. It should be noted that all of the major components of air (i.e., carbon dioxide, methane, nitrogen, oxygen etc.) have IP's above 12 eV. As a result, they will not be ionized by the 9.5, 10.2, 10.6 or 11.7 eV lamps typically utilized in field PIDs. The response of the PID will then be the sum of the organic and inorganic compounds in air that are ionized by the appropriate lamp (i.e., 9.5, 10.2, 10.6 or 11.7 eV). Attached to this FOP is a table summarizing common organic compounds and their respective IPs.

Calibration is performed to verify instrument accuracy and function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each day that the instrument is in use. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter.

Note: The information included below is equipment manufacturer- and model-specific, however, accuracy, calibration, and maintenance procedures for this type of portable equipment are typically similar. The information below pertains to the Photovac 2020 photoionization detector equipped with a 10.6 eV lamp. The actual equipment to be used in the field will be equivalent or similar. The previously mentioned attached table indicates the compounds that cannot be detected by a standard 10.6 eV lamp.

Note: The PID indicates <u>total</u> VOC concentration readings that are normalized to an isobutylene standard, so actual quantification of individual compounds is not provided. In addition, the PID response to compounds is highly variable, dependent on ionization potential of the compound, and the presence or absence of other compounds.

ACCURACY

The Photovac 2020 is temperature compensated so that a 20 ºC change in temperature corresponds to a change in reading of less than two percent full-scale at maximum sensitivity. The useful range of the instrument is from 0.5 – 2000 ppm isobutylene with an accuracy of ± 10% or ± 2 ppm. Response time is less than three seconds to 90 percent of full-scale. The operating temperature range is 0 to 40º C and the operating humidity range is 0 to 100 % relative humidity (non-condensing).

PROCEDURE

1. Calibrate all field test equipment at the beginning of each sampling day. Check and recalibrate the PID according to the manufacture's specifications.

2. Calibrate the PID meter using a compressed gas cylinder containing a 100-ppm isobutylene standard, a flow regulator, and a tubing assembly. In

addition, a compressed gas cylinder containing zero air ("clean" air) may be required if ambient air conditions do not permit calibration to "clean air".

3. Fill two Tedlar bags equipped with a one-way valve with zero-air (if applicable) and 100-ppm isobutylene gas.

4. Assemble the calibration equipment and actuate the PID in its calibration mode. Connect the PID probe to the zero air calibration bag (or calibrate to ambient air if conditions permit) and wait for a stable indication.

5. Change the response factor of the PID to the Methyl Isobutyl Ketone (MIBK) setting, which is a response factor of 1.0 for the Photovac 2020.

6. Connect the PID probe to the 100-ppm isobutylene standard calibration bag. Measure an initial reading of the isobutylene standard and wait for a stable indication.

7. Keep the PID probe connected to the 100-ppm isobutylene standard calibration bag, calibrate to 100-ppm with the isobutylene standard and wait for a stable indication.

8. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample), indicating the meter readings before and after the instrument has been adjusted. This is important, not only for data validation, but also to establish maintenance schedules and component replacement. Information will include, at a minimum:
   - Time, date and initials of the field team member performing the calibration
   - The unique identifier for the meter, including manufacturer, model, and serial number
   - The brand and expiration date of the isobutylene gas
   - The instrument readings: before and after calibration
   - The instrument settings (if applicable)

- Pass or fail designation in accordance with the accuracy specifications presented above
- Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate.

MAINTENANCE

- The probe and dust filter of the PID should be checked before and after every use for cleanliness. Should instrument response become unstable, recalibration should be performed. If this does not resolve the problem, access the photoionization bulb and clean with the manufacturer-supplied abrasive compound, then recalibrate.

- The PID battery must be recharged after each use. Store the PID in its carrying case when not in use. Additional maintenance details related to individual components of the PID are provided in the equipment manufacturer's instruction manual. If calibration or instrument performance is not in accordance with specifications, send the instrument to the equipment manufacturer for repair.

- Maintain a log for each monitoring instrument. Record all maintenance performed on the instrument on this log with date and name of the organization performing the maintenance.

ATTACHMENTS

Table 1; Summary of Ionization Potentials
Equipment Calibration Log (sample)

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
A		
2-Amino pyridine	8	
Acetaldehyde	10.21	
Acetamide	9.77	
Acetic acid	10.69	X
Acetic anhydride	10	
Acetone	9.69	
Acetonitrile	12.2	X
Acetophenone	9.27	
Acetyl bromide	10.55	
Acetyl chloride	11.02	X
Acetylene	11.41	X
Acrolein	10.1	
Acrylamide	9.5	
Acrylonitrile	10.91	X
Allyl alcohol	9.67	
Allyl chloride	9.9	
Ammonia	10.2	
Aniline	7.7	
Anisidine	7.44	
Anisole	8.22	
Arsine	9.89	
B		
1,3-Butadiene (butadiene)	9.07	
1-Bromo-2-chloroethane	10.63	X
1-Bromo-2-methylpropane	10.09	
1-Bromo-4-fluorobenzene	8.99	
1-Bromobutane	10.13	
1-Bromopentane	10.1	
1-Bromopropane	10.18	
1-Bromopropene	9.3	
1-Butanethiol	9.14	
1-Butene	9.58	
1-Butyne	10.18	
2,3-Butadione	9.23	
2-Bromo-2-methylpropane	9.89	
2-Bromobutane	9.98	
2-Bromopropane	10.08	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
2-Bromothiophene	8.63	
2-Butanone (MEK)	9.54	
3-Bromopropene	9.7	
3-Butene nitrile	10.39	
Benzaldehyde	9.53	
Benzene	9.25	
Benzenethiol	8.33	
Benzonitrile	9.71	
Benzotrifluoride	9.68	
Biphenyl	8.27	
Boron oxide	13.5	X
Boron trifluoride	15.56	X
Bromine	10.54	
Bromobenzene	8.98	
Bromochloromethane	10.77	X
Bromoform	10.48	
Butane	10.63	X
Butyl mercaptan	9.15	
cis-2-Butene	9.13	
m-Bromotoluene	8.81	
n-Butyl acetate	10.01	
n-Butyl alcohol	10.04	
n-Butyl amine	8.71	
n-Butyl benzene	8.69	
n-Butyl formate	10.5	
n-Butyraldehyde	9.86	
n-Butyric acid	10.16	
n-Butyronitrile	11.67	X
o-Bromotoluene	8.79	
p-Bromotoluene	8.67	
p-tert-Butyltoluene	8.28	
s-Butyl amine	8.7	
s-Butyl benzene	8.68	
sec-Butyl acetate	9.91	
t-Butyl amine	8.64	
t-Butyl benzene	8.68	
trans-2-Butene	9.13	
C		

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
1-Chloro-2-methylpropane	10.66	X
1-Chloro-3-fluorobenzene	9.21	
1-Chlorobutane	10.67	X
1-Chloropropane	10.82	X
2-Chloro-2-methylpropane	10.61	X
2-Chlorobutane	10.65	X
2-Chloropropane	10.78	X
2-Chlorothiophene	8.68	
3-Chloropropene	10.04	
Camphor	8.76	
Carbon dioxide	13.79	X
Carbon disulfide	10.07	
Carbon monoxide	14.01	X
Carbon tetrachloride	11.47	X
Chlorine	11.48	X
Chlorine dioxide	10.36	
Chlorine trifluoride	12.65	X
Chloroacetaldehyde	10.61	X
α -Chloroacetophenone	9.44	
Chlorobenzene	9.07	
Chlorobromomethane	10.77	X
Chlorofluoromethane (Freon 22)	12.45	X
Chloroform	11.37	X
Chlorotrifluoromethane (Freon 13)	12.91	X
Chrysene	7.59	
Cresol	8.14	
Crotonaldehyde	9.73	
Cumene (isopropyl benzene)	8.75	
Cyanogen	13.8	X
Cyclohexane	9.8	
Cyclohexanol	9.75	
Cyclohexanone	9.14	
Cyclohexene	8.95	
Cyclo-octatetraene	7.99	
Cyclopentadiene	8.56	
Cyclopentane	10.53	
Cyclopentanone	9.26	
Cyclopentene	9.01	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Cyclopropane	10.06	
m-Chlorotoluene	8.83	
o-Chlorotoluene	8.83	
p-Chlorotoluene	8.7	
D		
1,1-Dibromoethane	10.19	
1,1-Dichloroethane	11.12	X
1,1-Dimethoxyethane	9.65	
1,1-Dimethylhydrazine	7.28	
1,2-Dibromoethene	9.45	
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	12.2	X
1,2-Dichloroethane	11.12	X
1,2-Dichloropropane	10.87	X
1,3-Dibromopropane	10.07	
1,3-Dichloropropane	10.85	X
2,2-Dimethyl butane	10.06	
2,2-Dimethyl propane	10.35	
2,3-Dichloropropene	9.82	
2,3-Dimethyl butane	10.02	
3,3-Dimethyl butanone	9.17	
cis-Dichloroethene	9.65	
Decaborane	9.88	
Diazomethane	9	
Diborane	12	X
Dibromochloromethane	10.59	
Dibromodifluoromethane	11.07	X
Dibromomethane	10.49	
Dibutylamine	7.69	
Dichlorodifluoromethane (Freon 12)	12.31	X
Dichlorofluoromethane	12.39	X
Dichloromethane	11.35	X
Diethoxymethane	9.7	
Diethyl amine	8.01	
Diethyl ether	9.53	
Diethyl ketone	9.32	
Diethyl sulfide	8.43	
Diethyl sulfite	9.68	
Difluorodibromomethane	11.07	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Dihydropyran	8.34	
Diiodomethane	9.34	
Diisopropylamine	7.73	
Dimethoxymethane (methylal)	10	
Dimethyl amine	8.24	
Dimethyl ether	10	
Dimethyl sulfide	8.69	
Dimethylaniline	7.13	
Dimethylformamide	9.18	
Dimethylphthalate	9.64	
Dinitrobenzene	10.71	X
Dioxane	9.19	
Diphenyl	7.95	
Dipropyl amine	7.84	
Dipropyl sulfide	8.3	
Durene	8.03	
m-Dichlorobenzene	9.12	
N,N-Diethyl acetamide	8.6	
N,N-Diethyl formamide	8.89	
N,N-Dimethyl acetamide	8.81	
N,N-Dimethyl formamide	9.12	
o-Dichlorobenzene	9.06	
p-Dichlorobenzene	8.95	
p-Dioxane	9.13	
trans-Dichloroethene	9.66	
E		
Epichlorohydrin	10.2	
Ethane	11.65	X
Ethanethiol (ethyl mercaptan)	9.29	
Ethanolamine	8.96	
Ethene	10.52	
Ethyl acetate	10.11	
Ethyl alcohol	10.48	
Ethyl amine	8.86	
Ethyl benzene	8.76	
Ethyl bromide	10.29	
Ethyl chloride (chloroethane)	10.98	X
Ethyl disulfide	8.27	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Ethyl ether	9.51	
Ethyl formate	10.61	X
Ethyl iodide	9.33	
Ethyl isothiocyanate	9.14	
Ethyl mercaptan	9.29	
Ethyl methyl sulfide	8.55	
Ethyl nitrate	11.22	X
Ethyl propionate	10	
Ethyl thiocyanate	9.89	
Ethylene chlorohydrin	10.52	
Ethylene diamine	8.6	
Ethylene dibromide	10.37	
Ethylene dichloride	11.05	X
Ethylene oxide	10.57	
Ethylenelmine	9.2	
Ethynylbenzene	8.82	
F		
2-Furaldehyde	9.21	
Fluorine	15.7	X
Fluorobenzene	9.2	
Formaldehyde	10.87	X
Formamide	10.25	
Formic acid	11.05	X
Freon 11 (trichlorofluoromethane)	11.77	X
Freon 112 (1,1,2,2-tetrachloro-1,2-difluoroethane)	11.3	X
Freon 113 (1,1,2-trichloro-1,2,2-trifluororethane)	11.78	X
Freon 114 (1,2-dichloro-1,1,2,2-tetrafluoroethane)	12.2	X
Freon 12 (dichlorodifluoromethane)	12.31	X
Freon 13 (chlorotrifluoromethane)	12.91	X
Freon 22 (chlorofluoromethane)	12.45	X
Furan	8.89	
Furfural	9.21	
m-Fluorotoluene	8.92	
o-Fluorophenol	8.66	
o-Fluorotoluene	8.92	
p-Fluorotoluene	8.79	
H		
1-Hexene	9.46	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
2-Heptanone	9.33	
2-Hexanone	9.35	
Heptane	10.08	
Hexachloroethane	11.1	X
Hexane	10.18	
Hydrazine	8.1	
Hydrogen	15.43	X
Hydrogen bromide	11.62	X
Hydrogen chloride	12.74	X
Hydrogen cyanide	13.91	X
Hydrogen fluoride	15.77	X
Hydrogen iodide	10.38	
Hydrogen selenide	9.88	
Hydrogen sulfide	10.46	
Hydrogen telluride	9.14	
Hydroquinone	7.95	
I		
1-Iodo-2-methylpropane	9.18	
1-Iodobutane	9.21	
1-Iodopentane	9.19	
1-Iodopropane	9.26	
2-Iodobutane	9.09	
2-Iodopropane	9.17	
Iodine	9.28	
Iodobenzene	8.73	
Isobutane	10.57	
Isobutyl acetate	9.97	
Isobutyl alcohol	10.12	
Isobutyl amine	8.7	
Isobutyl formate	10.46	
Isobutyraldehyde	9.74	
Isobutyric acid	10.02	
Isopentane	10.32	
Isophorone	9.07	
Isoprene	8.85	
Isopropyl acetate	9.99	
Isopropyl alcohol	10.16	
Isopropyl amine	8.72	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Isopropyl benzene	8.69	
Isopropyl ether	9.2	
Isovaleraldehyde	9.71	
m-Iodotoluene	8.61	
o-Iodotoluene	8.62	
p-Iodotoluene	8.5	
K		
Ketene	9.61	
L		
2,3-Lutidine	8.85	
2,4-Lutidine	8.85	
2,6-Lutidine	8.85	
M		
2-Methyl furan	8.39	
2-Methyl napthalene	7.96	
1-Methyl napthalene	7.96	
2-Methyl propene	9.23	
2-Methyl-1-butene	9.12	
2-Methylpentane	10.12	
3-Methyl-1-butene	9.51	
3-Methyl-2-butene	8.67	
3-Methylpentane	10.08	
4-Methylcyclohexene	8.91	
Maleic anhydride	10.8	X
Mesityl oxide	9.08	
Mesitylene	8.4	
Methane	12.98	X
Methanethiol (methyl mercaptan)	9.44	
Methyl acetate	10.27	
Methyl acetylene	10.37	
Methyl acrylate	9.9	
Methyl alcohol	10.85	X
Methyl amine	8.97	
Methyl bromide	10.54	
Methyl butyl ketone	9.34	
Methyl butyrate	10.07	
Methyl cellosolve	9.6	
Methyl chloride	11.28	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Methyl chloroform (1,1,1-trichloroethane)	11	X
Methyl disulfide	8.46	
Methyl ethyl ketone	9.53	
Methyl formate	10.82	X
Methyl iodide	9.54	
Methyl isobutyl ketone	9.3	
Methyl isobutyrate	9.98	
Methyl isocyanate	10.67	X
Methyl isopropyl ketone	9.32	
Methyl isothiocyanate	9.25	
Methyl mercaptan	9.44	
Methyl methacrylate	9.7	
Methyl propionate	10.15	
Methyl propyl ketone	9.39	
α -Methyl styrene	8.35	
Methyl thiocyanate	10.07	
Methylal (dimethoxymethane)	10	
Methylcyclohexane	9.85	
Methylene chloride	11.32	X
Methyl-n-amyl ketone	9.3	
Monomethyl aniline	7.32	
Monomethyl hydrazine	7.67	
Morpholine	8.2	
n-Methyl acetamide	8.9	
N		
1-Nitropropane	10.88	X
2-Nitropropane	10.71	X
Naphthalene	8.12	
Nickel carbonyl	8.27	
Nitric oxide, (NO)	9.25	
Nitrobenzene	9.92	
Nitroethane	10.88	X
Nitrogen	15.58	X
Nitrogen dioxide	9.78	
Nitrogen trifluoride	12.97	X
Nitromethane	11.08	X
Nitrotoluene	9.45	
p-Nitrochloro benzene	9.96	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
O		
Octane	9.82	
Oxygen	12.08	X
Ozone	12.08	X
P		
1-Pentene	9.5	
1-Propanethiol	9.2	
2,4-Pentanedione	8.87	
2-Pentanone	9.38	
2-Picoline	9.02	
3-Picoline	9.02	
4-Picoline	9.04	
n-Propyl nitrate	11.07	X
Pentaborane	10.4	
Pentane	10.35	
Perchloroethylene	9.32	
Pheneloic	8.18	
Phenol	8.5	
Phenyl ether (diphenyl oxide)	8.82	
Phenyl hydrazine	7.64	
Phenyl isocyanate	8.77	
Phenyl isothiocyanate	8.52	
Phenylene diamine	6.89	
Phosgene	11.77	X
Phosphine	9.87	
Phosphorus trichloride	9.91	
Phthalic anhydride	10	
Propane	11.07	X
Propargyl alcohol	10.51	
Propiolactone	9.7	
Propionaldehyde	9.98	
Propionic acid	10.24	
Propionitrile	11.84	X
Propyl acetate	10.04	
Propyl alcohol	10.2	
Propyl amine	8.78	
Propyl benzene	8.72	
Propyl ether	9.27	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Propyl formate	10.54	
Propylene	9.73	
Propylene dichloride	10.87	X
Propylene imine	9	
Propylene oxide	10.22	
Propyne	10.36	
Pyridine	9.32	
Pyrrole	8.2	
Q		
Quinone	10.04	
S		
Stibine	9.51	
Styrene	8.47	
Sulfur dioxide	12.3	X
Sulfur hexafluoride	15.33	X
Sulfur monochloride	9.66	
Sulfuryl fluoride	13	X
T		
o-Terphenyls	7.78	
1,1,2,2-Tetrachloro-1,2-difluoroethane (Freon 112)	11.3	X
1,1,1-Trichloroethane	11	X
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	11.78	X
2,2,4-Trimethyl pentane	9.86	
o-Toluidine	7.44	
Tetrachloroethane	11.62	X
Tetrachloroethene	9.32	
Tetrachloromethane	11.47	X
Tetrahydrofuran	9.54	
Tetrahydropyran	9.25	
Thiolacetic acid	10	
Thiophene	8.86	
Toluene	8.82	
Tribromoethene	9.27	
Tribromofluoromethane	10.67	X
Tribromomethane	10.51	
Trichloroethene	9.45	
Trichloroethylene	9.47	
Trichlorofluoromethane (Freon 11)	11.77	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Trichloromethane	11.42	X
Triethylamine	7.5	
Trifluoromonobromo-methane	11.4	X
Trimethyl amine	7.82	
Tripropyl amine	7.23	
V		
o-Vinyl toluene	8.2	
Valeraldehyde	9.82	
Valeric acid	10.12	
Vinyl acetate	9.19	
Vinyl bromide	9.8	
Vinyl chloride	10	
Vinyl methyl ether	8.93	
W		
Water	12.59	X
X		
2,4-Xylidine	7.65	
m-Xylene	8.56	
o-Xylene	8.56	
p-Xylene	8.45	

EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name:

Date:

Project No.:

Client:

Instrument Source: ☐ TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	970600014560		< 0.4		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS		Myron L Company Ultra Meter 6P	606987		µS @ 25 °C		
☐ PID	ppm		Photovac 2020 PID	ED [illegible] 301		open air zero		MIBK re factor =
						_____ ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

SAMPLE

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Calibration and Maintenance of Portable Specific Conductance Meter

FOP 012.0

CALIBRATION AND MAINTENANCE OF PORTABLE SPECIFIC CONDUCTANCE METER

PURPOSE

This guideline describes a method for calibration of a portable specific conductance meter. This meter measures the ability of a water sample to conduct electricity, which is largely a function of the dissolved solids within the water. The instrument has been calibrated by the manufacturer according to factory specifications. This guideline presents a method for checking the factory calibration of a portable specific conductance meter. A calibration check is performed to verify instrument accuracy and function. All field test equipment will be checked at the beginning of each sampling day. This procedure also documents critical maintenance activities for this meter.

ACCURACY

The calibrated accuracy of the specific conductance meter will be within ± 1 percent of full-scale, with repeatability of ± 1 percent. The built-in cell will be automatically temperature compensated from at least 32° to 160° F (0° to 71°C).

PROCEDURE

Note: The information included below is equipment manufacturer- and model-specific, however, accuracy, calibration, and maintenance procedures for this type of portable equipment are typically similar. The information below pertains to the Myron L Company Ultrameter Model 6P. The actual equipment to be used in the field will be equivalent or similar.

1. Calibrate all field test equipment at the beginning of each sampling day. Check and recalibrate the specific conductance meter according to the manufacture's specifications.

2. Use a calibration solution of known specific conductivity and salinity. For maximum accuracy, use a Standard Solution Value closest to the samples to be tested.

3. Rinse conductivity cell three times with proper standard.

4. Re-fill conductivity cell with same standard.

5. Press **COND** or **TDS**, then press **CAL/MCLR**. The "CAL" icon will appear on the display.

6. Press the **↑/MS** or **MR/↓** key to step the displayed value toward the standard's value or hold a key down to cause rapid scrolling of the reading.

7. Press CAL/MCLR once to confirm new value and end the calibration sequence for this particular solution type.

8. Repeat steps 1 through 7 with additional new solutions, as necessary.

9. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample), indicating the meter readings before and after the instrument has been adjusted. This is important, not only for data validation, but also to establish maintenance schedules and component replacement. Information will include, at a minimum:
   - Time, date and initials of the field team member performing the calibration
   - The unique identifier for the meter, including manufacturer, model, and serial number
   - The brand and expiration date of the calibration standards
   - The instrument readings: before and after calibration

- The instrument settings (if applicable)
- The overall adequacy of calibration including the Pass or fail designation in accordance with the accuracy specifications presented above.
- Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate.

MAINTENANCE

NOTE: Ultrameters should be rinsed with clean water after use. Solvents should be avoided. Shock damage from a fall may cause instrument failure.

Temperature Extremes

Solutions in excess of 160°F/71°C should not be placed in the cell cup area; this may cause damage. Care should be exercised not to exceed rated operating temperature. Leaving the Ultrameter in a vehicle or storage shed on a hot day can easily subject the instrument to over 150°F voiding the warranty.

Battery Replacement

Dry Instrument THOROUGHLY. Remove the four bottom screws. Open instrument carefully; it may be necessary to rock the bottom slightly side to side to release it from the RS-232 connector. Carefully detach battery from circuit board. Replace with 9-volt alkaline battery. Replace bottom, ensuring the sealing gasket is installed in the groove of the top half of case. Re-install screws, tighten evenly and securely.

NOTE: Because of nonvolatile EEPROM circuitry, all data stored in memory and all calibration settings are protected even during power loss or battery replacement.

Cleaning Sensors

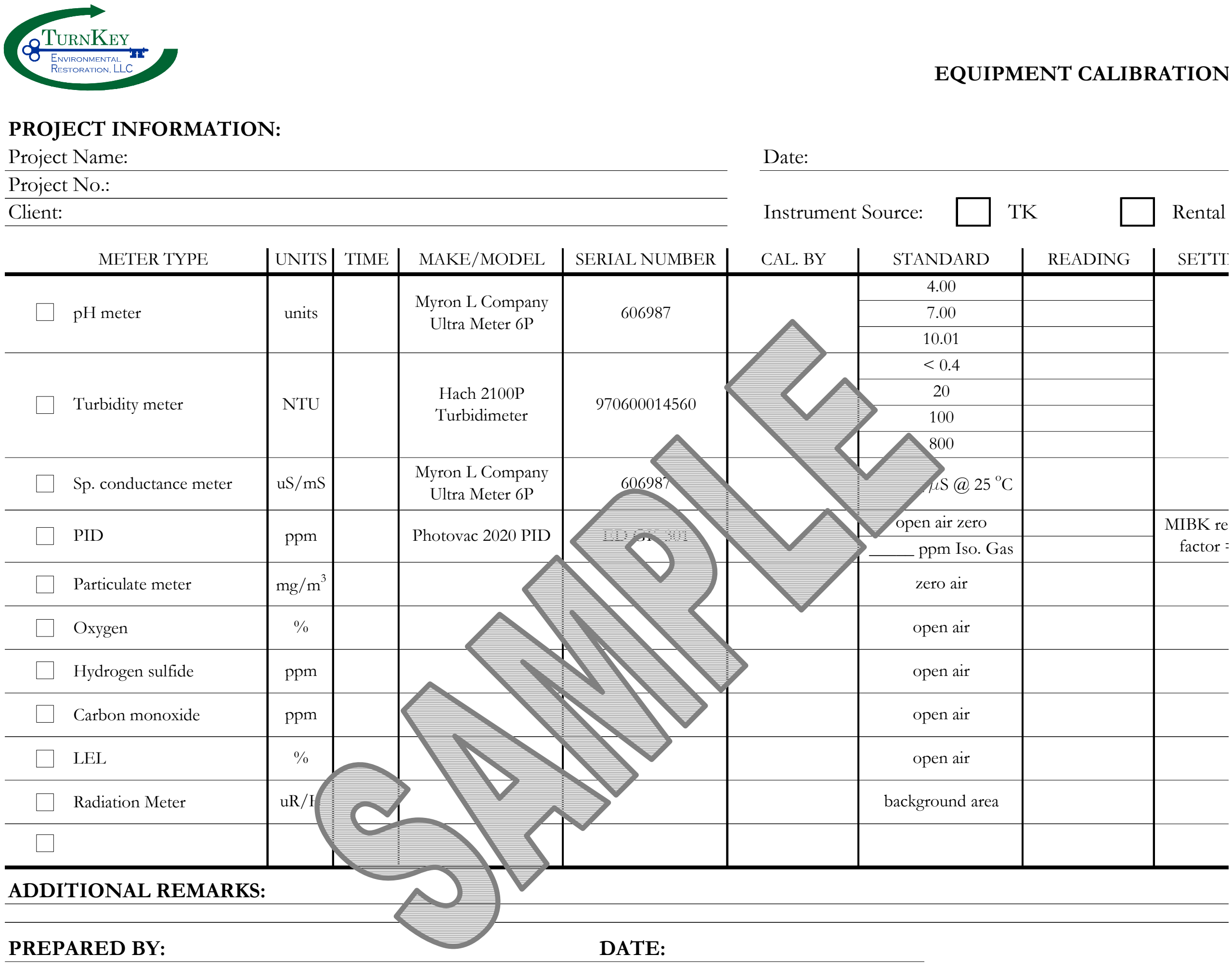
The conductivity cell cup should be kept as clean as possible. Flushing with clean water following use will prevent buildup on electrodes. However, if very dirty samples — particularly scaling types — are allowed to dry in the cell cup, a film will form. This film reduces accuracy. When there are visible films of oil, dirt, or scale in the cell cup or on the electrodes, use a foaming non-abrasive household cleaner. Rinse out the cleaner and your Ultrameter is ready for accurate measurements.

NOTE: Maintain a log for each monitoring instrument. Record all maintenance performed on the instrument on this log with date and name of the organization performing the maintenance.

ATTACHMENTS

Equipment Calibration Log (sample)

CALIBRATION AND MAINTENANCE OF PORTABLE SPECIFIC CONDUCTANCE METER



EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name:

Project No.:

Client:

Date:

Instrument Source: ☐ TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	970600014560		< 0.4		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS		Myron L Company Ultra Meter 6P	606987		µS @ 25 °C		
☐ PID	ppm		Photovac 2020 PID	[illegible]		open air zero		MIBK re factor =
						_____ ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

SAMPLE

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Documentation Requirements for Drilling and Well Installation

DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

PURPOSE

The purpose of these documentation requirements is to document the procedures used for drilling and installing wells in order to ensure the quality of the data obtained from these operations. TurnKey field technical personnel will be responsible for developing and maintaining documentation for quality control of field operations. At least one field professional will monitor each major operation (e.g. one person per drilling rig) to document and record field procedures for quality control. These procedures provide a description of the format and information for this documentation.

PROCEDURE

Project Field Book

Personnel assigned by the TurnKey Field Team Leader or Project Manager will maintain a Project Field Book for all site activities. These Field Books will be started upon initiation of any site activities to document the field investigation process. The Field Books will meet the following criteria:

- Permanently bound, with nominal 8.5-inch by 11-inch gridded pages.
- Water resistant paper.
- Pages must be pre-numbered or numbered in the field, front and back.

Notations in the field book will be in black or blue ink that will not smudge when wet. Information that may be recorded in the Field Book includes:

- Time and date of all entries.

- Name and location of project site and project job number.
- Listing of key project, client and agency personnel and telephone numbers.
- Date and time of daily arrivals and departures, name of person keeping the log, names and affiliation of persons on site, purpose of visit (if applicable), weather conditions, outline of project activities to be completed.
- Details of any variations to the procedures/protocols (i.e., as presented in the Work Plan or Field Operating Procedures) and the basis for the change.
- Field-generated data relating to implementation of the field program, including sample locations, sample descriptions, field measurements, instrument calibration, etc.
- Record of all photographs taken in the field, including date, time, photographer, site location and orientation, sequential number of photograph, and roll number.

Upon completion of the site activities, all Field Books will be photocopied and both the original and photocopied versions placed in the project files. In addition, all field notes except those presented on specific field forms will be neatly transcribed into Field Activity Daily Log (FADL) forms (sample attached).

Field Borehole/Monitoring Well Installation Log Form

Examples of the Field Borehole Log and Field Borehole/Monitoring Well Installation Log forms are attached to this Field Operating Procedure. One form will be completed for every boring by the TurnKey field person overseeing the drilling. At a minimum, these forms will include:

- Project name, location, and number.
- Boring number.

- Rig type and drilling method.
- Drilling dates.
- Sampling method.
- Sample descriptions, to meet the requirements of the Unified Soil Classification System (USCS) for soils and the Unified Rock Classification System (URCS) for rock.
- Results of photoionization evaluations (scan and/or headspace determinations).
- Blow counts for sampler penetration (Standard Penetration Test, N-Value).
- Drilling rate, rig chatter, and other drilling-related information, as necessary.

All depths recorded on Boring/Monitoring Well Installation Log forms will be expressed in increments tenths of feet, and not in inches.

Well Completion Detail Form

An example of this form is attached to this Field Operating Procedure. One form will be completed for every boring by the TurnKey field person overseeing the well installation. At a minimum, these forms will include:

- Project name, location, and number.
- Well number.
- Installation dates.
- Dimensions and depths of the various well components illustrated in the Well Completion Detail (attached). These include the screened interval, bottom caps or plugs, centralizers, and the tops and bottoms of the various annular materials.

- Drilling rate, rig chatter, and other drilling related information.

All depths recorded on Field Borehole/Monitoring Well Installation Logs will be expressed in tenths of feet, and not in inches.

Daily Drilling Report Form

An example of this form is attached to this Field Operating Procedure. This form should be used to summarize all drilling activities. One form should be completed for each rig for each day. These forms will include summaries of:

- Footage drilled, broken down by diameter (e.g. 200 feet of 6-inch diameter hole, 50 feet of 10-inch diameter hole).
- Footage of well and screen installed, broken down by diameter.
- Quantities of materials used, including sand, cement, bentonite, centralizers, protective casings, traffic covers, etc. recorded by well or boring location.
- Active time (hours), and activity (drilling, decontamination, development, well installation, surface completions, etc.)
- Down-time (hours) and reason.
- Mobilizations and other events.
- Other quantities that will be the basis for drilling invoices.

The form should be signed daily by both the TurnKey field supervisor and the driller's representative, and provided to the TurnKey Field Team Leader.

Other Project Field Forms

Well purging/well development forms, test pit logs, environmental sampling field data sheets, water level monitoring forms, and well testing (slug test or pumping test) forms. Refer to specific guidelines for form descriptions.

ATTACHMENTS

Field Activity Daily Log (FADL) (sample)
Field Borehole Log (sample)
Field Borehole/Monitoring Well Installation Log (sample)
Stick-up Well/Piezometer Completion Detail (sample)
Flush-mount Well/Piezometer Completion Detail (sample)
Daily Drilling Report (sample)

DAILY LOG	DATE			
	NO.			
	SHEET	OF		

FIELD ACTIVITY DAILY LOG

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
TIME	DESCRIPTION

SAMPLE

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
WEATHER CONDITIONS: A.M.: P.M.:	IMPORTANT TELEPHONE CALLS:
BM/TK PERSONNEL ON SITE:	
SIGNATURE	DATE:

TurnKey Environmental Restoration, LLC

FIELD BOREHOLE LOG

PROJECT:		**Log of Boring No.:**	
BORING LOCATION:		ELEVATION AND DATUM:	
DRILLING CONTRACTOR:		DATE STARTED:	DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:	SCREEN INTERVAL:
DRILLING EQUIPMENT:		DEPTH TO WATER: FIRST: COMPL.:	CASING:
SAMPLING METHOD:		LOGGED BY:	
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:	REG. NO.

Depth (fbgs)	SAMPLES					PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	REMARKS
	Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery			

ABANDONMENT:

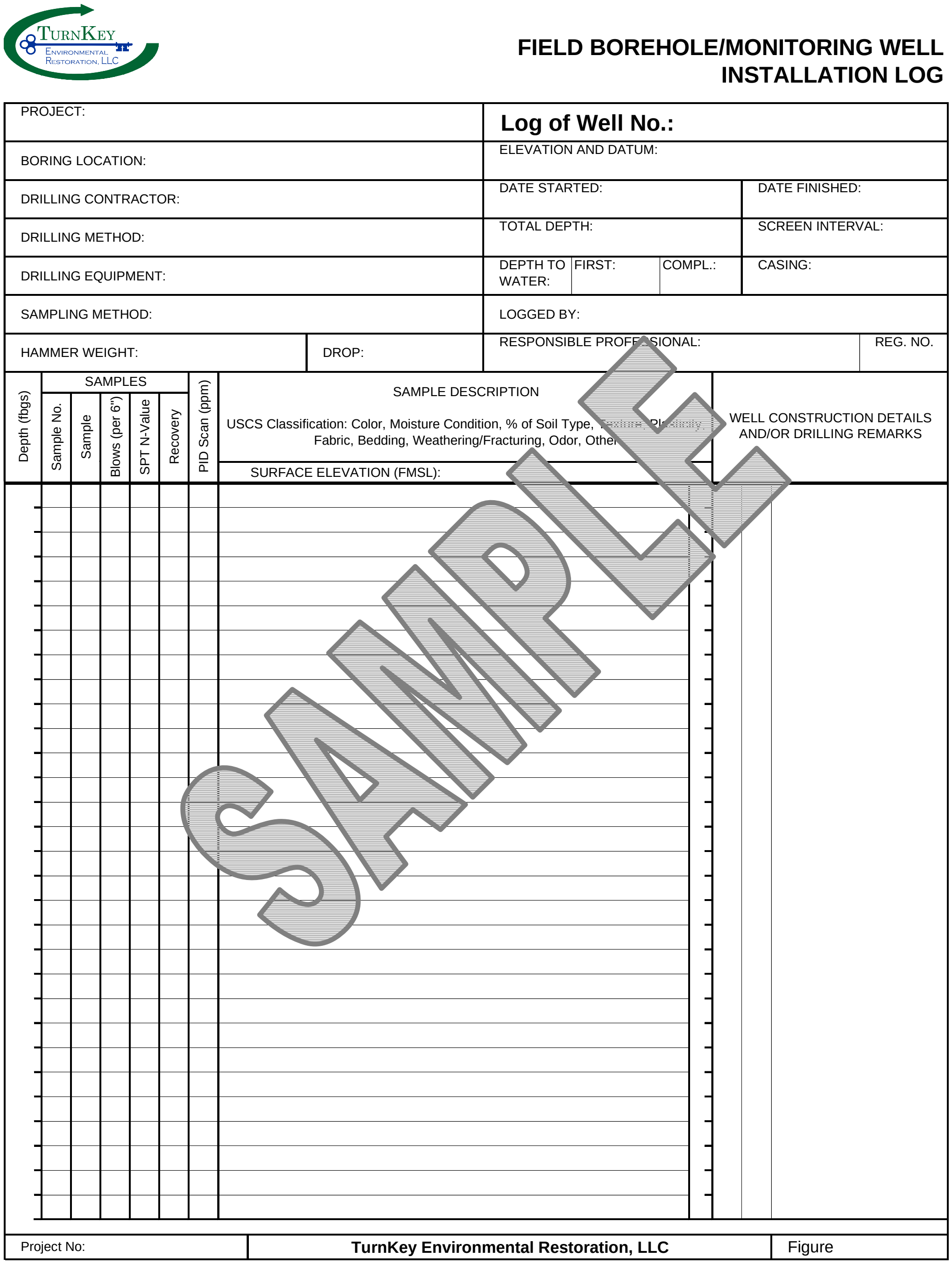
Volume of cement/bentonite grout required:	V = pr2 x 7.48 =	gallons	borehole depth =	ft.
Volume of cement/bentonite grout installed:		gallons	borehole diameter =	ft.
Has bridging of grout occurred?	☐ yes ☐ no		borehole radius =	ft.

If yes, explain resolution:

Method of installation:

Project No:	**TurnKey Environmental Restoration, LLC**	Figure

SAMPLE



TurnKey Environmental Restoration, LLC

FIELD BOREHOLE/MONITORING WELL INSTALLATION LOG

PROJECT:	**Log of Well No.:**		
BORING LOCATION:	ELEVATION AND DATUM:		
DRILLING CONTRACTOR:	DATE STARTED:		DATE FINISHED:
DRILLING METHOD:	TOTAL DEPTH:		SCREEN INTERVAL:
DRILLING EQUIPMENT:	DEPTH TO WATER:	FIRST: COMPL.:	CASING:
SAMPLING METHOD:	LOGGED BY:		
HAMMER WEIGHT: DROP:	RESPONSIBLE PROFESSIONAL:		REG. NO.

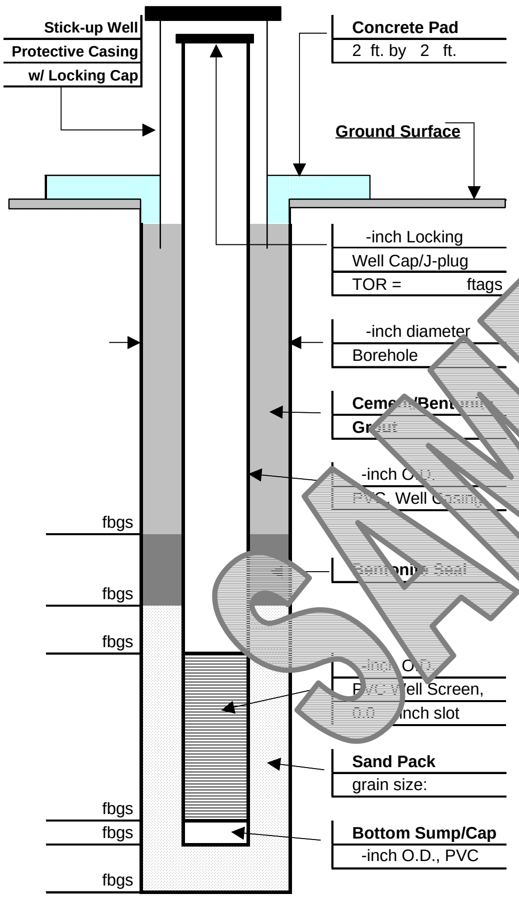
Depth (fbgs)	SAMPLES Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery	PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

SAMPLE

Project No:	**TurnKey Environmental Restoration, LLC**	Figure

STICK-UP MONITORING WELL COMPLETION DETAIL

Project Name:	WELL NUMBER:
Client:	Date Installed:
Boring Location:	Project Number:



Driller Information

Company:
Driller:
Helper:
Permit Number:
Drill Rig Type:

Well Information

Land Surface Elevation:	fmsl (approximate)
Drilling Method:	
Soil Sample Collection Method:	
Drilling Fluid:	
Fluid Loss During Drilling:	gallons (approximate)

Materials of Well Construction

Casing:
Screen:
Sump:
Sand Pack:
Annular Seal:

Well Development

Well Purpose:	
Techneque(s):	
Date Completed:	
BM/TK Personnel:	
Total Volume Purge:	gallons
Static Water Level (SWL):	fbTOR
Pump Depth: bottom of well	
Purge Duration:	minutes
Yeild:	gpm
Specific Capacity:	gpm/ft

SAMPLE

Comments:
saturated thickness: SWL - stickup = fbgs

Total Depth = fbTOR
Total Depth - SWL = feet

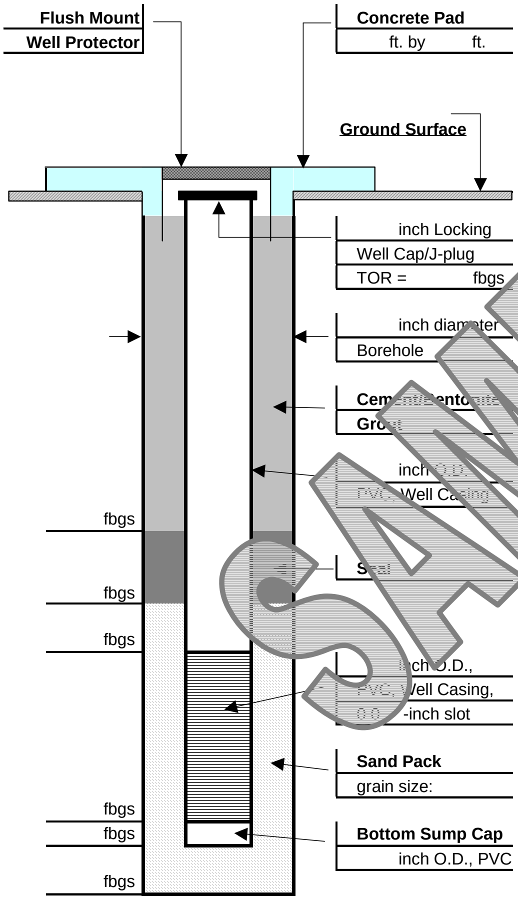
stick-up = feet

Total Depth = fbgs

PREPARED BY: DATE:

FLUSHMOUNT WELL/PIEZOMETER COMPLETION DETAIL

Project Name:	WELL NUMBER:
Client:	Date Installed:
Boring Location:	Project Number:



Driller Information

Company:
Driller:
Helper:
Permit Number:
Drill Rig Type:

Well Information

Land Surface Elevation:	fmsl (approximate)
Drilling Method:	
Soil Sample Collection Method:	
Drilling Fluid:	
Fluid Loss During Drilling:	gallons (approximate)

Materials of Well Construction

Casing:
Screen:
Sump:
Sand Pack:
Annular Seal:

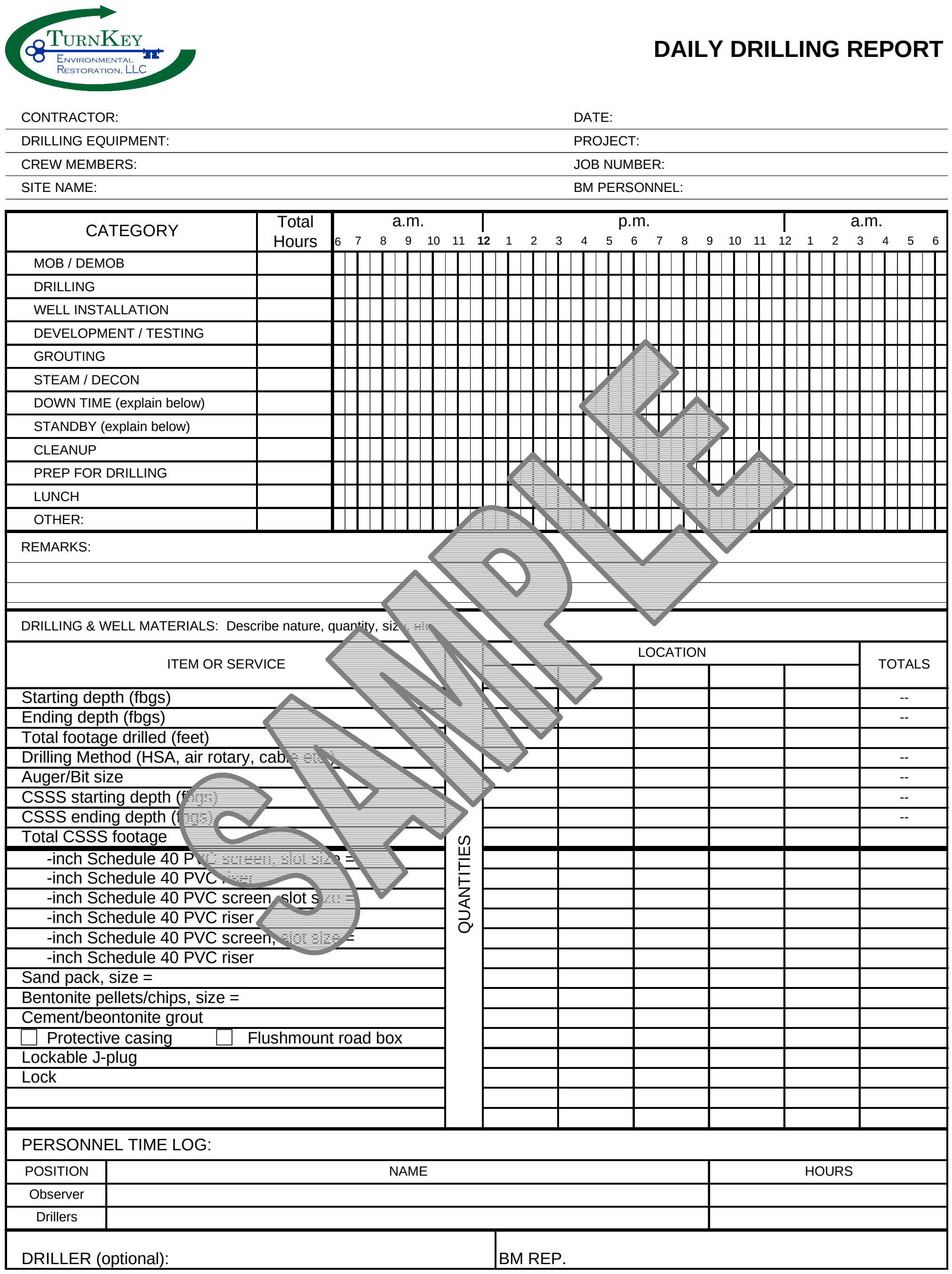
Well Development

Well Purpose:	
Techneque(s):	
Date Completed:	
BM/TK Personnel:	
Total Volume Purge:	gallons
Static Water Level:	fbTOR
Pump Depth:	
Purge Duration:	minutes
Yeild:	gpm
Specific Capacity:	gpm/ft

Comments:

PREAPRED BY: DATE:

SAMPLE



TurnKey Environmental Restoration, LLC

DAILY DRILLING REPORT

CONTRACTOR:	DATE:
DRILLING EQUIPMENT:	PROJECT:
CREW MEMBERS:	JOB NUMBER:
SITE NAME:	BM PERSONNEL:

CATEGORY	Total Hours	a.m.						p.m.												a.m.						
		6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
MOB / DEMOB																										
DRILLING																										
WELL INSTALLATION																										
DEVELOPMENT / TESTING																										
GROUTING																										
STEAM / DECON																										
DOWN TIME (explain below)																										
STANDBY (explain below)																										
CLEANUP																										
PREP FOR DRILLING																										
LUNCH																										
OTHER:																										

REMARKS:

DRILLING & WELL MATERIALS: Describe nature, quantity, size, etc.

ITEM OR SERVICE		LOCATION					TOTALS
Starting depth (fbgs)	QUANTITIES						--
Ending depth (fbgs)							--
Total footage drilled (feet)							
Drilling Method (HSA, air rotary, cable etc.)							--
Auger/Bit size							--
CSSS starting depth (fbgs)							--
CSSS ending depth (fbgs)							--
Total CSSS footage							
-inch Schedule 40 PVC screen, slot size =							
-inch Schedule 40 PVC riser							
-inch Schedule 40 PVC screen, slot size =							
-inch Schedule 40 PVC riser							
-inch Schedule 40 PVC screen, slot size =							
-inch Schedule 40 PVC riser							
Sand pack, size =							
Bentonite pellets/chips, size =							
Cement/beontonite grout							
☐ Protective casing ☐ Flushmount road box							
Lockable J-plug							
Lock							

PERSONNEL TIME LOG:

POSITION	NAME	HOURS
Observer		
Drillers		

DRILLER (optional):	BM REP.

SAMPLE

TurnKey
Environmental
Restoration, LLC

Field Operating Procedures

Drill Site Selection Procedure

FOP 017.0

DRILL SITE SELECTION PROCEDURE

PURPOSE

This procedure presents a method for selecting a site location for drilling. Drill site selection should be based on the project objectives, ease of site access, freedom from obstructions and buried metallic objects (drums) and site safety (appropriate set backs from overhead and buried services).

PROCEDURE

The following procedure outlines procedures prior to drilling activities:

1. Review project objectives and tentatively select drilling locations that provide necessary information for achieving objectives (i.e., Work Plan).

2. Clear locations with property owner/operator to ensure that drilling activities will not interfere with site operations and select appropriate access routes.

3. Stake locations in the field, measure distance from locations to recognizable landmarks, such as building or fence lines and plot locations on site plan. Ensure location is relatively flat, free of overhead wires and readily accessible. Survey location if property ownership is in doubt.

4. Obtain clearances from appropriate utilities and if buried waste/metallic objects are suspected, screen location with appropriate geophysical method.

5. Establish a secure central staging area for storage of drilling supplies and for equipment decontamination. Locate a secure storage area for drilling samples, as necessary.

ATTACHMENTS

none

TurnKey
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Restoration, LLC

FIELD OPERATING PROCEDURES

Drilling & Excavation Equipment Decontamination Procedures

FOP 018.0

DRILLING AND EXCAVATION EQUIPMENT DECONTAMINATION PROCEDURES

PURPOSE

This procedure is to be used for the decontamination of drilling and excavation equipment (i.e., drill rigs, backhoes, augers, drill bits, drill rods, buckets, and associated equipment) used during a subsurface investigation. The purpose of this procedure is to remove chemical constituents associated with a particular drilling or excavation location from this equipment. This prevents these constituents from being transferred between drilling or excavation locations, or being transported out of controlled areas.

PROCEDURE

The following procedure will be utilized prior to the use of drilling or excavation equipment at each location, and prior to the demobilization of such equipment from the site:

1. Remove all loose soil and other particulate materials from the equipment at the survey site.

2. Wrap augers, tools, plywood, and other reusable items with a plastic cover prior to transport from the site of use to the decontamination facility.

3. Transport equipment to the decontamination facility. All equipment must be decontaminated at an established decontamination facility. This facility will be placed within a controlled area, and will be equipped with necessary features to contain and collect wash water and entrained materials.

4. Wash equipment thoroughly with pressurized low-volume water or steam, supplied by a pressure washer or steam cleaner.

5. If necessary, use a brush or scraper to remove visible soils adhering to the equipment, and a non-phosphate detergent to remove any oils, grease, and/or hydraulic fluids adhering to the equipment. Continue pressure washing until all visible contaminants are removed.

6. Allow equipment to air dry.

7. Store equipment in a clean area or wrap the equipment in new plastic sheeting as necessary to ensure cleanliness until ready for use.

8. Manage all wash waters and entrained solids as described in the TurnKey Field Operating Procedure for Management of Investigation-Derived Waste.

ATTACHMENTS

none

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Establishing Horizontal and Vertical Control

FOP 021.0

ESTABLISHING HORIZONTAL AND VERTICAL CONTROL

PURPOSE

This guideline presents a method for establishing horizontal and vertical controls at a project site. It is imperative that this procedure be performed accurately, as all topographic and site maps, monitoring well locations and test pit locations will be based on these controls.

PROCEDURE

A. Establishing Horizontal Primary and Project Control

1. Research the State Plan Coordinate, USGS or project site applicable horizontal control monuments.
2. At the project site, recover the above-mentioned monuments, two markers minimum being recovered.
3. Establish control points on the project site by bringing in the primary control points recovered in the field.
4. All control points will be tied into a closed traverse to assure the error of closure.
5. Compute closures for obtaining degree of accuracy to adjust traverse points.

B. Establishing Vertical Primary and Project Control

1. Research project or USGS datum for recovering monument(s) for vertical control if different than those previously found.
2. Recover the monuments in the field, two markers minimum being found.
3. Set the projects benchmarks.
4. Run a level line from the monuments to the set project benchmarks and back, setting turning points on all benchmarks set on site.

5. Reduce field notes and compute error of closure to adjust benchmarks set on site.

6. Prepare the recovery sketches and tabulate a list for horizontal and vertical control throughout project site.

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Groundwater Level Measurement

FOP 022.0

GROUNDWATER LEVEL MEASUREMENT

PURPOSE

This procedure describes the methods used to obtain accurate and consistent water level measurements in monitoring wells, piezometers and well points. Water levels will be measured at monitoring wells and, if practicable, in supply wells to estimate purge volumes associated with sampling, and to develop a potentiometric surface of the groundwater in order to estimate the direction and velocity of flow in the aquifer. Water levels in monitoring wells will be measured using an electronic water level indicator (e-line) that has been checked for operation prior to mobilization.

PROCEDURE

1. Decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination. Store the e-line in a protected area until use. This may include wrapping the e-line in clean plastic until the time of use.

2. Unlock and remove the well protective cap or cover and place on clean plastic.

3. Lower the probe slowly into the monitoring well until the audible alarm sounds. This indicates the depth to water has been reached.

4. Move the cable up and down slowly to identify the depth at which the alarm just begins to sound. Measure this depth against the mark on the lip of the well riser used as a surveyed reference point (typically the north side of the riser).

5. Read depth from the graduated cable to the nearest 0.01 foot. Do not use inches. If the e-line is not graduated, use a rule or tape measure graduated in 0.01-foot increments to measure from the nearest reference mark on the e-line cable.

6. Record the water level on a Water Level Monitoring Record (sample attached).

7. Remove the probe from the well slowly, drying the cable and probe with a clean paper wipe. Be sure to repeat decontamination before use in another well.

8. Replace well plug and protective cap or cover. Lock in place as appropriate.

ATTACHMENTS

Water Level Monitoring Record (sample)

REFERENCES

<u>TurnKey FOPs:</u>

040 Non-Disposable and Non-Dedicated Sampling Equipment Decontamination

TurnKey Environmental Restoration, LLC

WATER LEVEL MONITORING RECORD

Project Name: Client:
Project No.: Location:
Field Personnel: Date:
Weather:

Well No.	Time	Top of Riser Elevation (fmsl)	Static Depth to Water (fbTOR)	Groundwater Elevation (fmsl)	Total Depth (fbTOR)	Last Total Depth Measurement (fbTOR)

SAMPLE

Comments/Remarks:

PREAPRED BY: DATE:

TurnKey
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FIELD OPERATING PROCEDURES

Groundwater Purging Procedures Prior to Sample Collection

FOP 023.0

GROUNDWATER PURGING PROCEDURES PRIOR TO SAMPLE COLLECTION

PURPOSE

This procedure describes the methods for monitoring well/piezometer purging prior to groundwater sample collection in order to collect representative groundwater samples. The goal of purging is to remove stagnant, non-representative groundwater from the well and/or prevent stagnant water from entering collected samples. Purging involves the removal of at least three to five volumes of water in wells with moderate yields and at least one well volume from wells with low yields (slow water level recovery).

Purge and sample wells in order of least-to-most contaminated (this is not necessary if dedicated or disposable equipment is used). If you do not know this order, sample the upgradient wells first, then the furthest down-gradient or side-gradient wells, and finally the wells closest to, but down-gradient of the most contaminated area. Sampling should commence immediately following purging or as soon as the well has adequately recharged and not more than 24-hours following end time of evacuation.

PROCEDURE

1. Prepare the electronic water level indicator (e-line) in accordance with the procedures referenced in the Benchmark Field Operating Procedure for Groundwater Level Measurement and decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the Benchmark Field Operating Procedure for Non-disposable and Non-dedicated Sampling Equipment Decontamination. Store the e-line in a protected area until use. This may include wrapping the e-line in clean plastic until the time of use.

2. Inspect the interior and exterior of the well/piezometer for signs of vandalism or damage and record condition on the Groundwater Field Form and/or Groundwater Well Inspection Form (samples attached). Specifically, inspect

the integrity of the following: concrete surface seal, lock, protective casing and well cover, well riser and J-plug/cap. Report any irregular findings to the Project Manager.

3. Unlock and remove the well protective cap or cover and place on clean plastic to avoid introducing foreign material into the well.

4. Calibrate the photoionization detector (PID) in accordance with the Benchmark Field Operating Procedure for Calibration and Maintenance of Portable Photoionization Detector.

5. Monitor the well for organic vapors using a PID, as per the Work Plan. If a reading of greater than 5 ppm is recorded, the well should be allowed to vent until levels drop below 5 ppm before proceeding with purging.

6. Lower the e-line probe slowly into the monitoring well and record the initial water level in accordance with the procedures referenced in the Benchmark Field Operating Procedure for Groundwater Level Measurement.

7. Following static water level determinations, slowly lower the e-line to the bottom of the well/piezometer. Record the total depth to the nearest 0.01-foot and compare to the previous total depth measurement. If a significant discrepancy exists, re-measure the total depth. Continue with purging activities observing purge water to determine whether the well/piezometer had become silted due to inactivity or damaged (i.e., well sand within purge water). Upon confirmation of the new total depth and determination of the cause (i.e., siltation or damage), notify the Project Manager following field activities.

8. Calculate the volume of water in the well based on the water level below the top of riser and the total depth of the well using the following equation:

$$V = 0.0408[(B)^2 \times \{(A) - (C)\}]$$

Where,

A = Total Depth of Well (feet below measuring point)
B = Casing diameter (inches)
C = Static Water Level (feet below measuring point)

9. **For wells where the water level is 20 feet or less below the top of riser**, a peristaltic pump may be used to purge the well. Measure the purged volume using a calibrated container (i.e., graduated 5-gallon bucket) and record measurements on the attached Groundwater Well Development and Purge Log. Use new and dedicated tubing for each well. During the evacuation of shallow wells, the intake opening of the pump tubing should be positioned just below the surface of the water. As the water level drops, lower the tubing as needed to maintain flow. For higher yielding wells, the intake level should not be lowered past the top of the screen. Pumping from the top of the water column will ensure proper flushing of the well. Continue pumping until the required volumes are removed (typically three well volumes). For higher yielding wells, adjust the purging rate to maintain the water level above the screen. For lower yielding wells or wells where the screen straddles the water table, maintain purging at a rate that matches the rate of recovery of the well (well yield). If the well purges to dryness and is slow to recharge (greater than 15 minutes), terminate evacuation.

10. **For wells where the water level is initially below 20 feet,** or drawn down to this level because of slow recharge rate, conduct purging using one of three devices listed below:

    - <u>Bailer</u> – A bottom filling dedicated polyethylene bailer attached to a length of dedicated hollow-braid polypropylene rope. Purging a well utilizing a bailer should be conducted smoothly and slowly as not to agitate the groundwater or damage the well.

    - <u>Well Wizard Purge Pump (or similar)</u> – This pneumatic bladder pump uses compressed air to push water to the surface. Groundwater is not in contact with the drive air during the pumping process, therefore the pump may be used for sample collection.

- Waterra™ Pump – This manually operated pump uses dedicated polyethylene tubing and a check valve that can be used as an optional method for purging deeper wells. The pump utilizes positive pressure to evacuate the well, therefore the pump may be used for sample collection, and however over-agitation groundwater should be avoided.

Prior to use in a well, non-dedicated bailers, exterior pump bodies and pump tubing should be cleaned in accordance with the Benchmark Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination. Dedicated and/or disposable equipment should be contained within the sealed original manufacturers packaging and certified pre-cleaned by the manufacturer with a non-phosphate laboratory detergent and rinsed using de-ionized water.

8. Purging will continue until a predetermined volume of water has been removed (typically three well volumes) or to dryness. Measurements for pH, temperature, specific conductance, dissolved oxygen (optional), Eh (optional) and turbidity will be recorded following removal of each well volume. Purge the well to dryness or until the readings for indicator parameters listed above (or well-specific indicator parameters) stabilize within the following limits for each parameter measured:

Field Parameter	**Stabilization Criteria**
Dissolved Oxygen	± 0.3 mg/L
Turbidity	± 10 %
Specific Conductance	± 3 %
Eh	± 10 mV
PH	± 0.1 unit

Stabilization criteria presented within the project Work Plan will take precedence.

DOCUMENTATION AND SAMPLE COLLECTION

This section pertains to the documentation of collected field data during and following purging activities and sample collection.

1. Record all data including the final three stable readings for each indicator parameter on the attached Groundwater Well Purge & Sample Log.
2. Record, at a minimum, the "volume purged," "purging stop-time," "purged dry (Y/N)," "purged below sand pack (Y/N)," and any problems purging on the attached Groundwater Well Purge & Sample Log.
3. Collect groundwater samples in accordance with the Benchmark Field Operating Procedure for Groundwater Sample Collection. Record "sample flow rate" as an average, "time sample collected," and any other pertinent information related to the sampling event on the attached Groundwater Well Purge & Sample Log.
4. Restore the well to its capped/covered and locked condition.

ALTERNATIVE METHODS

Alternative purging and sampling methods and equipment, other than those described herein are acceptable if they provide representative groundwater samples. The purging and sampling method and equipment must not adversely affect sample integrity, chemistry, temperature and turbidity. In addition, alternative equipment must have minimal or no effect on groundwater geochemistry, aquifer permeability and well materials. Equipment materials must also minimize sorption and leaching. The field team is responsible for documenting and describing any alternative equipment and procedures used to purge a well and collect samples.

ATTACHMENTS

Groundwater Field Form
Groundwater Well Inspection Form

REFERENCES

Benchmark FOPs:

011	*Calibration and Maintenance of Portable Photoionization Detector*
022	*Groundwater Level Measurement*
024	*Groundwater Sample Collection Procedures*
040	*Non-disposable and Non-dedicated Sampling Equipment Decontamination*

TurnKey Environmental Restoration, LLC

GROUNDWATER FIELD FORM

Project Name: Date:

Location: Project No.: Field Team:

SAMPLE

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sampling
Total Depth (fbTOR):	Purge Volume (gal):	Purge Method:

Time	Water Level (fbTOR)	Acc. Volume (gallons)	pH (units)	Temp. (deg. C)	SC (uS)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	0 Initial								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Sample Information:									
	S1								
	S2								

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sampling
Total Depth (fbTOR):	Purge Volume (gal):	Purge Method:

Time	Water Level (fbTOR)	Acc. Volume (gallons)	pH (units)	Temp. (deg. C)	SC (uS)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	0 Initial								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Sample Information:									
	S1								
	S2								

REMARKS:

Note: All measurements are in feet, distance from top of riser.

Volume Calculation

Diam.	Vol. (g/ft)
1"	0.041
2"	0.163
4"	0.653
6"	1.469

Stabilization Criteria

Parameter	Criteria
pH	± 0.1 unit
SC	± 3%
Turbidity	± 10%
DO	± 0.3 mg/L
ORP	± 10 mV

PREPARED BY:

TurnKey Environmental Restoration, LLC

GROUNDWATER WELL INSPECTION FORM

Project:	**WELL I.D.:**
Client:	
Job No.:	
Date:	
Time:	

EXTERIOR INSPECTION

Protective Casing:
Lock:
Hinge/Lid:
Concrete Surface Seal:
Bollards:
Label/I.D.:
Other:

SAMPLE

INTERIOR INSPECTION

Well Riser:
Annular Space:
Well Cap:
Water Level (fbTOR):
Total Depth (fbTOR):
Other:

Comments/Corrective Actions:

PREPARED BY: DATE:

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FIELD OPERATING PROCEDURES

Groundwater Sample Collection Procedures

FOP 024.0

GROUNDWATER SAMPLE COLLECTION PROCEDURES

PURPOSE

This procedure describes the methods for collecting groundwater samples from monitoring wells and domestic supply wells following purging and sufficient recovery. This procedure also includes the preferred collection order in which water samples are collected based on the volatilization sensitivity or suite of analytical parameters required.

PROCEDURE

Allow approximately 3 to 10 days following well development before performing purge and sample activities at any well location. Conversely, perform sampling as soon as practical after sample purging at any time after the well has recovered sufficiently to sample, or within 24 hours after evacuation, if the well recharges slowly. If the well does not yield sufficient volume for all required laboratory analytical testing (including quality control), a decision should be made to prioritize analyses based on contaminants of concern at the site. If the well takes longer than 24 hours to recharge, the Project Manager should be consulted. The following two procedures outline sample collection activities for monitoring and domestic type wells.

Monitoring Wells

1. Purge the monitoring well in accordance with the TurnKey's FOPs for Groundwater Purging Procedures Prior to Sample Collection or Low Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedures. Perform sampling as soon as practical after purging at any time after the well has recovered sufficiently to sample, or within 24 hours after evacuation, if the well recharges slowly. If the well does not yield sufficient volume for all required laboratory analytical testing (including quality control), a decision should be made to prioritize analyses based on contaminants of concern at the site. Analyses will be prioritized in the order of the parameters volatilization sensitivity. After volatile organics have been collected, field parameters

must be measured from the next sample collected. If a well takes longer than 24 hours to recharge, the Project Manager should be consulted.

2. Sampling equipment that is not disposable or dedicated to the well will be decontaminated in accordance with the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

3. Calibrate all field meters (i.e., pH/Eh, turbidity, specific conductance, dissolved oxygen, PID etc.) in accordance with the TurnKey's Field Operating Procedure for Calibration and Maintenance of the specific field meter.

4. Prepare the electronic water level indicator (e-line) in accordance with the procedures referenced in the TurnKey's Field Operating Procedure for Groundwater Level Measurement and decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the TurnKey's Field Operating Procedure for Non-disposable and Non-dedicated Sampling Equipment Decontamination. Store the e-line in a protected area until use. This may include wrapping the e-line in clean plastic until the time of use.

5. Inspect the well/piezometer for signs of vandalism or damage and record condition on the Groundwater Well Purge & Sample Collection Log (sample attached). Specifically, inspect the integrity of the following: concrete surface seal, lock, protective casing and well cover, well casing and J-plug/cap. Report any irregular findings to the Project Manager.

6. Unlock and remove the well protective cap or cover and place on clean plastic to avoid introducing foreign material into the well.

7. Calibrate the photoionization detector (PID) in accordance with the TurnKey's Field Operating Procedure for Calibration and Maintenance of Portable Photoionization Detector.

8. Monitor the well for organic vapors using a PID, as per the Work Plan. If a reading of greater than 5 ppm is recorded, the well should be allowed to vent until levels drop below 5 ppm before proceeding with purging. Record PID measurements on a well-specific Groundwater Well Purge & Sample Collection Log (sample attached).

9. Lower the e-line probe slowly into the monitoring well and record the measurement on a well-specific Groundwater Well Purge & Sample Collection Log (sample attached).

10. Groundwater samples will be collected directly from the sampling valve on the flow through cell (low-flow), discharge port of a standard pump assembly (peristaltic, pneumatic, submersible, or Waterra™ pump) or bailer (stainless steel, PVC or polyethylene) into appropriate laboratory provided containers. In low-yielding wells at which the flow through cell is not used, the samples may be collected using a disposable bailer.

11. If disposable polyethylene bailers are used, the bailer should be lowered *slowly* below the surface of the water to minimize agitation and volatilization. For wells that are known to produce turbid samples (values greater than 50 NTU), the bailer should be lowered and retrieved at a rate that limits surging of the well.

12. Sampling data will be recorded on a Groundwater Well Purge & Sample Collection Log (sample attached).

13. Pre-label all sample bottles in the field using a waterproof permanent marker in accordance with the TurnKey's Sample Labeling, Storage and Shipment FOP. The following information, at a minimum, should be included on the label:

    - Project Number;
    - Sample identification code (as per project specifications);
    - Date of sample collection (mm, dd, yy);
    - Time of sample collection (military time only) (hh:mm);
    - Specify "grab" or "composite" sample type;
    - Sampler initials;
    - Preservative(s) (if applicable); and
    - Analytes for analysis (if practicable).

14. Collect a separate sample of approximately 200 ml into an appropriate container prior to collecting the first and following the last groundwater sample collected to measure the following field parameters:

Parameter	Units
Dissolved Oxygen	parts per million (ppm)
Specific Conductance	μmhos/cm or μS or mS
pH	pH units
Temperature	^{o}C or ^{o}F
Turbidity	NTU
Eh (*optional*)	mV
PID VOCs (*optional*)	ppm

Record all field measurements on a Groundwater Well Purge & Sample Collection Log (sample attached).

15. Collect samples into pre-cleaned bottles provided by the analytical laboratory with the appropriate preservative(s) added based on the volatilization sensitivity or suite of analytical parameters required, as designated in the **Sample Collection Order** section below.

16. Lower the e-line probe slowly into the monitoring well and record the measurement on a well-specific Groundwater Well Purge & Sample Collection Log (sample attached).

17. The samples will be labeled, stored and shipped in accordance with the TurnKey's Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

Domestic Supply Wells

1. Calculate or estimate the volume of water in the well. It is desirable to purge at least one casing volume before sampling. This is controlled, to some extent, by the depth of the well, well yield and the rate of the existing pump. If the volume of water in the well cannot be calculated, the well should be purged continuously for no less than 15 minutes.

2. Connect a sampling tap to an accessible fitting between the well and the pressure tank where practicable. A hose will be connected to the device and the hose discharge located 25 to 50 feet away. The well will be allowed to pump until the lines and one well volume is removed. Flow rate will be measured with a container of known volume and a stopwatch.

3. Place a clean piece of polyethylene or Teflon™ tubing on the sampling port and collect the samples in the order designated below and in the sample containers supplied by the laboratory for the specified analytes. ***DO NOT*** use standard garden hose to collect samples.

4. Sampling results and measurements will be recorded on a Groundwater Well Purge & Sample Collection Log (sample attached) as described in the previous section.

5. Collect samples into pre-cleaned bottles provided by the analytical laboratory with the appropriate preservative(s) added based on the volatilization sensitivity or suite of analytical parameters required, as designated in the **Sample Collection Order** section below.

6. The samples will be labeled, stored and shipped in accordance with the TurnKey's Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

SAMPLE COLLECTION ORDER

All groundwater samples, from monitoring wells and domestic supply wells, will be collected in accordance with the following.

1. Samples will be collected preferentially in recognition of volatilization sensitivity. The preferred order of sampling if no free product is present is:

   - Field parameters
   - Volatile Organic Compounds (VOCs)
   - Purgeable organic carbons (POC)
   - Purgeable organic halogens (POH)
   - Total Organic Halogens (TOX)
   - Total Organic Carbon (TOC)

- Extractable Organic Compounds (i.e., BNAs, SVOCs, etc.)
- Total petroleum hydrocarbons (TPH) and oil and grease
- PCBs and pesticides
- Total metals (Dissolved Metals)
- Total Phenolic Compounds
- Cyanide
- Sulfate and Chloride
- Turbidity
- Nitrate (as Nitrogen) and Ammonia
- Preserved inorganics
- Radionuclides
- Unpreserved inorganics
- Bacteria
- Field parameters

2. Document the sampling procedures and related information in the Project Field Book and on a Groundwater Well Purge & Sample Collection Log (sample attached).

DOCUMENTATION

The three words used to ensure adequate documentation for groundwater sampling are accountability, controllability, and traceability. Accountability is undertaken in the sampling plan and answers the questions who, what, where, when, and why to assure that the sampling effort meets its goals. Controllability refers to checks (including QA/QC) used to ensure that the procedures used are those specified in the sampling plan. Traceability is documentation of what was done, when it was done, how it was done, and by whom it was done, and is found in the field forms, Project Field Book, and chain-of-custody forms. At a minimum, adequate documentation of the sampling conducted in the field consists of an entry in the Project Field Book (with sewn binding), field data sheets for each well, and a chain-of-custody form.

As a general rule, if one is not sure whether the information is necessary, it should nevertheless be recorded, as it is impossible to over-document one's fieldwork. Years may go by before the documentation comes under close scrutiny, so the documentation must be capable of defending the sampling effort without the assistance or translation of the sampling crew.

The minimum information to be recorded daily with an indelible pen in the Project Field Book and/or field data sheets includes date and time(s), name of the facility, name(s) of the sampling crew, site conditions, the wells sampled, a description of how the sample shipment was handled, and a QA/QC summary. After the last entry for the day in the Project Field Book, the Field Team Leader should sign the bottom of the page under the last entry and then draw a line across the page directly under the signature.

PRECAUTIONS/RECOMMENDATIONS

The following precautions should be adhered to prior to and during sample collection activities:

- Field vehicles should be parked downwind (to avoid potential sample contamination concerns) at a minimum of 15 feet from the well and the engine turned off prior to PID vapor analysis and VOC sample collection.
- Ambient odors, vehicle exhaust, precipitation, or windy/dusty conditions can potentially interfere with obtaining representative samples. These conditions should be minimized and should be recorded in the field notes. Shield sample bottles from strong winds, rain, and dust when being filled.

- The outlet from the sampling device should discharge below the top of the sample's air/water interface, when possible. The sampling plan should specify how the samples will be transferred from the sample collection device to the sample container to minimize sample alterations.

- The order of sampling should be from the least contaminated to the most contaminated well to reduce the potential for cross contamination of sampling equipment (see the Sampling Plan or Work Plan).

- Samples should not be transferred from one sampling container to another.

- Sampling equipment must not be placed on the ground, because the ground may be contaminated and soil contains trace metals. Equipment and supplies should be removed from the field vehicle only when needed.

- Smoking and eating should not be allowed until the well is sampled and hands are washed with soap and water, due to safety and possibly sample contamination concerns. These activities should be conducted beyond a 15-foot radius of the well.

- No heat-producing or electrical instruments should be within 15 feet of the well, unless they are intrinsically safe, prior to PID vapor analysis.

- Minimize the amount of time that the sample containers remain open.

- Do not touch the inside of sample bottles or the groundwater sample as it enters the bottle. Disposable gloves may be a source of phthalates, which could be introduced into groundwater samples if the gloves contact the sample.

- Sampling personnel should use a new pair of disposable gloves for each well sampled to reduce the potential for exposure of the sampling personnel to contaminants and to reduce sample cross contamination. In addition, sampling personnel should change disposable gloves between purging and sampling operations at the same well.

- Sampling personnel should not use perfume, insect repellent, hand lotion, etc., when taking groundwater samples. If insect repellent must be used, then sampling personnel should not allow samples or sampling equipment to contact the repellent, and it should be noted in the documentation that insect repellent was used.

- Complete the documentation of the well. A completed assemblage of paperwork for a sampling event includes the completed field forms, entries in the Project Field Book (with a sewn binding), transportation documentation (if required), and possibly chain-of-custody forms.

ATTACHMENTS

Groundwater Well Purge & Sample Collection Log (sample)

REFERENCES

1. Wilson, Neal. *Soil Water and Ground Water Sampling*, 1995

TurnKey FOPs:

007	*Calibration and Maintenance of Portable Dissolved Oxygen Meter*
008	*Calibration and Maintenance of Portable Field pH/Eh Meter*
009	*Calibration and Maintenance of Portable Field Turbidity Meter*
011	*Calibration and Maintenance of Portable Photoionization Detector*
012	*Calibration and Maintenance of Portable Specific Conductance Meter*
022	*Groundwater Level Measurement*
023	*Groundwater Purging Procedures Prior to Sample Collection (optional)*
031	*Low Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedures (optional)*
040	*Non-Disposable and Non-Dedicated Sampling Equipment Decontamination*
046	*Sample Labeling, Storage and Shipment Procedures*

GROUNDWATER WELL
PURGE & SAMPLE COLLECTION LOG

Project Name: WELL NUMBER:

Project Number: Sample Matrix:

Client: Weather:

WELL DATA:

DATE:	TIME:
Casing Diameter (inches):	Casing Material:
Screened interval (fbTOR):	Screen Material:
Static Water Level (fbTOR):	Bottom Depth (fbTOR):
Elevation Top of Well Riser (fmsl):	Ground Surface Elevation (fmsl):
Elevation Top of Screen (fmsl):	Stick-up (feet):

PURGING DATA:

DATE:	START TIME:	END TIME:
Method:	Is purge equipement dedicated to sample location?	yes no
No. of Well Volumes Purged:	Was well purged to dryness?	yes no
Standing Volume (gallons):	Was well purged below top of sand pack?	yes no
Volume Purged (gallons):	Condition of Well:	
Purge Rate (gal/min):	Field Personnel:	

VOLUME CALCULATION:

(A) Total Depth of Well (fbTOR):	
(B) Casing Diameter (inches):	
(C) Static Water Level (fbTOR):	
One Well Volume (V, gallons): V = 0.0408 [$(B)^2$ x { (A) - (C) }]	

* Use the table to the right to calculate one well volume by subtracting C from A, then multiplying by the volume calculation in the table per well diamter.

Volume Calculation

Well Diameter	Volume gal/ft
1"	0.041
2"	0.163
3"	0.367
4"	0.653
5"	1.020
6"	1.469

Stabilization Criteria

Parameter	Criteria
pH	+/- 0.1 unit
SC	+/- 3%
Turbidity	+/- 10%
DO	+/- 0.3 mg/L
ORP	+/- 10 mV

EVACUATION STABILIZATION TEST DATA:

Time	Water Level (fbTOR)	Accumulated Volume (gallons)	pH (units)	Temperature (degrees C)	Specific Conductance (uS/cm)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	Initial	0.0							

SAMPLING DATA:

DATE:	START TIME:	END TIME:
Method:	Is sampling equipement dedicated to sample location?	yes no
Initial Water Level (fbTOR):	Was well sampled to dryness?	yes no
Final Water Level (fbTOR):	Was well sampled below top of sand pack?	yes no
Air Temperature (^{o}F):	Field Personnel:	

Source and type of water used in the field for QC purposes:

PHYSICAL & CHEMICAL DATA:

DESCRIPTION OF WATER SAMPLE	
Odor	
Color	
NAPL	
Contains Sediment?	yes no

WATER QUALITY MEASUREMENTS

Sample	Time	pH (units)	TEMP. (^{o}C)	SC (uS)	TURB. (NTU)	DO (ppm)	ORP (mV)
initial							
final							

REMARKS:

PREPARED BY:

SAMPLE

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Hollow Stem Auger (HSA) Drilling Procedures

HOLLOW STEM AUGER (HSA) DRILLING PROCEDURES

PURPOSE

This guideline presents a method for drilling a borehole through unconsolidated materials, including soils or overburden, and consolidated materials, including bedrock.

PROCEDURE

The following procedure will be used to drill a borehole for sampling and/or well installation, using hollow-stem auger methods and equipment.

1. Follow TurnKey's Field Operating Procedure for Drill Site Selection Procedure prior to implementing any drilling activity.
2. Perform drill rig safety checks with the driller by completing the Drilling Safety Checklist form (sample attached).
3. Conduct tailgate health and safety meeting with project team and drillers by completing the Tailgate Safety Meeting Form.
4. Calibrate air-monitoring equipment in accordance with the appropriate TurnKey's Field Operating Procedures or manufacturers recommendations for calibration of field meters.
5. Ensure all drilling equipment (i.e., augers, rods, split-spoons) appear clean and free of soil prior to initiating any subsurface intrusion. Decontamination of drilling equipment should be in accordance with TurnKey's FOP: Drilling and Excavation Equipment Decontamination Procedures.
6. Mobilize the auger rig to the site and into position.
7. Level and stabilize the rig using the rig jacks, and recheck the rig location against the planned drilling location. If necessary, raise the jacks and adjust the rig position.

8. Place a metal or plywood auger pan over the borehole location to collect the auger cuttings. This auger pan will be equipped with a 12-inch nominal diameter hole for auger passage. As an alternative, a piece of polyethylene tarp may be used as a substitute.

9. Advance augers into the subsurface. For sampling or pilot-hole drilling, nominal 8-inch outside diameter (OD) augers should be used. The boring diameter will be approved by the TurnKey field supervisor.

10. Collect soil samples via split spoon sampler in accordance with TurnKey's Field Operating Procedure for Split Spoon Sampling.

11. Check augers periodically during drilling to ensure the boring is plumb. Adjust rig position as necessary to maintain plumb.

12. Continue drilling until reaching the assigned total depth, or until auger refusal occurs. Auger refusal is when the drilling penetration drops below 0.1 feet per 10 minutes, with the full weight of the rig on the auger bit, and a center <u>bit</u> (not center plug) in place.

13. Plug and abandon boreholes not used for well installation in accordance with TurnKey's Field Operating Procedure for Abandonment of Borehole.

OTHER PROCEDURAL ISSUES

- Slip rings may be used for lifting a sampling or bit string. The string will not be permitted to extend more than 15 feet above the mast crown.

- Borings will not be over drilled (rat holed) without the express permission of the TurnKey field supervisor. All depth measurements should be accurate to the nearest 0.1 foot, to the extent practicable.

- Potable water may be placed in the auger stem if critically necessary for borehole control or to accomplish sampling objectives. This will be performed only with the express permission of the TurnKey field supervisor.

ATTACHMENTS

Drilling Safety Checklist (sample)
Tailgate Safety Meeting Form (sample)

REFERENCES

TurnKey FOPs:

001	*Abandonment of Borehole Procedures*
010	*Calibration and Maintenance of Portable Flame Ionization Detector*
011	*Calibration and Maintenance of Portable Photoionization Detector*
017	*Drill Site Selection Procedure*
018	*Drilling and Excavation Equipment Decontamination Procedures*
058	*Split Spoon Sampling Procedures*

DRILLING SAFETY CHECKLIST

Project:
Project No.:
Client:
Date:
Drilling Company:
Drill Rig Type:

ITEMS TO CHECK	OK	ACTION NEEDED
"Kill switches" installed by the manufacturer are in operable condition and all workers at the drill site are familiar with their location and how to activate them?		
"Kill switches" are accessible to workers on both sides of the rotating stem? NOTE: Optional based on location and number of switches provided by the manufacturer.		
Cables on drill rig are free of kinks, frayed wires, "bird cages" and worn or missing sections?		
Cables are terminated at the working end with a proper eye splice, either swaged Coupling or using cable clamps?		
Cable clamps are installed with the saddle on the live or load side? Clamps should not be alternated and should be of the correct size and number for the cable size to which it is installed. Clamps are complete with no missing parts?		
Hooks installed on hoist cables are the safety type with a functional latch to prevent accidental separation?		
Safety latches are functional and completely span the entire throat of the hook and have positive action to close the throat except when manually displaced for connecting or disconnecting a load?		
Drive shafts, belts, chain drives and universal joints shall be guarded to prevent accidental insertion of hands and fingers or tools.		
Outriggers shall be extended prior to and whenever the boom is raised off its cradle. Hydraulic outriggers must maintain pressure to continuously support and stabilize the drill rig even while unattended.		
Outriggers shall be properly supported on the ground surface to prevent settling into the soil.		
Controls are properly labeled and have freedom of movement? Controls should not be blocked or locked in an action position.		
Safeties on any device shall not be bypassed or neutralized.		
Controls shall be operated smoothly and cables and lifting devices shall not be jerked or operated erratically to overcome resistance.		
Slings, chokers and lifting devices are inspected before using and are in proper working order? Damaged units are removed from service and are properly tagged?		
Shackles and clevises are in proper working order and pins and screws are fully inserted before placing under a load?		
High-pressure hoses have a safety (chain, cable or strap) at each end of the hose section to prevent whipping in the event of a failure?		
Rotating parts of the drill string shall be free of sharp projections or hooks, which could entrap clothing or foreign objects?		

SAMPLE

DRILLING SAFETY CHECKLIST

Project: Date:

ITEMS TO CHECK	OK	ACTION NEEDED
Wire ropes should not be allowed to bend around sharp edges without cushion material.		
The exclusion zone is centered over the borehole and the radius is equal or greater than the boom height?		
The work area around the borehole shall be kept clear of trip hazards and walking surfaces should be free of slippery material.		
Workers shall not proceed higher than the drilling deck without a fall restraining device and must attach the device in a manner to restrict fall to less than 6 feet.		
A fire extinguisher of appropriate size shall be immediately available to the drill crew. The drill crew shall have received annual training on proper use of the fire extinguisher.		
29 CFR 1910.333 © (3) Except where electrical distribution and transmission lines have been de-energized and visibly grounded, drill rigs will be operated proximate to, under, by, or near power lines only in accordance with the following: .333 © (3) (ii) 50 kV or less -minimum clearance is 10 ft. For 50 kV or over - 10ft. Plus ½ in. For each additional kV **TurnKey Policy: Maintain 20 feet clearance**		
29 CFR 1910.333 © (3) (iii) While the rig is in transit with the boom in the down position, clearance from energized power lines will be maintained as follows: Less than 50 kV - 4 feet 50 to 365 kV - 10 feet 365 to 720 kV - 16 feet		

SAMPLE

Name: (printed)

Signed: Date:

TAILGATE SAFETY MEETING FORM

Project Name: Date: Time:
Project Number: Client:
Work Activities:

HOSPITAL INFORMATION:

Name:
Address: *City:* *State:* *Zip:*
Phone No.: *Ambulance Phone No.*

SAFETY TOPICS PRESENTED:

Chemical Hazards:

Physical Hazards: Slips, Trips, Falls

PERSONAL PROTECTIVE EQUIPMENT:

Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D

New Equipment:

Other Safety Topic (s): Environmental Hazards (aggressive fauna)
Eating, drinking, use of tobacco products is prohibited in the Exclusion Zone (EZ)

ATTENDEES

Name Printed	**Signatures**

Meeting conducted by:

SAMPLE

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Low-Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedure

FOP 031.0

LOW FLOW (MINIMAL DRAWDOWN) GROUNDWATER PURGING & SAMPLING PROCEDURES

PURPOSE

This procedure describes the methods used for performing low flow (minimal drawdown) purging, also referred to as micro-purging, at a well prior to groundwater sampling to obtain a representative sample from the water-bearing zone. This method of purging is used to minimize the turbidity of the produced water. This may increase the representativeness of the groundwater samples by avoiding the necessity of filtering suspended solids in the field prior to preservation of the sample.

Well purging is typically performed immediately preceding groundwater sampling. The sample should be collected as soon as the parameters measured in the field (i.e., pH, specific conductance, dissolved oxygen, Eh, temperature, and turbidity) have stabilized.

PROCEDURE

1. Water samples should not be taken immediately following well development. Sufficient time should be allowed to stabilize the groundwater flow regime in the vicinity of the monitoring well. This lag time will depend on site conditions and methods of installation but may exceed one week.

2. Prepare the electronic water level indicator (e-line) in accordance with the procedures referenced in the TurnKey's Groundwater Level Measurement FOP and decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the TurnKey's Non-disposable and Non-dedicated Sampling Equipment Decontamination FOP. Store the e-line in a protected area until use. This may include wrapping the e-line in clean plastic until the time of use.

3. Calibrate all sampling devices and monitoring equipment in accordance with manufacturer's recommendations, the site Quality Assurance Project Plan (QAPP) and/or Field Sampling Plan (FSP). Calibration of field

instrumentation should be followed as specified in TurnKey's Calibration and Maintenance FOP for each individual meter.

4. Inspect the well/piezometer for signs of vandalism or damage and record condition on the Groundwater Well Purge & Sample Collection Log form (sample attached). Specifically, inspect the integrity of the following: concrete surface seal, lock, protective casing and well cover, well casing and J-plug/cap. Report any irregular findings to the Project Manager.

5. Unlock and remove the well protective cap or cover and place on clean plastic to avoid introducing foreign material into the well.

6. Monitor the well for organic vapors using a PID, as per the Work Plan. If a reading of greater than 5 ppm is recorded, the well should be allowed to vent until levels drop below 5 ppm before proceeding with purging.

7. Lower the e-line probe slowly into the monitoring well and record the initial water level in accordance with the procedures referenced in TurnKey's Groundwater Level Measurement FOP. Refer to the construction diagram for the well to identify the screened depth.

8. Decontaminate all non-dedicated pump and tubing equipment following the procedures referenced in the TurnKey's Non-disposable and Non-dedicated Sampling Equipment Decontamination FOP.

9. Lower the purge pump or tubing (i.e., low-flow electrical submersible, peristaltic, etc.) slowly into the well until the pump/tubing intake is approximately in the middle of the screened interval. Rapid insertion of the pump will increase the turbidity of well water, and can increase the required purge time. This step can be eliminated if dedicated tubing is already within the well.

   Placement of the pump close to the bottom of the well will cause increased entrainment of solids, which may have settled in the well over time. Low-flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval. The objective of low-flow purging is to maintain a purging rate, which minimizes stress (drawdown) of the water level in the well. Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen.

10. Lower the e-line back down the well as water levels will be frequently monitored during purge and sample activities.

11. Begin pumping to purge the well. The pumping rate should be between 100 and 500 milliliters (ml) per minute (0.03 to 0.13 gallons per minute) depending on site hydrogeology. Periodically check the well water level with the e-line adjusting the flow rate as necessary to stabilize drawdown within the well. If possible, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 feet or less). If the water level exceeds 2 feet below static and declining, slow the purge rate until the water level generally stabilizes. Record each pumping rate and water level during the event.

    The low flow rate determined during purging will be maintained during the collection of analytical samples. At some sites where geologic heterogeneities are sufficiently different within the screened interval, high conductivity zones may be preferentially sampled.

12. Measure and record field parameters (pH, specific conductance, Eh, dissolved oxygen (DO), temperature, and turbidity) during purging activities. In lieu of measuring all of the parameters, a minimum subset could be limited to pH, specific conductance, and turbidity or DO.

    Water quality indicator parameters should be used to determine purging needs prior to sample collection in each well. Stabilization of indicator parameters should be used to determine when formation water is first encountered during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by Eh, DO and turbidity. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. An in-line flow through cell to continuously measure the above parameters may be used. The in-line device should be disconnected or bypassed during sample collection.

13. Purging will continue until parameters of water quality have stabilized. Record measurements for field indicator parameters (including water levels) at regular intervals during purging. The stability of these parameters with time can be used to guide the decision to discontinue purging. Proper adjustments must be made to stabilize the flow rate as soon as possible.

14. Record well purging and sampling data in the Project Field Book or on the attached Groundwater Well Purge & Sample Collection Log (sample attached). Measurements should be taken approximately every three to five minutes, or as merited given the rapidity of change.

15. Purging is complete when field indicator parameters stabilize. Stabilization is achieved after all field parameters have stabilized for three successive readings. Three successive readings should be within ± 0.1 units for pH, ± 3% for specific conductance, ± 10 mV for Eh, and ± 10% for turbidity and dissolved oxygen. These stabilization guidelines are provided for rough estimates only, actual site-specific knowledge may be used to adjust these requirements higher or lower.

    An in-line water quality measurement device (e.g., flow-through cell) should be used to establish the stabilization time for several field parameters on a well-specific basis. Data on pumping rate, drawdown and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

16. Collect all project-required samples from the discharge tubing at the flow rate established during purging in accordance with TurnKey's Groundwater Sample Collection Procedures FOP. **If a peristaltic pump and dedicated tubing is used, collect all project-required samples from the discharge tubing as stated before, however volatile organic compounds should be collected in accordance with the procedure presented in the next**

section. Continue to maintain a constant flow rate such that the water level is not drawn down as described above. Fill sample containers with minimal turbulence by allowing the ground water to flow from the tubing along the inside walls of the container.

17. If field filtration is recommended as a result of increased turbidity, an in-line filter equipped with a 0.45-micron filter should be utilized.
18. Replace the dedicated tubing down the well taking care to avoid contact with the ground surface.
19. Restore the well to its capped/covered and locked condition.
20. Upon purge and sample collection completion, slowly lower the e-line to the bottom of the well/piezometer. Record the total depth to the nearest 0.01-foot and compare to the previous total depth measurement. If a significant discrepancy exists, re-measure the total depth. Record observations of purge water to determine whether the well/piezometer had become silted due to inactivity or damaged (i.e., well sand within purge water). Upon confirmation of the new total depth and determination of the cause (i.e., siltation or damage), notify the Project Manager following project field activities.

PERISTALTIC PUMP VOC SAMPLE COLLECTION PROCEDURE

The collection of VOCs from a peristaltic pump and dedicated tubing assembly shall be collected using the following procedure.

1. Once all other required sample containers have been filled, turn off the peristaltic pump. The negative pressure effects of the pump head have not altered groundwater remaining within the dedicated tubing assembly and as such, this groundwater can be collected for VOC analysis.
2. While maintaining the pressure on the flexible tubing within the pump head assembly, carefully remove and coil the polyethylene tubing from the well; taking care to prevent the tubing from coming in contact with the ground

surface and without allowing groundwater to escape or drain from the tubing intake.

3. Once the polyethylene tubing is removed, turn the variable speed control to zero and reverse the pump direction.

4. Slowly increase the pump rate allowing the groundwater within the polyethylene tubing to be "pushed" out of the intake end (i.e., positive displacement) making sure the groundwater within the tubing is not "pulled" through the original discharge end (i.e., negative displacement). Groundwater pulled through the pump head assembly CANNOT be collected for VOC analysis.

5. Slowly fill each VOC vial by holding the vial at a 45-degree angle and allowing the flowing groundwater to cascade down the side until the vial is filled with as minimal disturbance as possible. As the vial fills, slowly rotate the vial to vertical. **DO NOT OVERFILL THE VIAL, AS THE PRESERVATIVE WILL BE LOST.** The vial should be filled only enough so that the water creates a slight meniscus at the vial mouth.

6. Cap the VOC vials leaving no visible headspace (i.e., air-bubbles). Gently tap each vial against your hand checking for air bubbles.

7. If an air bubble is observed, slowly remove the cap and repeat Steps 5 and 6.

ATTACHMENTS

Groundwater Well Purge & Sample Collection Log (sample)

REFERENCES

United States Environmental Protection Agency, 540/S-95/504, 1995. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.*

TurnKey FOPs:

007	*Calibration and Maintenance of Portable Dissolved Oxygen Meter*
008	*Calibration and Maintenance of Portable Field pH/Eh Meter*
009	*Calibration and Maintenance of Portable Field Turbidity Meter*
011	*Calibration and Maintenance of Portable Photoionization Detector*
012	*Calibration and Maintenance of Portable Specific Conductance Meter*
022	*Groundwater Level Measurement*
024	*Groundwater Sample Collection Procedures*
040	*Non-Disposable and Non-Dedicated Sampling Equipment Decontamination*
046	*Sample Labeling, Storage and Shipment Procedures*

LOW FLOW METHOD GROUNDWATER PURGE & SAMPLE COLLECTION LOG

Project Name:	WELL LOCATION:
Project Number:	Sample Matrix: groundwater
Client:	Weather:

WELL DATA:

DATE:	TIME:
Casing Diameter (inches):	Casing Material:
Screened interval (fbTOR):	Screen Material:
Static Water Level (fbTOR):	Bottom Depth (fbTOR):
Elevation Top of Well Riser (fmsl):	Ground Surface Elevation (fmsl):
Elevation Top of Screen (fmsl):	Stick-up (feet):
Standing volume in gallons: [(bottom depth - static water level) x vol calculation in table per well diameter]:	

Volume Calculation

Well Diameter	Volume gal/ft
1"	0.041
2"	0.163
3"	0.367
4"	0.653
5"	1.020
6"	1.469

PURGING DATA:

Pump Type:

Is equipment dedicated to location? yes no	Is tubing dedicated to location? yes no
Depth of Sample (i.e. Level of Intake) (fbTOR):	Approximate Purge Rate (gal/min):

Time	Water Level (fbTOR)	Accumulated Volume (gallons)	pH (units)	Temperature (degrees C)	Specific Conductance (μS/cm)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	Initial								

SAMPLING DATA:

DATE:	START TIME:	END TIME:

Method: low-flow with dedicated tubing	Was well sampled to dryness? yes no
Initial Water Level (fbTOR):	Was well sampled below top of sand pack? yes no
Final Water Level (fbTOR):	Field Personnel:

PHYSICAL & CHEMICAL DATA:

Appearance:

Color:

Odor:

Sediment Present?

WATER QUALITY MEASUREMENTS

pH (units)	TEMP. (°C)	SC (uS)	TURB. (NTU)	DO (ppm)	ORP (mV)

REMARKS:

PREPARED BY:

SAMPLE

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Management of Investigation-Derived Waste (IDW)

MANAGEMENT OF INVESTIGATION-DERIVED WASTE (IDW)

PURPOSE

The purpose of these guidelines is to ensure the proper holding, storage, transportation, and disposal of materials generated from field investigation activities that may contain hazardous wastes. Investigation-derived waste (IDW) include the following:

- Drill cuttings, discarded soil samples, drilling mud solids, and used sample containers.
- Well development and purge waters and discarded groundwater samples.
- Decontamination waters and associated solids.
- Soiled disposable personal protective equipment (PPE).
- Used disposable sampling equipment.
- Used plastic sheeting and aluminum foil.
- Other equipment or materials that either contain or have been in contact with potentially impacted environmental media.

Because these materials may contain regulated chemical constituents, they must be managed as a solid waste. This management may be terminated if characterization analytical results indicate the absence of these constituents.

PROCEDURE

1. Contain all investigation-derived wastes in Department of Transportation (DOT)-approved 55-gallon drums, roll-off boxes, or other containers suitable for the wastes.

2. Contain wastes from separate borings or wells in separate containers (i.e. do not combine wastes from several borings/wells in a single container, unless it is a container used specifically for transfer purposes, or unless specific permission to do so has been provided by the TurnKey Field Team Leader. Unused samples from surface sample locations within a given area may be combined.

3. To the extent practicable, separate solids from drilling muds, decontamination waters, and similar liquids. Place solids within separate containers.

4. Transfer all waste containers to a staging area. Access to this area will be controlled. Waste containers must be transferred to the staging area as soon as practicable after the generating activity is complete.

5. Pending transfer, all containers will be covered and secured when not immediately attended.

6. Label all containers with regard to contents, origin, date of generation, using TurnKey's IDW container label (sample attached). Use indelible ink for all labeling.

7. Complete the Investigative Derived Waste Container Log (sample attached) as waste containers are labeled in order to track and inventory project waste. Leave a copy of the log with the site manager or fax copy to the owner/operator as necessary.

8. Collect samples for waste characterization purposes, or use boring/well sample analytical data for characterization.

9. For wastes determined to be hazardous in character, **be aware of accumulation time limitations**. Coordinate the disposal of these wastes with the plant manager/owner/operator, if applicable.

10. Dispose of investigation-derived wastes as follows:
    - Soil, water, and other environmental media for which analysis does not detect organic constituents, and for which inorganic constituents are at

levels consistent with background, may be spread on the Property or otherwise treated as a non-waste material as directed by the plant manager/owner/operator or Project Manager.

- Soils, water, and other environmental media in which organic compounds are detected or metals are present above background will be disposed as industrial waste. Alternate disposition must be consistent with applicable State and Federal laws.
- Personal protective equipment, disposable bailers, and similar equipment may be disposed as municipal waste, unless waste characterization results mandate disposal as industrial wastes.

WASTE STORAGE MANAGEMENT

Hazardous materials generated on site should be temporarily stored in a secure location that is under the control of the owner/operator or does not allow for vandalism (i.e., within a locked building structure or within a locked fenced in area). A waste-staging area should be designated on-site by the Project Manager in conjunction with the owner/operator.

ATTACHMENTS

Investigation Derived Waste Container Log (sample)
Investigation Derived Waste Container Label (sample)

REFERENCES

None

INVESTIGATION DERIVED WASTE CONTAINER LOG

Project Name:

Location:

Project Number:

Personnel:

Container		Contents	Date		Staging Location	Date Sampled	Comments
Number	Description		Started	Ended			

SAMPLE

Prepared By:

Signed:

IDW Container Label (sample):

TurnKey
Environmental
Restoration, LLC

Project Name:
Project Number:

Container I.D.:
Contents/Matrix:
Estimated Quantity:
Date of Generation:
Date of Sample Collection:

Contact Name:
Contact Phone Number:

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Monitoring Well Construction for Hollow Stem Auger Boreholes

FOP 033.0

MONITORING WELL CONSTRUCTION FOR HOLLOW STEM AUGER BOREHOLES

PURPOSE

Wells will be installed within selected boreholes for the purpose of evaluating groundwater characteristics. Well installation procedures depend upon the drilling method. This procedure describes well construction and installation for boreholes drilled using the hollow stem auger method. Refer to the TurnKey's Hollow Stem Auger Drilling Procedures FOP. Nominal dimensions and materials for the well are shown in the attached well construction diagram.

PROCEDURE

1. Advance borehole in accordance with the TurnKey's Hollow Stem Auger Drilling Procedure FOP to the required depth. The nominal inside diameter (ID) of the auger stem used should be at least 2 inches larger than the outside diameter (OD) of the riser and screen selected for the well installation. Record the monitoring well construction on the Field Borehole/Monitoring Well Installation Log (sample attached) (see Documentation Requirements for Drilling and Well Installation FOP).

2. Remove the drill rods and center bit/plug from the auger stem and verify borehole depth using weighted measuring tape.

3. In the event of an over drill (i.e. borehole depth is more than one foot greater than desired base of screen depth), use bentonite chips poured through the auger stem to seal the over drilled portion of the borehole. Be sure to note bentonite chip thickness on Field Borehole/Monitoring Well Installation Log.

4. Add a maximum of 6 inches of filter pack material through the auger stem to the base of the borehole. (Note: This step may be avoided if dense non-aqueous phase liquids are suspected to be present and it is desirable to have the screen and/or sump at the base of the borehole.)

5. Measure the length of the well string (i.e. riser and screen), and lower the well string into the well assembly to the desired depth. All measurements during the well installation process will be accurate to 0.1 foot.

6. Surface pour filter pack material into the annulus between the well and the auger stem as the augers are gradually withdrawn from the borehole. Use a weighted tape to confirm that the level of sand is maintained within the augers at all times. Record material volumes used.

7. After filter pack materials are brought to the required level, surface pour bentonite chips or pellets into the annulus between the well and the auger stem to form the filter pack seal. If necessary to avoid bridging, delayed hydration (coated) pellets may be used. Record the volume of material used.

8. Allow the bentonite chips/pellets to adequately hydrate for approximately 30 to 45-minutes. Cap or cover the well top of riser.

9. Mix cement/bentonite grout to a smooth consistency using a centrifugal or reciprocating pump. Do not hand mix. All water used must be potable quality. Record the volume of water used.

10. Fill the remaining annulus between the well and the auger stem with grout by surface pouring or pumping, and begin withdrawal of the auger string. Periodically top the auger string off with additional grout. If groundwater is present within the annulus above the bentonite chip/pellet seal, cement/bentonite grout will be pressure tremie grouted from bottom to top in order to displace groundwater from the borehole.

11. When the auger string is withdrawn, center the upper portion of the well riser within the borehole, and place drums or barricades around the well for protection while the grout cures. Place and lock a security cap (i.e., J-plug) in the opening of the well riser.

12. Leave the well undisturbed for at least 24 hours to allow the grout to cure. If excessive grout fallback occurs, top off as necessary with bentonite chips or additional grout.

13. Construct the surface completion as shown in the attached Typical Monitoring Well Detail (Figure 1). Select flush completions for all locations in active operational or high traffic areas, or in other areas where an above grade completion would be undesirable. Use aboveground completions in all other areas.

14. Place a dedicated lock on the well or protective casing, and keep well locked when not actively attended.

15. Permanently label the well with the appropriate well identifier as determined by the Project Manager or specified in the Work Plan.

16. Permanently mark a survey location on the north side at the top of the casing with a saw cut. Survey all wells for horizontal location and elevation, using a surveyor licensed by the State of New York. Coordinates and elevations will be provided in a coordinate system consistent with previous well surveys at the Site. Information obtained will include location (x and y) of the well, and elevation (z) of the ground surface, the pad, and the top of riser.

17. Develop the well as described in the TurnKey's Field Operating Procedure for Monitoring Well Development.

18. Manage all waste materials generated during well installation and development as described in the TurnKey's Field Operating Procedure for Management of Investigation Derived Waste.

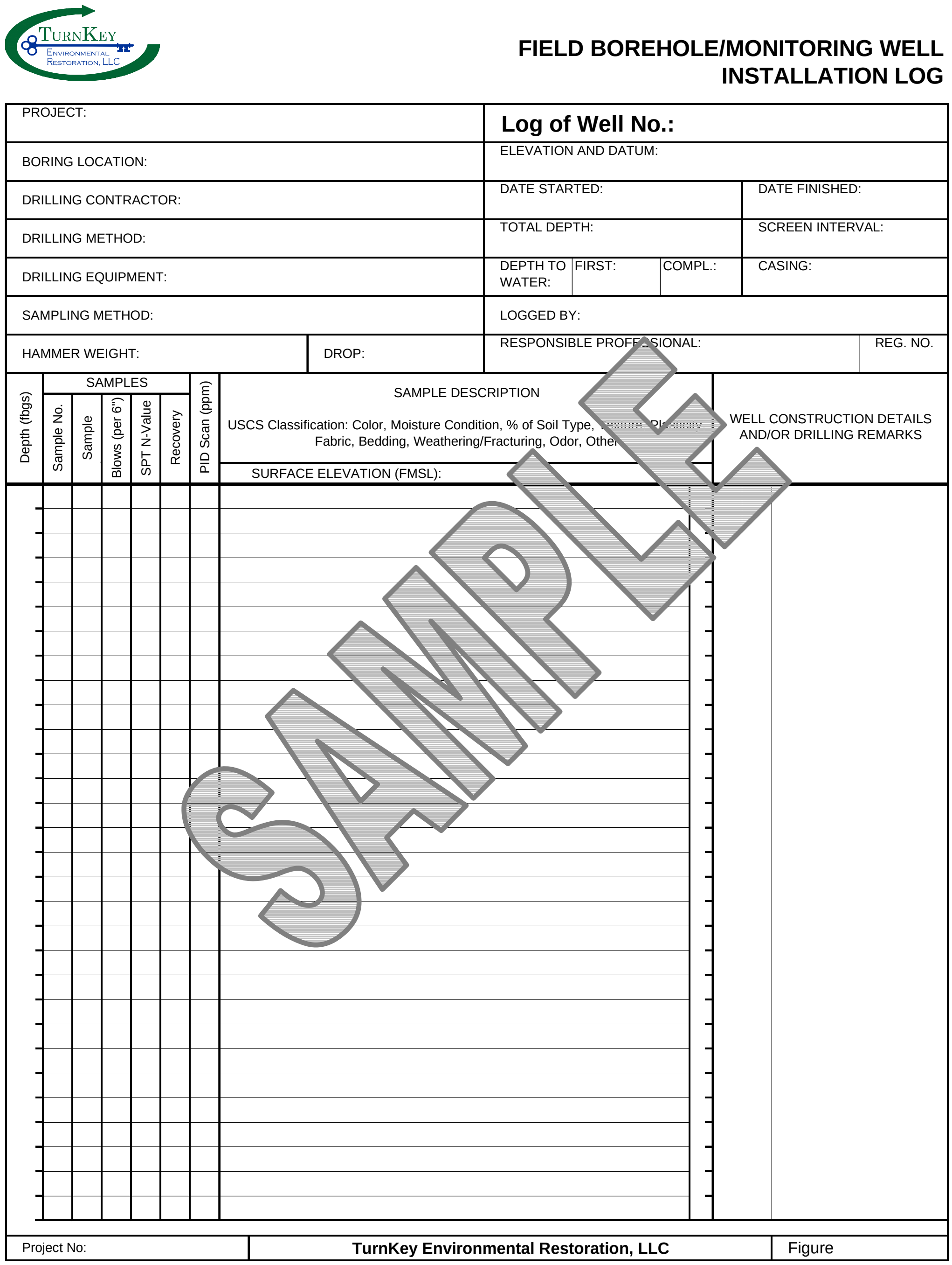
ATTACHMENTS

Field Borehole/Monitoring Well Installation Log (sample)
Typical Monitoring Well Detail (Figure 1)

REFERENCES

TurnKey FOPs:

015 Documentation Requirements for Drilling and Well Installation
026 Hollow Stem Auger Drilling Procedures
032 Management of Investigation Derived Waste
036 Monitoring Well Development Procedures



FIELD BOREHOLE/MONITORING WELL INSTALLATION LOG

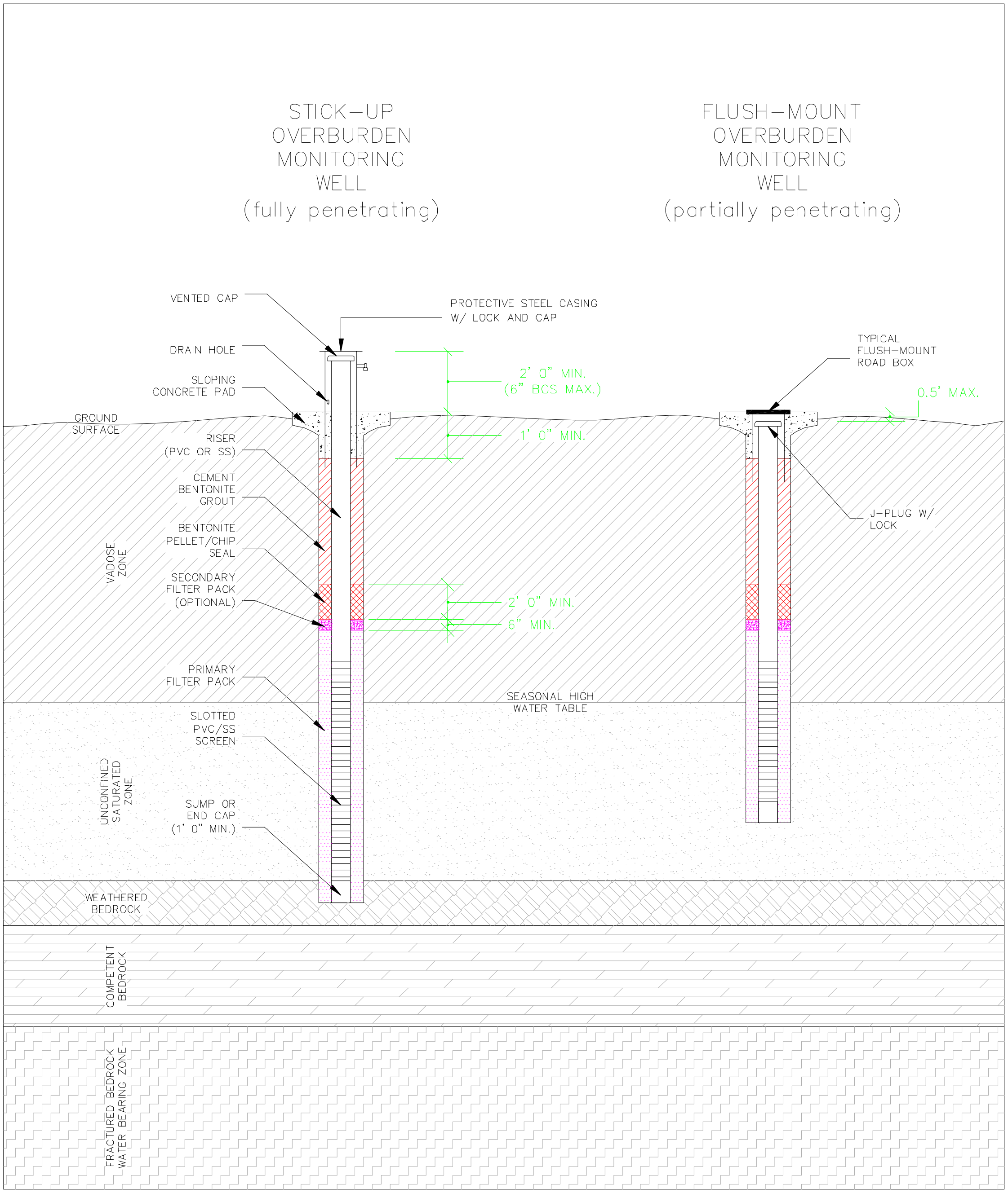
PROJECT:		**Log of Well No.:**		
BORING LOCATION:		ELEVATION AND DATUM:		
DRILLING CONTRACTOR:		DATE STARTED:		DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:		SCREEN INTERVAL:
DRILLING EQUIPMENT:		DEPTH TO WATER:	FIRST: COMPL.:	CASING:
SAMPLING METHOD:		LOGGED BY:		
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:		REG. NO.

Depth (fbgs)	SAMPLES					PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery			

Project No:	**TurnKey Environmental Restoration, LLC**	Figure

SAMPLE

FIGURE 1


STICK–UP OVERBURDEN MONITORING WELL (fully penetrating)
FLUSH–MOUNT OVERBURDEN MONITORING WELL (partially penetrating)
VENTED CAP
PROTECTIVE STEEL CASING W/ LOCK AND CAP
DRAIN HOLE
SLOPING CONCRETE PAD
GROUND SURFACE
2' 0" MIN. (6" BGS MAX.)
1' 0" MIN.
TYPICAL FLUSH–MOUNT ROAD BOX
0.5' MAX.
RISER (PVC OR SS)
CEMENT BENTONITE GROUT
BENTONITE PELLET/CHIP SEAL
SECONDARY FILTER PACK (OPTIONAL)
J–PLUG W/ LOCK
2' 0" MIN.
6" MIN.
VADOSE ZONE
PRIMARY FILTER PACK
SEASONAL HIGH WATER TABLE
SLOTTED PVC/SS SCREEN
UNCONFINED SATURATED ZONE
SUMP OR END CAP (1' 0" MIN.)
WEATHERED BEDROCK
COMPETENT BEDROCK
FRACTURED BEDROCK WATER BEARING ZONE

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Monitoring Well Development Procedures

FOP 036.0

MONITORING WELL DEVELOPMENT PROCEDURES

PURPOSE

This procedure describes the methods for the development of newly installed monitoring wells and re-development of existing monitoring wells that have been inactive for an extended period of time (i.e., one year or more). Monitoring wells are developed after installation in order to remove introduced water and drilling fluids, reduce the turbidity of the water, and improve the hydraulic communication between the well and the water-bearing formation. Well development will not commence until the annular grout seal has cured, but will be performed within ten calendar days of well installation.

PROCEDURE

1. All well development will include surge blocking or false bailing with one or more of the following fluid removal methods. Well development activities may include:
    - Bailing
    - Air Lifting
    - Submersible Pumping
    - Other methods as approved by the TurnKey Field Team Leader.
    - The appropriate water removal method will be selected based on water level depth and anticipated well productivity.
2. Assemble and decontaminate equipment (if necessary), and place in the well. Reference the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.
3. Alternate the use of agitation methods with water removal methods, using the former to suspend solids in the well water, and the latter to remove the turbid water. For example, use a vented surge block to agitate the well, moving up and down within the screened interval and then use a pump to clear the well. A bailer may be used for both purposes, by surging with the bailer (false

bailing) for a period within the screened interval, then bailing a volume of water from the well.

4. When using surging methods, initiate this activity gradually, with short (2 to 3 feet) strokes. After several passes across the screened interval, increase the speed and length of the surge strokes.

5. Continue development until the following objectives are achieved:

   - Field parameters stabilize to the following criteria:
     - Dissolved Oxygen: ± 0.3 mg/L
     - Turbidity: ± 10%
     - Specific Conductance: ± 3%
     - ORP: ± 10 mV
     - pH: ± 0.1 units
   - The well will generate non-turbid water during continued pumping typically less than 50 NTU.
   - A minimum of 10 well volumes has been evacuated from the well.
   - In the case of lost water during drilling activities, the volume of water removed exceeds twice the volume of water lost to the formation during the drilling process, as indicated by the water balance.

6. Document the development methods, volumes, field parameter measurements, and other observations on the attached Groundwater Well Development Log (sample attached).

ATTACHMENTS

Groundwater Well Development Log (sample)

REFERENCES

<u>TurnKey FOPs:</u>

040 Non-Disposable and Non-Dedicated Sampling Equipment Decontamination

GROUNDWATER WELL DEVELOPMENT LOG

Project Name:	WELL NUMBER:
Project Number:	Sample Matrix:
Client:	Weather:

WELL DATA:

DATE:	TIME:
Casing Diameter (inches):	Casing Material:
Screened interval (fbTOR):	Screen Material:
Static Water Level (fbTOR):	Bottom Depth (fbTOR):
Elevation Top of Well Riser (fmsl):	Datum Ground Surface: Mean Sea Level
Elevation Top of Screen (fmsl):	Stick-up (feet):

PURGING DATA:

DATE:	START TIME:	END TIME:

VOLUME CALCULATION:

(A) Total Depth of Well (fbTOR):	
(B) Casing Diameter (inches):	
(C) Static Water Level (fbTOR):	
One Well Volume (V, gallons): $V = 0.0408\ [\ (B)^2\ \ x\ \{\ (A) - (C)\ \}\ ]$	

*Use the table to the right to calculate one well volume.

Field Personnel:

Volume Calculation

Well Diameter	Volume gal/ft
1"	0.041
2"	0.163
3"	0.367
4"	0.653
5"	1.020
6"	1.469
8"	2.611

Stabilization Criteria

Parameter	Criteria
DO	+/- 0.3 mg/L
Turbidity	+/- 10%
SC	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

EVACUATION STABILIZATION TEST DATA:

Time	Water Level (fbTOR)	Accumulated Volume (gallons)	pH (units)	Temperature (degrees C)	Specific Conductance (mS/cm)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor

REMARKS:

PREPARED BY:

SAMPLE

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Non-Disposable and Non-Dedicated Sampling Equipment Decontamination

FOP 040.0

NON-DISPOSABLE AND NON-DEDICATED SAMPLING EQUIPMENT DECONTAMINATION

PURPOSE

This procedure is to be used for the decontamination of non-disposable and non-dedicated equipment used in the collection of environmental samples. The purpose of this procedure is to remove chemical constituents from previous samples from the sampling equipment. This prevents these constituents from being transferred to later samples, or being transported out of controlled areas.

HEALTH AND SAFETY

Nitric acid is a strong oxidizing agent as well as being extremely corrosive to the skin and eyes. Solvents such as acetone, methanol, hexane and isopropanol are flammable liquids. Limited contact with skin can cause irritation, while prolonged contact may result in dermatitis. Eye contact with the solvents may cause irritation or temporary corneal damage. Safety glasses with protective side shields, neoprene or nitrile gloves and long-sleeve protective clothing must be worn whenever acids and solvents are being used.

PROCEDURE – GENERAL EQUIPMENT

Bailers, split-spoons, steel or brass split-spoon liners, Shelby tubes, submersible pumps, soil sampling knives, and similar equipment will be decontaminated as described below.

1. Wash equipment thoroughly with non-phosphate detergent and potable-quality water, using a brush where possible to remove any particulate matter or surface film. If the sampler is visibly coated with tars or other phase-separated hydrocarbons, pre-wash with acetone or isopropanol, or by steam cleaning. Decontamination will adhere to the following procedure:

   a. Rinse with potable-quality water;
   b. If the sampling equipment is very oily and use of a solvent is necessary, rinse with pesticide-grade isopropanol.
   c. Rinse with potable-quality water;
   d. Rinse with deionized water demonstrated analyte-free, such as distilled water;
   e. Air dry; and
   f. Store in a clean area or wrap in aluminum foil (shiny side out) or new plastic sheeting as necessary to ensure cleanliness.

2. All non-dedicated well evacuation equipment, such as submersible pumps and bailers, which are put into the well, must be decontaminated following the procedures listed above. All evacuation tubing must be dedicated to individual wells (i.e., tubing cannot be reused). However, if submersible pump discharge tubing must be reused, the tubing and associated sample valves or flow-through cells used in well purging or pumping tests will be decontaminated as described below:

   a. Pump a mixture of potable water and a non-phosphate detergent through the tubing, sample valves and flow cells, using the submersible pump.
   b. Steam clean or detergent wash the exterior of the tubing, sample valves, flow cells and pump.
   c. Pump potable water through the tubing, sample valve, and flow cell until no indications of detergent (e.g. foaming) are observed.
   d. Double rinse the exterior of the tubing with potable water.

e. Rinse the exterior of the tubing with distilled water.

f. Store in a clean area or wrap the pump and tubing assembly in new plastic sheeting as necessary to ensure cleanliness until ready for use.

3. All unused sample bottles and sampling equipment must be maintained in such a manner that there is no possibility of casual contamination.

4. Manage all waste materials generated during decontamination procedures as described in the TurnKey's Field Operating Procedure for Management of Investigation Derived Waste.

PROCEDURE – SUBMERSIBLE PUMPS

Submersible pumps used in well purging or purging tests will be decontaminated thoroughly each day before use as well as between well locations as described below:

Daily Decontamination Procedure:

1. Pre-rinse: Operate the pump in a basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

2. Wash: Operate the pump in 8 to 10 gallons of non-phosphate detergent solution (i.e., Alconox) for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes.

3. Rinse: Operate the pump in a basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

4. Disassemble pump.

5. Wash pump parts with a non-phosphate detergent solution (i.e., Alconox). Scrub all pump parts with a test tube brush or similar device.

6. Rinse pump with potable water.

7. Rinse the inlet screen, the shaft, the suction interconnection, the motor lead assembly, and the stator housing with distilled/deionized water.

8. Rinse the impeller assembly with 1% nitric acid (HNO_3).

9. Rinse the impeller assembly with isopropanol.

10. Rinse the impeller assembly with distilled/deionized water.

Between Wells Decontamination Procedure:

1. Pre-rinse: Operate the pump in a basin containing 8 to 10 gallons of potable water for 5 minutes.

2. Wash: Operate the pump in 8 to 10 gallons of non-phosphate detergent solution (i.e., Alconox) for 5 minutes.

3. Rinse: Operate the pump in a basin of potable water for 5 minutes.

4. Final rinse the pump in distilled/deionized water.

ATTACHMENTS

None

REFERENCES

TurnKey FOPs:
032 Management of Investigation-Derived Waste

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Overburden Casing Installation Procedure

FOP 041.0

OVERBURDEN CASING INSTALLATION PRCEDURES

PURPOSE

This guideline presents a method for the installation of casing to prevent downhole contamination of hazardous compounds from shallow overburden material. This method is particularly applicable where contaminated strata overlie uncontaminated strata of lower permeability. The method can be used with hollow stem auger drilling or rotary wash drilling (where temporary casing is used). This guideline also presents a method for the evaluation of the integrity of the grout seal around an overburden casing, which has been positioned into a confining layer.

CASING INSTALLATION PROCEDURE

1. Advance boring by appropriate drilling methods, through the contaminated strata a short distance (1 to 2 feet) into an underlying lower permeable unit.

2. Calculate the volume of the borehole base on the bit/auger head or steel casing diameter plus 10% and determine the volume of grout to be emplaced. Generally, the total mixed volume is the borehole volume plus 20%.

3. Identify the equipment to be used for the preparation and mixing of the grout. Ensure the volume of the tanks to be used for mixing has been measured adequately. Document these volumes on the Field Borehole/Monitoring Well Installation Log (sample attached).

4. Identify the source of the water to be used for the grout and determine its suitability for use. In particular, water with high sulfate, or chloride levels or heated water should not be used. These types of waters can cause operational difficulties or modify the set-up for the grout.

5. Identify the equipment to be used for emplacing the grout. Ensure that the pump to be used has adequate pressure to enable complete return to surface.

6. Identify the volumes to be pumped at each stage or in total if only one stage is to be used.

7. Begin mixing the grout to be emplaced. Grout specifications generally have mixture ratios as follows:

   Grout Slurry Composition (% Weight)

1.5 to 3.0%	-	Bentonite (Quick Gel)
40 to 60 %	-	Cement (Portland Type I)
40 to 60 %	-	Potable Water

8. Record the type and amount of materials used during the mixing operation. Ensure the ratios are within specifications tolerance.

9. Begin pumping the grout through the return line bypass system to confirm all pump and surface fittings are secure.

10. Remove drill rods and center plug (or clean out temporary casing) and insert a tremie pipe to the bottom of the boring. Pump the cement/bentonite grout slurry through the tremie pipe until grout return is observed at grade and no bridging of the slurry is evident. Slowly withdraw the augers (or casing) from the boring while maintaining the grout level at grade. Record the times and volumes emplaced on the Field Borehole/Monitoring Well Installation Log (sample attached).

11. Document the return circulation of grout. This may be facilitated by using a colored dye or other tagging method if a mudded borehole condition exists prior to grout injection.

12. Place a drillable plug (preferably untreated wood) at the downhole end of black steel or other appropriate casing, insert the casing through the slurry, and seat it into the underlying formation.

13. Allow grout to set for 24 to 48 hours.

HYDROSTATIC TESTING OF CASING PROCEDURE

1. Following adequate setting time for the grout, drill through the grout inside the casing until the top of the confining layer has been reached (refer to Field Borehole/Monitoring Well Installation Log during casing installation).

2. Fill the casing with potable water and measure the water level within the casing with a water level indicator to the nearest 0.01-foot and record the measurement on the Pipe Leakage Testing Log (sample attached).

3. Monitor the water level for 30 minutes and record the final water level within the casing with a water level indicator to the nearest 0.01-foot and record the measurement on the Pipe Leakage Testing Log (sample attached).

4. Should the water level drop more than the allowable volume calculated using the following equation, the seal shall be regrouted at the Subcontractor's expense.

   $Q_{(allowable)} = 2.75\ DKH$

   Where:
   $Q_{(allowable)}$ = Flow rate during a 30 minute test
   D = Inside diameter of overburden casing
   K = Confining layer hydraulic conductivity (see Table 1)
   H = Head of water applied

   Note: Be sure to use consistent units of measure.

ATTACHMENTS

Field Borehole/Monitoring Well Installation Log (sample)
Pipe Leakage Testing Log (sample)

Table 1 – Range of Values of Hydraulic Conductivity and Permeability

REFERENCES

Freeze, R.A. and J.A. Cherry. 1979. *Groundwater*. Prentice-Hall, Inc., Englewood, New Jersey, 604 p.

TurnKey FOPs:
018 Drilling and Excavation Equipment Decontamination Protocols

TurnKey Environmental Restoration, LLC

FIELD GEOPROBE BOREHOLE \ TEMPORARY WELL INSTALLATION LOG

PROJECT:	**Log of Temp. Well No.:**		
BORING LOCATION:	ELEVATION AND DATUM:		
DRILLING CONTRACTOR:	DATE STARTED:		DATE FINISHED:
DRILLING METHOD:	TOTAL DEPTH:		SCREEN INTERVAL:
DRILLING EQUIPMENT:	DEPTH TO WATER:	FIRST: / COMPL.:	CASING:
SAMPLING METHOD:	LOGGED BY:		
HAMMER WEIGHT: / DROP:	RESPONSIBLE PROFESSIONAL:		REG. NO.

Depth (fbgs)	SAMPLES					PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery			

Project No:	**TurnKey Environmental Restoration, LLC**	Figure

SAMPLE

PIPE LEAKAGE TESTING LOG

Project: Location:

Client: Date:

Job No: Personnel:

Location Description	Test Procedure (Air or Hydrostatic)	QC Initials	Readings				Elapsed Time (minutes)	Change in Pressure/ Water Level (psi/fbMP)	Pass/Fail	Passing Retest Date	Comments/Notes
			Start		End						
			Pressure or Water Level	Time	Pressure or Water Level	Time					

SAMPLE

Prepared By: Date:

TABLE 1: (From Freeze and Cherry, page 29.)

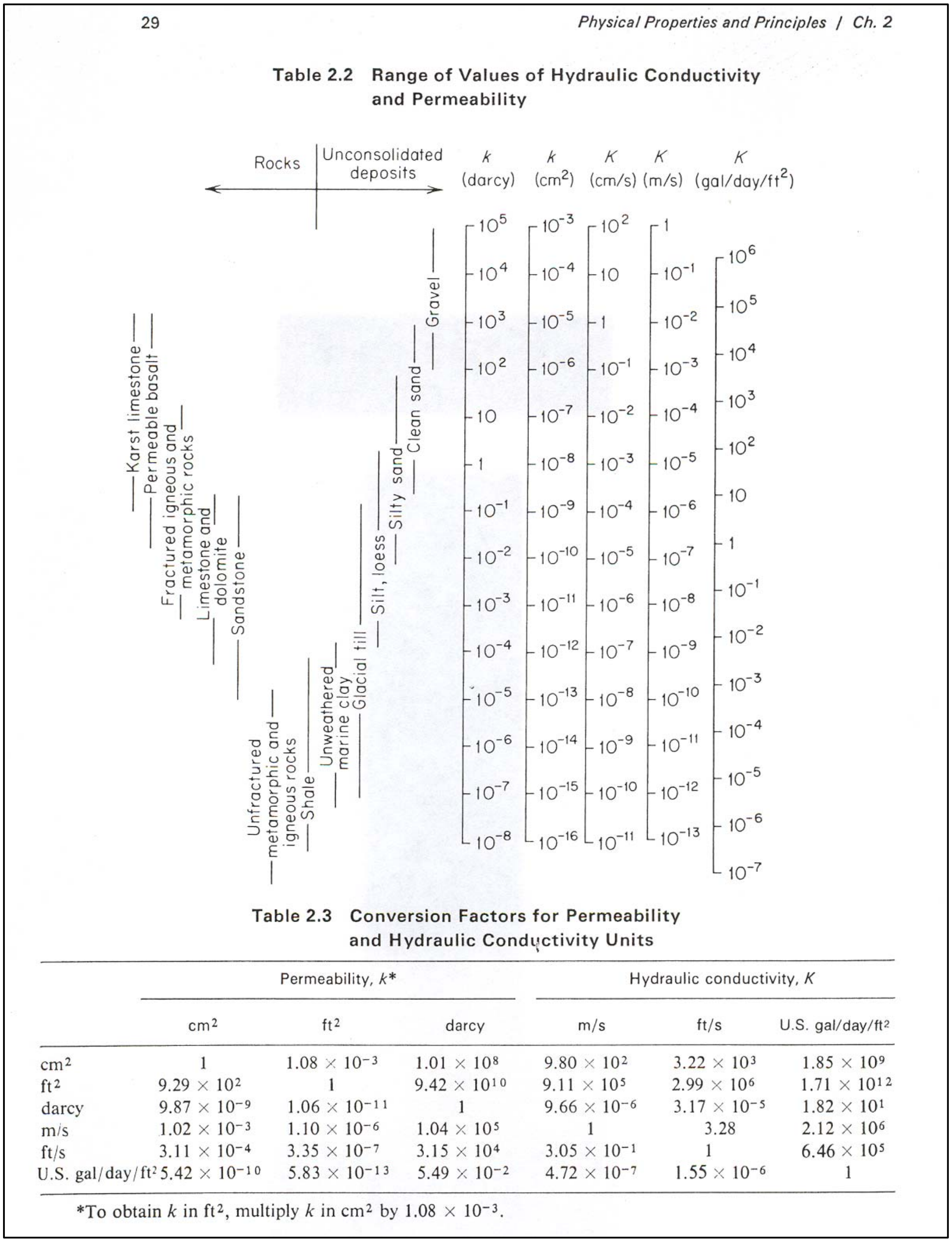


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Table 2.2 Range of Values of Hydraulic Conductivity and Permeability

Table 2.3 Conversion Factors for Permeability and Hydraulic Conductivity Units

	Permeability, *k**			Hydraulic conductivity, *K*		
	cm²	ft²	darcy	m/s	ft/s	U.S. gal/day/ft²
cm²	1	1.08×10^{-3}	1.01×10^{8}	9.80×10^{2}	3.22×10^{3}	1.85×10^{9}
ft²	9.29×10^{2}	1	9.42×10^{10}	9.11×10^{5}	2.99×10^{6}	1.71×10^{12}
darcy	9.87×10^{-9}	1.06×10^{-11}	1	9.66×10^{-6}	3.17×10^{-5}	1.82×10^{1}
m/s	1.02×10^{-3}	1.10×10^{-6}	1.04×10^{5}	1	3.28	2.12×10^{6}
ft/s	3.11×10^{-4}	3.35×10^{-7}	3.15×10^{4}	3.05×10^{-1}	1	6.46×10^{5}
U.S. gal/day/ft²	5.42×10^{-10}	5.83×10^{-13}	5.49×10^{-2}	4.72×10^{-7}	1.55×10^{-6}	1

*To obtain *k* in ft², multiply *k* in cm² by 1.08×10^{-3}.

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Sample Labeling, Storage, and Shipment Procedures

FOP 046.0

SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES

PURPOSE

The collection and analysis of samples of environmental media, including soils, groundwater, surface water, and sediment, are the central activities of the field investigation. These samples must be properly labeled to preserve its identity, and properly stored and shipped in a manner that preserves its integrity and chain of custody. This procedure presents methods for these activities.

SAMPLE LABELING PROCEDURE

1. Assign each sample retained for analysis a unique 9-digit alphanumeric identification code or as indicated in the Project Work Plan. Typically, this code will be formatted as follows:

Sample I.D. Example: GW051402047	
GW	**Sample matrix** GW = groundwater; SW = surface water; SUB = subsurface soil; SS = surface soil; SED = sediment; L = leachate; A = air
05	Month of sample collection
14	Day of sample collection
02	Year of sample collection
047	Consecutive sample number

2. Consecutive sample numbers will indicate the individual sample's sequence in the total set of samples collected during the investigation/sampling event. The sample number above, for example, would indicate the 47th sample retained for analysis during the field investigation, collected on May 14, 2002.

3. Affix a non-removable (when wet) label to each sample container. The following information will be written on the label with black or blue ink that will not smudge when wet:

   - Project number
   - Sample ID (see Step 1 above)
   - Date of sample collection
   - Time of sample collection (military time only)
   - Specify "grab" or "composite" sample with an "X"
   - Sampler initials
   - Preservative(s) (if applicable)
   - Analytes for analysis (if practicable)

4. Record all sample label information in the Project Field Book and on a Sample Summary Collection Log (see attached samples), keyed to the sample identification number. In addition, add information regarding the matrix, sample location, depth, etc. to provide a complete description of the sample.

SAMPLE STORAGE PROCEDURE

1. Immediately after collection, placement in the proper container, and labeling, place samples to be retained for chemical analysis into resealable plastic bags.

2. Place bagged samples into an ice chest filled approximately half-full of double bagged ice. Blue ice is not an acceptable substitute for ice.

3. Maintain samples in an ice chest or in an alternative location (e.g. sample refrigerator) as approved by the TurnKey Field Team Leader until time of shipment. Periodically drain melt-water off coolers and replenish ice as necessary.

4. Ship samples on a daily basis, unless otherwise directed by the TurnKey Field Team Leader.

5. Maintain appropriate custody procedures on coolers and other sample storage containers at all times. These procedures are discussed in detail in the Project Quality Assurance Project Plan, Monitoring Plan or Work Plan.

6. Samples shall be kept in a secure location locked and controlled (i.e., locked building or fenced area) so that only the Project Field Team Leader has access to the location or under the constant visual surveillance of the same.

SAMPLE SHIPPING PROCEDURE

1. Fill out the chain-of-custody form completely (see attached sample) with all relevant information. The white original goes with the samples and should be placed in a resealable plastic bag and taped inside the sample cooler lid; the sampler should retain the copy.

2. Place a layer of inert cushioning material such as bubble pack in the bottom of cooler.

3. Place each bottle in a bubble wrap sleeve or other protective wrap. To the extent practicable, then place each bottle in a resealable plastic bag.

4. Open a garbage bag (or similar) into a cooler and place sample bottles into the garbage bag (or similar) with volatile organic analysis (VOA) vials near the center of the cooler.

5. Pack bottles with ice in plastic bags. At packing completion, cooler should be at least 50 percent ice, by volume. Coolers should be completely filled, so that samples do not move excessively during shipping.

6. Duct tape (or similar) cooler drain closed and wrap cooler completely in two or more locations to secure lid, specifically covering the hinges of the cooler.

7. Place laboratory label address identifying cooler number (i.e., 1 of 4, 2 of 4 etc.) and overnight delivery waybill sleeves on cooler lid or handle sleeve (Federal Express).

8. Sign the custody seal tape with an indelible soft-tip marker and place over the duct tape across the front and back seam between the lid and cooler body.

9. Cover the signed custody seal tape with an additional wrap of transparent strapping tape.

10. Place "Fragile" and "This Side Up" labels on all four sides of the cooler. "This Side Up" labels are yellow labels with a black arrow with the arrowhead pointing toward the cooler lid.

11. For coolers shipped by overnight delivery, retain a copy of the shipping waybill, and attach to the chain-of-custody documentation.

ATTACHMENTS

Soil/Sediment Sample Summary Collection Log (sample)
Groundwater/Surface Water Sample Summary Collection Log (sample)
Wipe Sample Summary Collection Log (sample)
Air Sample Summary Collection Log (sample)
Chain-Of-Custody Form (sample)

REFERENCES

None

SOIL/SEDIMENT
SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Depth (feet)		Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, depth changes, important matrix observations or description, gravel thickness, etc.)
			from	to						

Equipment Rinsate Blanks *- Pour clean deionized water over or through decontaminated sampling equipment into sample containers. Collect at a frequency of 1 per sampling method per day. Analyze for all those parameters analyzed for in the samples collected the same day. HSL Metals can be substituted by only the Metals analyzed for that day (except Hexavalent Chromium which needs a separate container). Match equipment used for constituents of concern to rinsate analyte. Note deionized water lot # or distilled water manufacturers info & date.*

MS/MSD/MSB *- Collect at a frequency of 1 per 20 samples of each matrix per day. Analyze for all those parameters analyzed for the samples collected the same day.*

Field Blank *- Pour clean deionized water (used as final decon rinse water) into sample containers while at the sampling site. Collect field blanks at a frequency of 1 per lot of deionized water. Note water lot number and dates in use for decon in 'Comments' section.*

Investigation Derived Waste (IDW) Characterization samples *- One composited sample from all drums of decon fluids and soil. Please note number of drums and labels on collection log.*

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. HDPE - high density polyethylene bottle.
4. MS/MSD/MSB - Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blank.
5. BD - Blind Duplicate - indicate location of duplicate.

SAMPLE

TurnKey Environmental Restoration, LLC

GROUNDWATER/SURFACE WATER SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Depth (feet)		Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, depth changes, important matrix observations or description, gravel thickness, etc.)
			from	to						

Equipment Rinsate Blanks *- Pour clean deionized water over or through decontaminated sampling equipment into sample containers. Collect at a frequency of 1 per sampling method per day. Analyze for all those parameters analyzed for in the samples collected the same day. HSL Metals can be substituted by only the Metals analyzed for that day (except Hexavalent Chromium which needs a separate container). Match equipment used for constituents of concern to rinsate analyte. Note deionized water lot # or distilled water manufacturers info & date.*

MS/MSD/MSB *- Collect at a frequency of 1 per 20 samples of each matrix per day. Analyze for all those parameters analyzed for the samples collected the same day.*

Field Blank *- Pour clean deionized water (used as final decon rinse water) into sample containers while at the sampling site. Collect field blanks at a frequency of 1 per lot of deionized water. Note water lot number and dates in use for decon in 'Comments' section.*

Investigation Derived Waste (IDW) Characterization samples *- One composited sample from all drums of decon fluids and soil. Please note number of drums and labels on collection log.*

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. HDPE - high density polyethylene bottle.
4. FD - Field Duplicate.
5. MS/MSD/MSB - Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blank.
6. BD - Blind Duplicate.

SAMPLE

WIPE SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, important observations or descriptions, etc.)

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. FD - Field Duplicate.
4. FB - Field Blank.
5. RS - Rinsate.
6. No Matrix Spike, Matrix Spike Duplicate or Matrix Spike Blanks for wipe samples.
7. Rinsates should be taken at a rate of 1 per day during wipe sampling. Only take when reusable equipment is used.
8. Wipe sample FB collected by wiping unused glove (and any other sampling equipment coming into contact with sampled surface) with prepared gauze pad and place in sample jar. Take at a rate of 1 FB per 20 samples.
9. Wipe sample FDs taken adjacent to original sample at a rate of 1 FD per 20 samples.
10. **EH :** Extract and Hold

SAMPLE

TurnKey Environmental Restoration, LLC

AIR SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, important observations or descriptions, etc.)

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. SC - Summa Canister.
3. TB - Tedlar Bag (quantity).
4. No Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blanks, Field Duplicates, Field Blanks or Rinsates collected for air samples.

SAMPLE

TurnKey Environmental Restoration, LLC

CHAIN OF CUSTODY RECORD

Project No.	Project Name	Number of Containers	VOCs	SVOCs	Metals						REMARKS
Samplers (Signature)											

No.	Date	Time	comp	grab	Sample Identification		▨	▨	▨	▨	▨	▨	▨	▨	

Possible Hazard Identification:
☐ Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal:
Return to Client ☐ Disposal by Lab ☐ Archive ______________(mos.)

Turnaround Time Required:
Normal ☐ Rush ☐

QC Level:
I. ☐ II. ☐ III. ☐ Project Specific (specify):____________________

Relinquished by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	REMARKS:
Relinquished by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	

SAMPLE

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Screening of Soil Samples for Organic Vapors During Drilling Activities

FOP 047.0

SCREENING OF SOIL SAMPLES FOR ORGANIC VAPORS DURING DRILLING ACTIVITIES

PURPOSE

This procedure is used to screen soil samples for the presence of volatile organic constituents (VOCs) using a field organic vapor meter. These meters will be either photoionization detector (PID) or flame-ionization detector (FID) type. This screening is performed at the drilling and sampling location as a procedure for ensuring the health and safety of personnel at the site and to identify potentially contaminated soil samples for laboratory analysis. All soil samples will be field screened to provide a vertical profile of soil contamination by volatile organic substances.

PROCEDURE

1. Calibrate air-monitoring equipment in accordance with the appropriate TurnKey's Field Operating Procedures or manufacturers recommendations for calibration of field meters.
2. Collect split-spoon (or other sampler) samples in accordance with TurnKey's Split Spoon Sampling Procedure FOP.
3. When the split-spoon or other sampler is opened or accessed, shave a thin layer of material from the entire length of the core.
4. Scan the core visually and with the PID or FID noting stratification, visible staining, or other evidence of contamination.
5. Based on this initial scan of the sample, collect approximately 100 milliliters (ml) of soil using a decontaminated or dedicated stainless steel spatula, scoop, or equivalent. Place this soil into a labeled wide-mouth glass jar approximately ½ to ¾ full and seal with aluminum foil and a screw top cap. Alternatively, the soil may be placed into a clean, re-sealable plastic bag and sealed. Be sure to leave some headspace above the soil sample within the sealed container.

6. Place field screening sample (i.e., jar or bag) in a location where the ambient temperature is at least 70° Fahrenheit.

7. Leave the field screening sample bag for at least 30 minutes, but no more than 60 minutes.

8. Carefully remove the screw top cap from the jar and slowly insert the tip of the organic vapor meter (PID or FID) through the aluminum foil seal making the smallest hole possible. Alternatively, unseal a portion of the plastic bag just big enough to insert the probe of a calibrated PID.

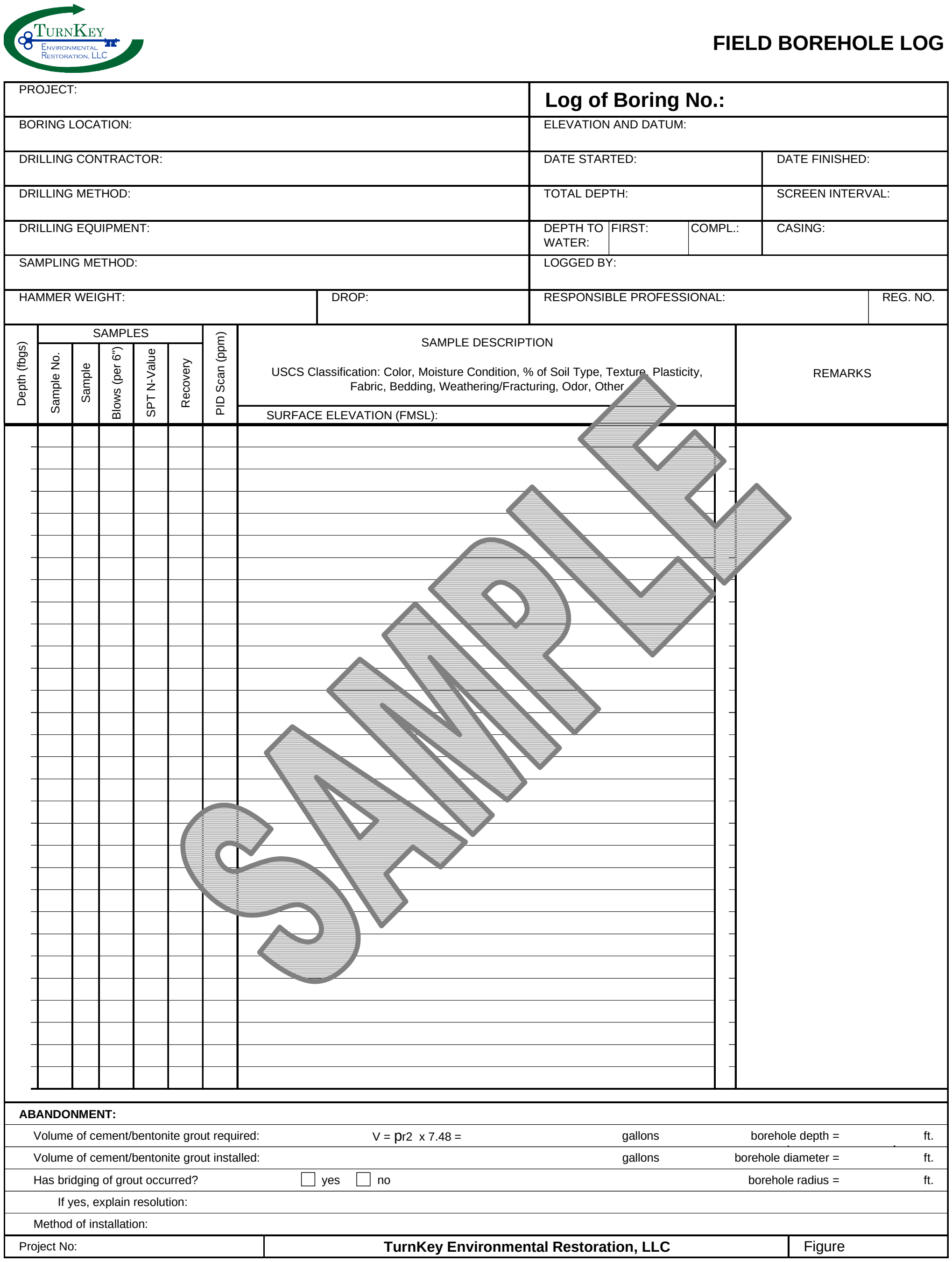
9. Record the maximum reading in parts per million by volume (ppmv) on the Field Borehole Log or Field Borehole/Monitoring Well Installation Log form (see attached samples) (see Documentation Requirements for Drilling and Well Installation FOP), at the depth interval corresponding to the depth of sample collection.

ATTACHMENTS

Field Borehole Log (sample)
Field Borehole/Monitoring Well Installation Log (sample)

REFERENCES

<u>TurnKey FOPs:</u>
010 *Calibration and Maintenance of Portable Flame Ionization Detector*
011 *Calibration and Maintenance of Portable Photoionization Detector*
015 *Documentation Requirements for Drilling and Well Installation*
058 *Split Spoon Sampling Procedures*



FIELD BOREHOLE LOG

PROJECT:		**Log of Boring No.:**	
BORING LOCATION:		ELEVATION AND DATUM:	
DRILLING CONTRACTOR:		DATE STARTED:	DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:	SCREEN INTERVAL:
DRILLING EQUIPMENT:		DEPTH TO WATER: FIRST: COMPL.:	CASING:
SAMPLING METHOD:		LOGGED BY:	
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:	REG. NO.

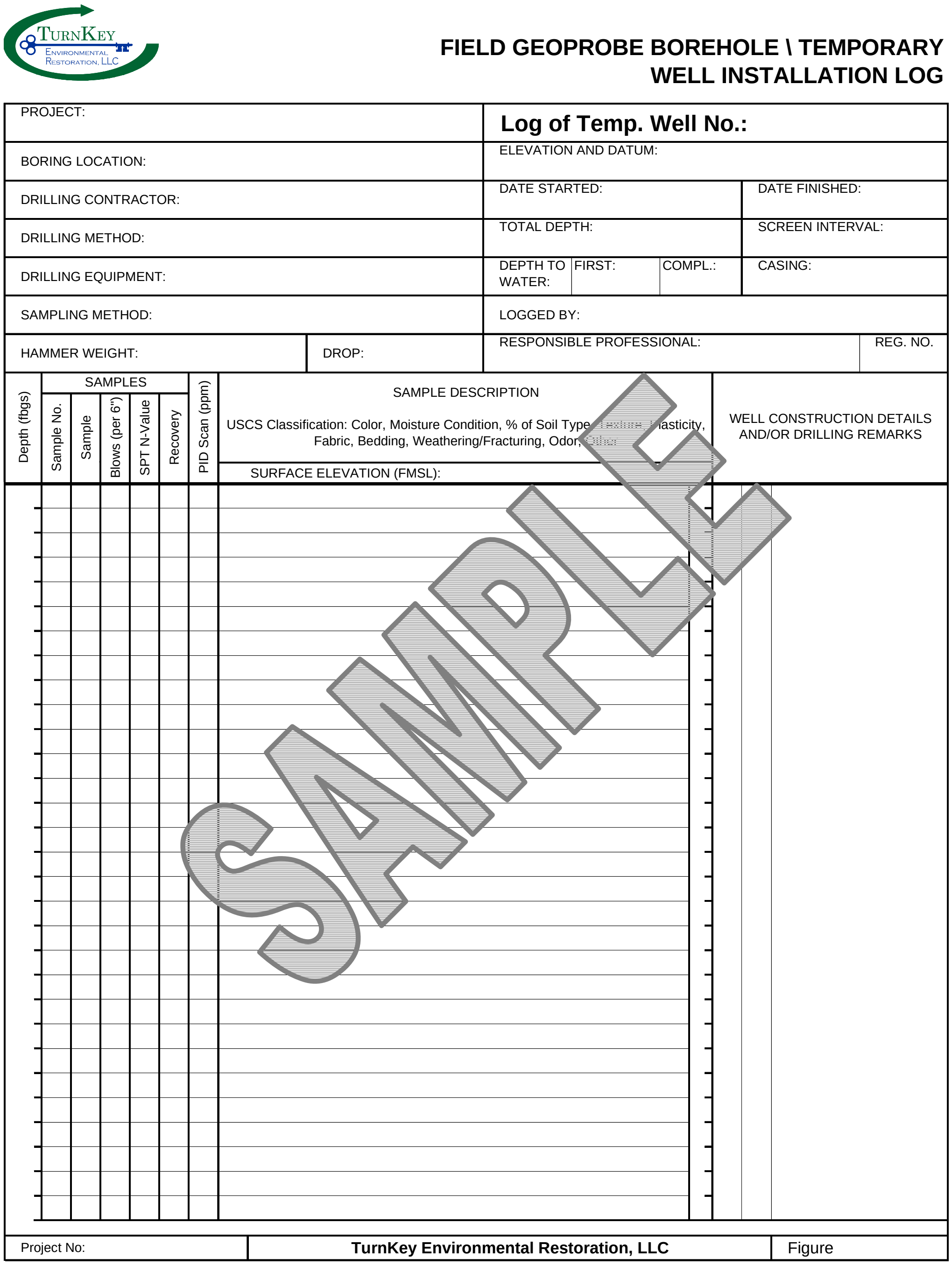
Depth (fbgs)	SAMPLES Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery	PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	REMARKS

SAMPLE

ABANDONMENT:

Volume of cement/bentonite grout required:	V = pr2 x 7.48 =	gallons	borehole depth =	ft.
Volume of cement/bentonite grout installed:		gallons	borehole diameter =	ft.
Has bridging of grout occurred?	☐ yes ☐ no		borehole radius =	ft.
If yes, explain resolution:				
Method of installation:				

Project No:	**TurnKey Environmental Restoration, LLC**	Figure



FIELD GEOPROBE BOREHOLE \ TEMPORARY WELL INSTALLATION LOG

PROJECT:		**Log of Temp. Well No.:**			
BORING LOCATION:		ELEVATION AND DATUM:			
DRILLING CONTRACTOR:		DATE STARTED:			DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:			SCREEN INTERVAL:
DRILLING EQUIPMENT:		DEPTH TO WATER:	FIRST:	COMPL.:	CASING:
SAMPLING METHOD:		LOGGED BY:			
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:			REG. NO.

Depth (fbgs)	SAMPLES Sample No.	 Sample	 Blows (per 6")	 SPT N-Value	 Recovery	PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Project No:	**TurnKey Environmental Restoration, LLC**	Figure

SAMPLE

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Sediment Sample Collection in Shallow Water Procedures

FOP 050.0

SEDIMENT SAMPLE COLLECTION IN SHALLOW WATER PROCEDURES

PURPOSE

This guideline presents a method for collection of representative sediment samples in shallow waters. The methodologies discussed in this FOP are applicable to the sampling of sediment in both flowing and standing water. They are generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. However, if modifications to this FOP are deemed necessary, they should be documented in the Project Field Book, Variance Log (sample attached) and discussed in reports summarizing field activities and analytical results.

For the purposes of this procedure, sediments are defined as those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, and impoundments; or flowing, as in rivers and streams. Generally, surface and subsurface sediment samples are required for contaminant delineation and to assess the potential for resuspension of contaminated sediments during flood/current-based scouring events, dredging operations, or other disturbances. Sample collection of two types of sediment is discussed in this procedure, and include:

- Surface sediment samples, typically collected from the 0-6" interval, generally considered the biotic zone in sediments; and
- Subsurface sediment (or sub-sediment) core samples, typically collected immediately below surface sediments from the 6-24" interval (actual depth based on site-specific conditions). Sub-sediment core samples are appropriate in areas of known discharge of contaminated groundwater to surface water or where known historic discharges have become overlain with newer sediment.

Sediment samples may be collected using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion of the sediment profile required (surface vs.

subsurface), the type of sample required (disturbed vs. undisturbed), contaminants present, and sediment type. Generally, shallow water sediment is collected from beneath an aqueous layer directly using a dedicated stainless steel hand held device such as a shovel, trowel, spoon or auger and deep water sediment is collected using a remotely activated device such as an Ekman or Ponar dredge (see TurnKey's Sediment Sample Collection in Deep Water FOP). The most widely used method for sub-sediment sample collection involves a sampler consisting of Type 304 stainless steel corer/hand auger (i.e., sampler) fitted with a cellulose acetate sleeve. The hand auger is driven into the sediment by hand to obtain a 2-inch diameter sample core. Both methods are considered acceptable unless stated otherwise in the Project Work Plan and both are described in this FOP. Each method is discussed in this FOP.

INTERFERENCES AND POTENTIAL PROBLEMS

Substrate particle size and organic matter content are a direct consequence of the flow characteristics of a water body. Contaminants are more likely to be concentrated in sediments typified by fine particle size and a high organic matter content. This type of sediment is most likely to be collected from depositional zones. In contrast, coarse sediments with low organic matter content do not typically concentrate pollutants and are generally found in erosional zones. The selection of a sampling location, can, therefore, greatly influence the analytical results and should be justified and specified in the project Work Plan.

SAMPLE COLLECTION

Selection of a sampling device is most often contingent upon: (1) the depth of water at the sample location, and (2) the physical characteristics of the sediment to be sampled. The following procedures may be utilized.

SURFACE SEDIMENT SAMPLING PROCEDURES

Direct Grab Method:

For the purposes of this method, surface sediment is considered to range from 0 to 6 inches in depth and a shallow aqueous layer is considered to range from 0 to 12 inches in depth. Collection of surface sediment from beneath a shallow aqueous layer will be accomplished with stainless steel tools such as spades, shovels, trowels, scoops, and/or spoons. Care should be exercised to avoid the use of devices plated with chrome or other materials; plating is particularly common with garden trowels.

The following procedure will be used to collect surface sediment with a stainless steel scoop, shovel, trowel or spoon:

1. Sampling equipment, including, but not limited to, stainless steel spoons, stainless steel bowls etc., that are not disposable or dedicated to one sample location will be decontaminated in accordance with the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

2. Wearing appropriate protective gear (i.e., latex gloves, safety glasses, boots, waders) prepare sampling equipment for use.

3. If samples are to be collected from a stream, creek or other running water body, collect downstream samples first to minimize impacts on sample quality.

4. Measure the surface sediment thickness in the vicinity of the sample location, taking care not to disturb the area of sample collection, in accordance with TurnKey's FOP for Stream Sediment Thickness Measurement. Record measurement in the Project Field Book and on the Sediment Sample Collection Log form (sample attached).

5. Collect a grab sample by slowly digging approximately 6 inches into the sediments, being careful to minimize disturbance at the sediment/water interface.

6. Retrieve the sample and transfer contents to a stainless steel bowl for mixing. Repeat the collection procedure as necessary immediately adjacent to the previous sampling point until adequate sample volume is obtained.

7. Samples designated for volatile organic analysis must be collected directly before homogenization to minimize volatilization of contaminants.

8. Gently mix the retrieved sediment with the stainless steel spoon to provide a homogeneous sample. Decant off any free-standing water, as necessary; care should be taken to retain the fine sediment fraction during this procedure.

9. Transfer surface sediment samples utilizing dedicated stainless steel tools into pre-cleaned bottles provided by the analytical laboratory.

10. Label, store and ship the samples in accordance with TurnKey's FOP for Sample Labeling, Storage and Shipment Procedures.

11. Record field measurements, such as weather conditions, depth to sediment, thickness of surface sediment, sample location, sample appearance/odor, types of sediment present and other pertinent information in the Project Field Book and on the Sediment Sample Collection Log form (sample attached).

<u>Ponar Dredge Direct Grab Method:</u>

For the purposes of this method, surface sediment is considered to range from 0 to 6 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of surface sediment can be accomplished with a system consisting of a remotely activated device (dredge) and a deployment system. This technique consists of slowly lowering a sampling device (dredge) to the surface of the sediment by use of a rope, cable, or extended handle. The mechanism is activated, and the device entraps sediment in spring-loaded or lever-operated jaws.

A Ponar dredge is a heavyweight sediment-sampling device with weighted jaws that are lever or spring activated. It is used to collect consolidated fine to coarse textured sediment. The following procedure will be used to collect surface sediment with a Ponar dredge (see attached Figure 1):

1. Decontaminate the dredge in accordance with the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

2. Wearing appropriate protective gear (i.e., latex gloves, safety glasses, boots, waders) prepare sampling equipment for use.

3. If samples are to be collected from a stream, creek or other running water body, collect downstream samples first to minimize impacts on sample quality.

4. Measure the surface sediment thickness in the vicinity of the sample location, taking care not to disturb the area of sample collection, in accordance with TurnKey's FOP for Stream Sediment Thickness Measurement. Record measurement in the Project Field Book and on the Sediment Sample Collection Log form (sample attached).

5. Attach a sturdy nylon rope or steel cable to the ring provided on top of the dredge.

6. Arrange the Ponar dredge with the jaws in the open position, setting the trip bar so the sampler remains open when lifted from the top. If the dredge is so equipped, place the spring-loaded pin into the aligned holes in the trip bar.

7. Slowly lower the sampler to a point approximately two inches above the sediment.

8. Drop the sampler to the sediment. Slack on the line will release the trip bar or spring loaded pin; pull up sharply on the line closing the dredge.

9. Raise the dredge to the surface and slowly decant any free liquid through the screens on top of the dredge. Care should be taken to retain the fine sediment fraction during this operation.

10. Open the dredge and transfer the sediment to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated.

11. Thoroughly homogenize the sediment sample. Repeat the collection procedure as necessary immediately adjacent to the previous sampling point until adequate sample volume is obtained.

12. Samples designated for volatile organic analysis must be collected directly from the dredge before homogenization to minimize volatilization of contaminants.

13. Gently mix the retrieved sediment with the stainless steel spoon to provide a homogeneous sample. Decant off any free-standing water, as necessary; care should be taken to retain the fine sediment fraction during this procedure.

14. Transfer surface sediment samples utilizing dedicated stainless steel tools into pre-cleaned bottles provided by the analytical laboratory.

15. Label, store and ship the samples in accordance with TurnKey's FOP for Sample Labeling, Storage and Shipment Procedures.

16. Record field measurements, such as weather conditions, depth to sediment, thickness of surface sediment, sample location, sample appearance/odor, types of sediment present and other pertinent information in the Project Field Book and on the Sediment Sample Collection Log form (sample attached).

SUB-SEDIMENT SAMPLING PROCEDURES

Bucket/Tube Auger Method:

For the purposes of this method, subsurface sediment is considered to range from 6 to greater than 18 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of subsurface sediment from beneath a shallow aqueous layer will be accomplished with a system consisting of a bucket auger, a tube auger, a series of extensions and a "T" handle. The use of additional extensions can increase the depth of water from which sediment can be collected from 24 inches to five feet or more. However, water clarity must be high enough to permit the sampler to directly observe the sampling operation. In addition, sample handling and manipulation increases in difficulty with increasing depth of water. The bucket auger is used to bore a hole to the upper range of the desired sampling depth and then withdrawn. The tube auger is then lowered down the borehole and driven into the sediment depth. The tube is then withdrawn and the sample recovered from the tube. This method can be used to collect firmly consolidated sediments, but is somewhat limited by the depth of the aqueous layer, and the integrity of the initial borehole.

The following procedure will be used to collect subsurface sediment samples with a bucket auger and a tube auger (see attached Figure 2):

1. Decontaminate the stainless steel bucket auger in accordance with the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

2. Wearing appropriate protective gear (i.e., latex gloves, safety glasses, boots, waders) prepare sampling equipment for use.

3. Attach the bucket auger bit to the required lengths of extensions, and then attach the "T" handle to the upper extension. Make sure that the handle and extension rods are tightened securely.

4. If samples are to be collected from a stream, creek or other running water body, collect downstream samples first to minimize impacts on sample quality.

5. Clear the area to be sampled of any surface debris.

6. Measure the surface sediment thickness in the vicinity of the sample location, taking care not to disturb the area of sample collection, in accordance with TurnKey's Stream Sediment Thickness Measurement FOP. Record measurement in the Project Field Book and on the Sediment Sample Collection Log form (sample attached).

7. Begin augering, periodically removing any accumulated sediment (i.e., cuttings) form the auger bucket. Cuttings should be disposed of far enough from the sampling area to minimize cross contamination of various depths.

8. After reaching the upper range of the desired depth, slowly and carefully remove bucket auger from the boring.

9. Attach the tube auger bit to the required lengths of extensions, and then attach the "T" handle to the upper extension. Make sure that the handle and extension rods are tightened securely.

10. Carefully lower the tube auger down the borehole using care to avoid making contact with the borehole sides and, thus cross contaminating the sample. Gradually force the tube auger into the sub-sediment to the lower range of the desired sampling depth. Hammering of the tube auger to facilitate coring should be avoided as the vibrations may cause the boring walls to collapse.

11. Remove the tube auger from the borehole, again taking care to avoid making contact with the borehole sides and, thus, cross contaminating the sample.

12. Discard the top of the core (approximately 1-inch); as this represents material collected by the tube auger before penetration to the desired sample interval.

13. Transfer the sub-sediment sample to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated.

14. Thoroughly homogenize the sediment sample. Repeat the collection procedure as necessary immediately adjacent to the previous sampling point until adequate sample volume is obtained.

15. Samples designated for volatile organic analysis must be collected directly from the tube auger before homogenization to minimize volatilization of contaminants.

16. Gently mix the retrieved sediment with the stainless steel spoon to provide a homogeneous sample. Decant off any free-standing water, as necessary.

17. Transfer subsurface sediment samples utilizing dedicated stainless steel tools into pre-cleaned bottles provided by the analytical laboratory.

18. Label, store and ship the samples in accordance with TurnKey's FOP for Sample Labeling, Storage and Shipment Procedures.

19. Record field measurements, such as weather conditions, depth to sediment, thickness of surface sediment, sample location, sample appearance/odor, types of sediment present, sample depth interval and other pertinent information in the Project Field Book and on the Sediment Sample Collection Log form (sample attached).

Coring Device Method:

For the purposes of this method, sub-surface sediment is considered to range from 6 to 24 inches in depth and a shallow aqueous layer is considered to range from 0 to 24 inches in depth. Collection of subsurface sediment from beneath a shallow aqueous layer will be accomplished with a system consisting of a tube sampler, acetate tube, eggshell check valve, nosecone, a series of extensions, and a "T" handle. The use of additional extensions can increase the depth of water from which sediment can be collected from 24 inches to 10 feet or more. This sampler may be used with either a drive hammer for firm sediment, or a "T" handle for soft sediment. However, sample handling and manipulation increases in difficulty with increasing depth of water.

The following procedure will be used to collect subsurface sediment samples with a coring device (see attached Figure 3):

1. Decontaminate the stainless steel coring device in accordance with the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

2. Wearing appropriate protective gear (i.e., latex gloves, safety glasses, boots, waders) prepare sampling equipment for use.

3. Assemble the coring device by inserting the acetate sleeve into the sampling tube.

4. Insert the "egg shell" check valve into the lower end of the sampling tube with the convex surface positioned inside the acetate sleeve.

5. Screw the nosecone onto the lower end of the sampling tube, securing the acetate sleeve and eggshell check valve.

6. Screw the handle onto the upper end of the sampling tube and add extension rods as necessary. Make sure that the handle and extension rods are tightened securely.

7. If samples are to be collected from a stream, creek or other running water body, collect downstream samples first to minimize impacts on sample quality.

8. Measure the surface sediment thickness in the vicinity of the sample location, taking care not to disturb the area of sample collection, in accordance with TurnKey's Stream Sediment Thickness Measurement FOP. Record

measurement in the Project Field Book and on the Sediment Sample Collection Log form (sample attached).

9. Place the sampler in a perpendicular position on the sediment to be sampled.

10. If the "T" handle is used, place downward pressure on the device until the desired depth is reached. After the desired depth is reached, rotate the sampler to shear off the core at the bottom. Lowly withdraw the sampler from the sediment and proceed to Step 19.

11. If the drive hammer selected, insert the tapered handle (drive head) of the drive hammer through the drive head.

12. Drive the sampler into the sediment to the desired depth.

13. Record the length of the tube that penetrated the sample material and the number of blows required to obtain this depth on the Sediment Sample Collection Log form (sample attached).

14. Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto the drive head. In this position, the hammer serves as a handle for the sampler.

15. Rotate the sampler to shear off the core at the bottom.

16. Lower the sampler handle (hammer) until is just clears the two ear-like protrusions on the drive head, and rotate about 90°.

17. Slowly withdraw the sampler from the sediment. If the drive head was used, pull the hammer upwards and dislodge the sampler from the sediment.

18. Carefully remove the coring device from the water.

19. Unscrew the nosecone and remove the eggshell check valve.

20. Slide the acetate sleeve out of the sampler tube. Decant surface water, using care to retain the fine sediment fraction. If headspace is present in the upper end, a hacksaw may be used to shear the acetate sleeve off at the sediment surface. The acetate sleeve may then be capped at both ends. Indicate on the acetate sleeve the appropriate orientation of the sediment core using a waterproof marker. The sample may be used in this fashion, or the contents transferred to a sample or homogenization container.

21. Open the acetate sleeve and transfer the sub-sediment sample utilizing dedicated stainless steel tools to a stainless steel, plastic or other appropriate composition (e.g., Teflon) container. Ensure that non-dedicated containers have been adequately decontaminated.

22. Thoroughly homogenize the sediment sample. Repeat the collection procedure as necessary immediately adjacent to the previous sampling point until adequate sample volume is obtained.

23. Samples designated for volatile organic analysis must be collected directly from the acetate sleeve before homogenization to minimize volatilization of contaminants.

24. Gently mix the retrieved sub-sediment with the stainless steel spoon to provide a homogeneous sample. Decant off any free-standing water, as necessary.

25. Transfer subsurface sediment samples utilizing dedicated stainless steel tools into pre-cleaned bottles provided by the analytical laboratory.

26. Label, store and ship the samples in accordance with TurnKey's FOP for Sample Labeling, Storage and Shipment Procedures.

27. Record field measurements, such as weather conditions, depth to sediment, thickness of surface sediment, sample location, sample appearance/odor, types of sediment present, sample depth interval and other pertinent information in the Project Field Book and on the Sediment Sample Collection Log form (sample attached).

REQUIRED EQUIPMENT

- Personal protective equipment (PPE) (as necessary)
- Waders or water proof boots
- Tape measure
- Survey flagging
- Stainless steel bowl or other appropriate composition container
- Stainless steel spoons, trowel and or shovel
- Bucket auger
- Tube auger
- Sediment coring device (hand auger with stainless steel corer, extension rods, "T" handle)
- Sediment coring device (tube, drive head, eggshell check valve, nosecone, acetate sleeve, extension rods, "T" handle)
- Ponar dredge
- Nylon rope or steel cable
- Regular cellulose acetate sleeve
- Eggshell-type cellulose acetate sleeve (as necessary)
- Laboratory-provided bottles
- Camera
- Cell phone
- Field forms
- Project Field Book

ATTACHMENTS

Figure 1; Ponar Dredge Sampler Schematic
Figure 2; Sampling Hand Auger Schematic
Figure 3; Sample Coring Device Schematic

Sediment Sample Collection Log (sample)
Variance Log (sample)

REFERENCES

1. USEPA, November 17, 1994. *Sediment Sampling. SOP 2016*.

<u>TurnKey FOPs:</u>
040 Non-Disposable and Non-Dedicated Sampling Equipment Decontamination
046 Sample Labeling, Storage and Shipment Procedures
049 Sediment Sample Collection In Deep Water Procedures
062 Stream Sediment Thickness Measurement

FIGURE 1

PONAR DREDGE SAMPLER SCHEMATIC

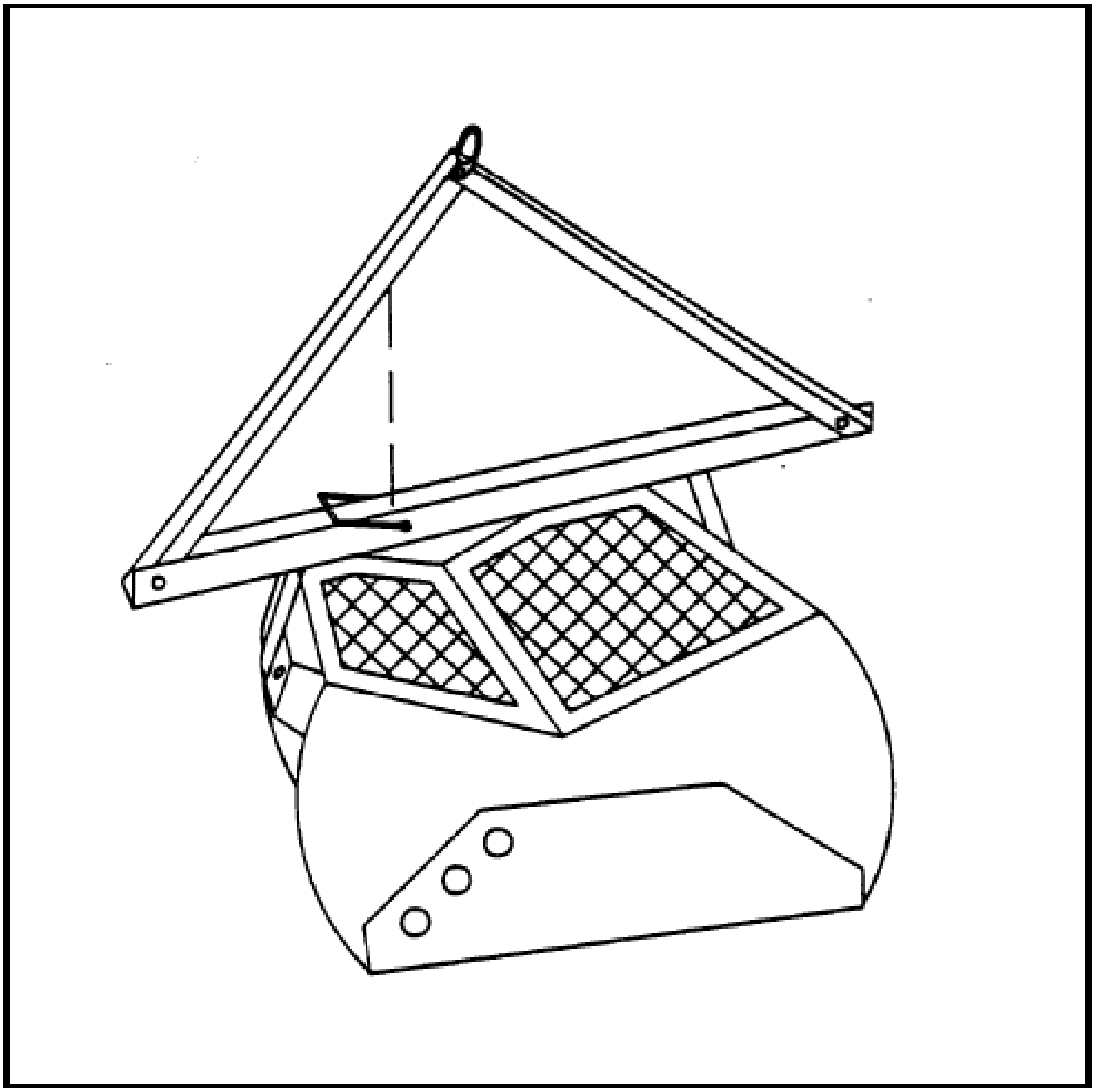


FIGURE 2

SAMPLING HAND AUGER SCHEMATIC

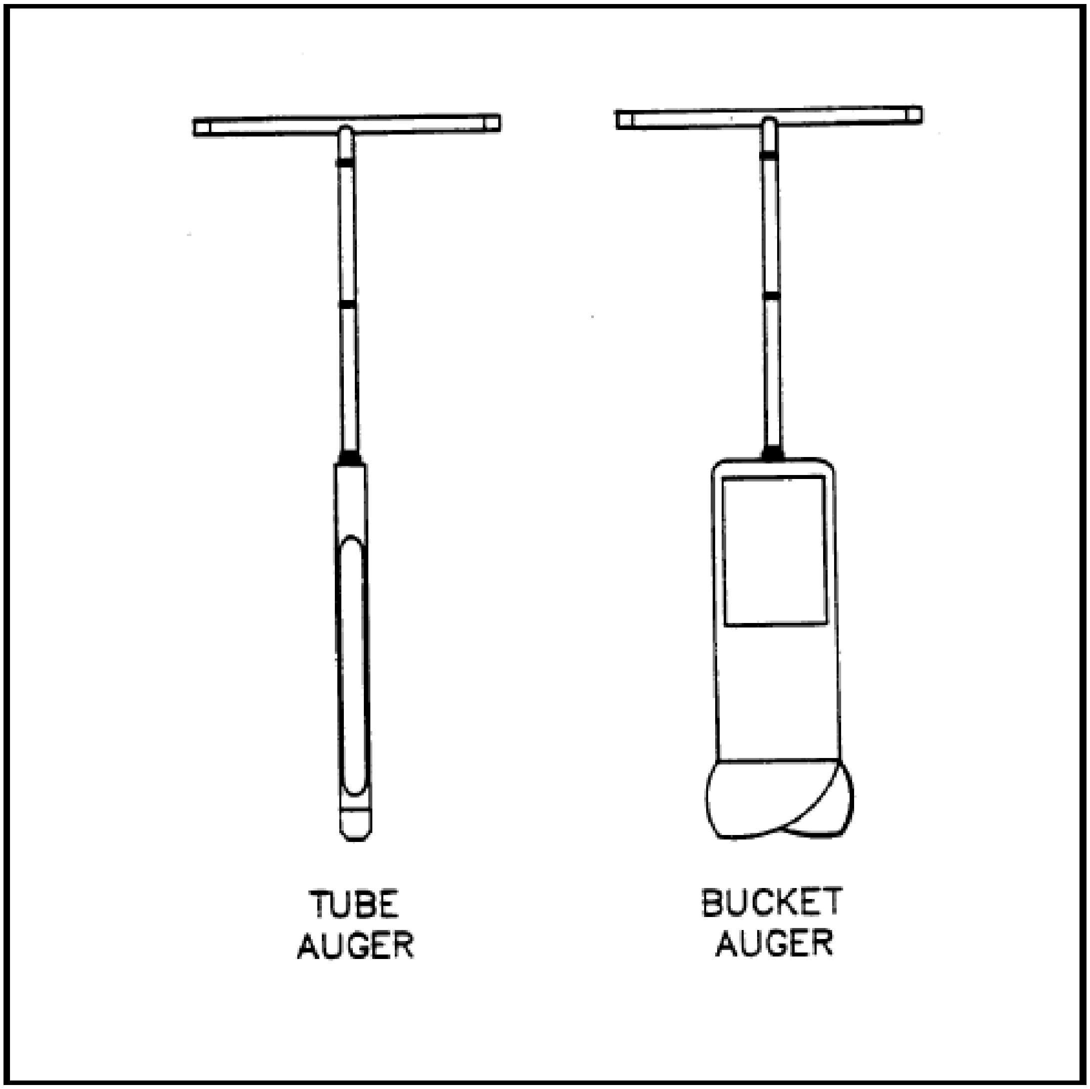
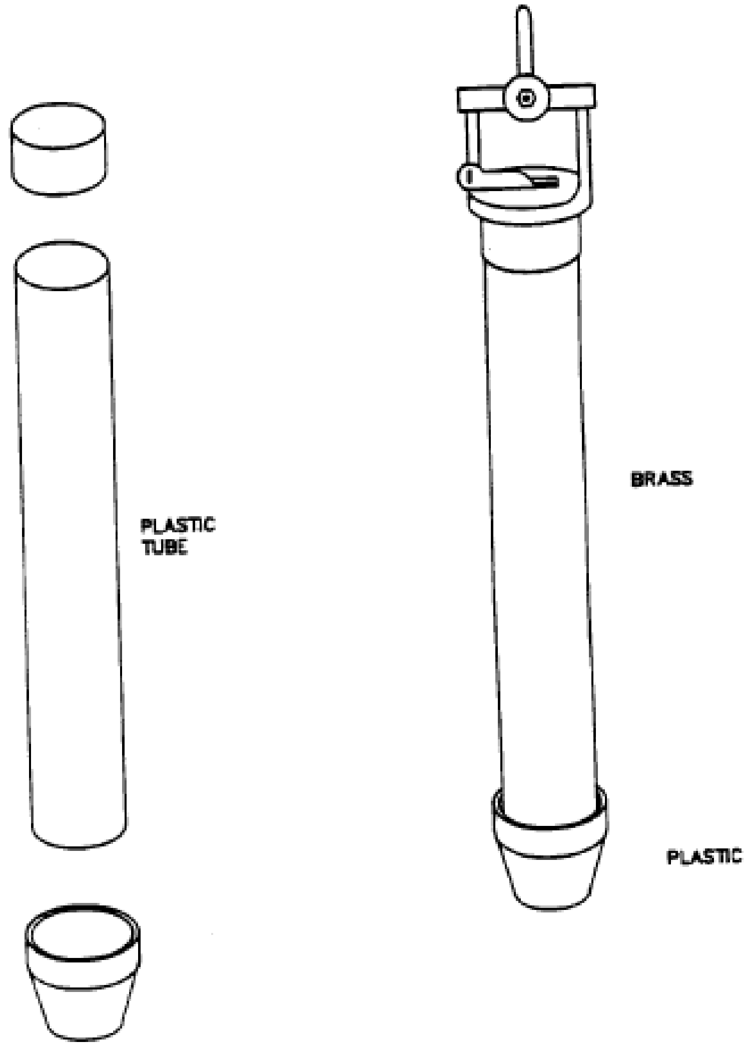


FIGURE 3

SAMPLE CORING DEVICE SCHEMATIC



TurnKey Environmental Restoration, LLC

SEDIMENT SAMPLE COLLECTION LOG

PROJECT INFORMATION

Project Name:
Project No.:
Client:

SAMPLE DESCRIPTION

I.D.:
Matrix:
Location:

SAMPLE INFORMATION

Date Collected:
Time Collected:
Date Shipped to Lab:
Collected By:
Sample Collection Meth

LABORATORY ANALYSIS

SAMPLING INFORMATION

Weather:
Air Temperature:
Depth of Sample:

Parameter	Value/Description
pH (units):	
Temperature (deg. C):	
Specific Conductance (uS/mS):	
Odor:	
Color:	
Sediment Type:	
Type of Non-sediment present:	
Other:	

LOCATION SKETCH

(not to scale, dimensions are approximate)

SAMPLE

EXACT LOCATION (if applicable)

Northing (ft)	Easting (ft)	Surface Elevation (fmsl)

ADDITIONAL LABORATORY ANALYSIS:

ADDITIONAL REMARKS:

PREPARED BY:

DATE:

Variance No.: _______________

Date of Issue: _______________

Page: ______ of ______

Project Name:

Project Number:

Project Location: Date:

- Variance Log -

I. Summary of Nonconformance or Change: (completed by field team leader)

II. Variance Requested: (completed by field team leader)

III. Justification for Variance: (completed by field team leader)

IV. Applicable Document / Work Plan: (completed by field team leader)

SAMPLE

Requested By: _______________ Date:

Approved By: _______________ Date:

Project Manager Approval: _______________ Date:

Quality Assurance Approval: _______________ Date:

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Soil Description Procedures Using the USCS

FOP 054.1

SOIL DESCRIPTION PROCEDURES
USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

PURPOSE

This guideline presents a means for insuring consistent and proper field identification and description of collected soils during a project (via, split-spoon (barrel) sampler, hand auger, test pit etc.). The lithology and moisture content of each soil sample will be physically characterized by visual-manual observation in accordance with ASTM Method D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). When precise classification of soils for engineering purposes is required, the procedures prescribed in ASTM Method D2487 (Standard Practice for Classification of Soils for Engineering Purposes [Unified Soil Classification System, USCS]) will be used. The method of soil characterization presented herein describes soil types based on grain size, liquid and plastic limits, and moisture content based on visual examination and manual tests. When using this FOP to classify soil, the detail of description provided for a particular material should be dictated by the complexity and objectives of the project. However, more often than not, "after the fact" field information is required later in the project, therefore, every attempt to describe the soil as completely as possibly should be made.

Intensely weathered or decomposed rock that is friable and can be reduced to gravel size or smaller by normal hand pressure should be classified as a soil. The soil classification would be followed by the parent rock name in parenthesis. Projects requiring depth to bedrock determinations should always classify weathered or decomposed bedrock as bedrock (i.e., landfill siting). The project manager should always be consulted prior to making this determination.

PROCEDURE

Assemble necessary equipment and discuss program requirements with drilling contractor.

1. Calibrate air-monitoring equipment in accordance with the appropriate Benchmark's Field Operating Procedures or manufacturers recommendations for calibration of field meters.

2. Collect desired soil sample in accordance with appropriate Benchmark FOP (i.e., split-spoon sampling, hand augering, test pitting etc.).

3. Shave a thin layer off the entire length of the sample to expose fresh sample.

4. Photograph and scan the sample with a photoionization detector (PID) at this time, if applicable, in accordance with Benchmark's Screening of Soil Samples for Organic Vapors During Drilling Activities FOP.

5. Describe the sample using terminology presented in the Descriptive Terms section below.

6. Record all pertinent information in the Project Field Book and Field Borehole Log (sample attached) or Field Borehole/Monitoring Well Installation Log (sample attached).

7. After the sample has been described, place a representative portion of the sample in new, precleaned jars for archival purposes. Label the jar with a sample identification number, sample interval, date, project number and store in a secure location.

8. If the soil is to be submitted to a laboratory for analysis, collect the soil sample with a dedicated stainless steel sampling tool, place the sample into the appropriate laboratory-supplied containers, and store in an ice-chilled cooler staged in a secure location in accordance with Benchmark's Sample Labeling, Storage and Shipment Procedures FOP.

9. All remaining soil from soil sample collection activities shall be containerized in accordance with Benchmark's Management of Investigative-Derived Waste (IDW) FOP and/or the Project Work Plan.

DESCRIPTIVE TERMS

All field soil samples will be described using the Unified Soil Classification System (USCS) presented in Figures 1 and 2 (attached). In addition to ASTM Method D2488, Method D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils (a.k.a., Standard Penetration Test, STP), when implemented, can also be used to classify the resistance of soils. In certain instances, it is desirable to supplement the USCS classification with a geologic interpretation of the soil sample that is supported by the soil descriptive terms presented in this section. The project manager should be consulted when making any geologic interpretation. Classification of sampled soils will use the following ASTM descriptive terms and criteria:

- **Group Name** (USCS, see Figure 2)
- **Group Symbol** (USCS, see Figure 2) – only use if physical laboratory testing has been performed to substantiate
- **Angularity** (ASTM D2488; Table 1)
  - Angular – particles have sharp edges and relatively planar sides with unpolished surfaces
  - Subangular – particles are similar to angular description but have rounded edges
  - Subrounded – particles have nearly planar sides but have well-rounded corners and edges
  - Rounded – particles have smoothly curved sides and no edges
- **Particle Shape** (ASTM D2488; Table 2)

  - Flat – particles with width/thickness > 3
  - Elongated – particles with length/width > 3
  - Flat and Elongated – particles meet criteria for both flat and elongated
- **Moisture Condition** (ASTM D2488; Table 3)
  - Dry – absence of moisture, dusty, dry to the touch
  - Moist – damp, but no visible water
  - Wet – visible free water, usually soil is below water table
- **Reaction with Hydrochloric Acid (HCl)** (ASTM D2488; Table 4)
  - None – no visible reaction
  - Weak – some reaction, with bubbles forming slowly
  - Strong – violent reaction, with bubbles forming immediately
- **Consistency of Cohesive Soils** (ASTM D2488; Table 5)
  - Very soft – squeezes between fingers when fist is closed; easily penetrated several inches by fist (SPT = 2 or less)
  - Soft – easily molded by fingers; easily penetrated several inches by thumb (SPT = 2 to 4)
  - Firm – molded by strong pressure of fingers; can be penetrated several inches by thumb with moderate effort (SPT = 4 to 8)
  - Stiff – dented by strong pressure of fingers; readily indented by thumb but can be penetrated only with great effort (SPT = 8 to 15)
  - Very stiff – readily indented by thumbnail (SPT = 15 to 30)
  - Hard – indented with difficultly by thumbnail (SPT >30)
- **Cementation** (ASTM D2488; Table 6)
  - Weak – crumbles or breaks with handling or slight finger pressure
  - Moderate – crumbles or breaks with considerable finger pressure
  - Strong – will not crumble or break with finger pressure

- **Structure (Fabric)** (ASTM D2488; Table 7)
  - Varved – alternating 1 mm to 12 mm (0.04 – 0.5 inch) layers of sand, silt and clay
  - Stratified – alternating layers of varying material or color with the layers less than 6 mm (0.23 inches) thick; note thickness
  - Laminated – alternating layers of varying material or color with the layers less than 6 mm (0.23 inches) thick; note thickness
  - Fissured – contains shears or separations along planes of weakness
  - Slickensided – shear planes appear polished or glossy, sometimes striated
  - Blocky – cohesive soil that can be broken down into small angular lumps which resist further breakdown
  - Lensed – inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
  - Homogeneous – same color and appearance throughout
- **Inorganic Fine-Grained Soil Characteristics** (ASTM D2488; Table 12)
  - Dry Strength (ASTM D2488; Table 8)
    - None – the dry specimen crumbles with the slightest pressure of handling
    - Low – the dry specimen crumbles with some finger pressure
    - Medium – the dry specimen breaks into pieces or crumbles with considerable finger pressure
    - High – the dry specimen cannot be broken with finger pressure. The specimen will break into pieces between the thumb and a hard surface.
    - Very High – the dry specimen cannot be broken between the thumb and a hard surface
  - Dilatency (ASTM D2488; Table 9)
    - None – no visible change in the specimen

        - Slow – water slowly appears on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
        - Rapid – water quickly appears on the surface of the specimen during shaking and disappears upon squeezing
    - Toughness (ASTM D2488; Table 10)
        - Low – only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and very soft.
        - Medium – medium pressure is required to roll the thread to near the plastic limit. The thread and the lump are soft.
        - High – considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump are firm.
- **Plasticity** (ASTM D2488; Table 11)
    - Nonplastic – a 3 mm (0.12 inches) thread cannot be rolled at any water content
    - Low Plasticity – the thread can barely be rolled, and crumbles easily
    - Medium Plasticity – the thread is easy to roll and not much time is required to reach the plastic limit before crumbling
    - High Plasticity – it takes considerable time rolling and kneading to reach the plastic limit; the thread can be rolled several times before crumbling
- **Relative Density of Cohesionless (Granular) Soils**
    - Very loose – easily penetrated 30 cm (1.2 inches) with 13 mm (0.5 inch) rebar pushed by hand (SPT = 0 to 4)
    - Loose – easily penetrated several cm with 13 mm (0.5 inch) rebar pushed by hand (SPT = 4 to 10)
    - Medium dense – easily to moderately penetrated with 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer (SPT = 10 to 30)
    - Dense – penetrated 0.3 m (1 foot) with difficulty using 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer (SPT = 30 to 50)

  - Very dense – penetrated only a few cm with 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer (SPT = >50)
- **Color** (use Munsel® Color System)
- **Particle Size** (see Figure 3)
  - Boulder – larger than a basketball
  - Cobble – grapefruit, orange, volleyball
  - Coarse Gravel – tennis ball, grape
  - Fine Gravel – pea
  - Coarse Sand – rock salt
  - Medium Sand – opening in window screen
  - Fine Sand – sugar, table salt
  - Fines (silt and clay) – cannot visually determine size (unaided)
- **Gradation**
  - Well Graded (GW, SW) – full range and even distribution of grain sizes present
  - Poorly-graded (GP, SP) – narrow range of grain sizes present
  - Uniformly-graded (GP, SP) – consists predominantly of one grain size
  - Gap-graded (GP-SP) – within the range of grain sizes present, one or more sizes are missing
- **Organic Material** – Organic soils usually have a dark brown to black color and may have an organic odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air-dried. Organic soils normally will not have a high toughness or plasticity. The thread of the toughness test will be spongy.
  - PEAT – 50 to 100 percent organics by volume, primary constituent
  - Organic (soil name) – 15 to 50 percent organics by volume, secondary organic constituent

  - (Soil name) with some organics – 5 to 15 percent organics by volume, additional organic constituents

- **Fill Materials** – All soils should be examined to see if they contain materials indicative of man-made fills. Man-made fill items should be listed in each of the soil descriptions. Common fill indicators include glass, brick, dimensioned lumber, concrete, pavement sections, asphalt, metal, plastics, plaster etc. Other items that could suggest fill include buried vegetation mats, tree limbs, stumps etc. The soil description for a fill material should be followed by the term "FILL", i.e., for a sandy silt with some brick fragments the description would be "SANDY SILT (ML), with brick fragments (Fill)". The size and distribution of fill indicators should be noted. The limits (depth range) of fill material should be determined and identified at each exploration location.

- **Other Constituents/Characteristics**
  - Additional constituents and/or pertinent soil characteristics not included in the previous categories should be described depending on the scope and objectives of the project. Observations that may be discussed include:
    - Oxide staining
    - Odor
    - Origin
    - Presence of root cast
    - Presence of mica
    - Presence of gypsum
    - Presence of calcium carbonate
    - Percent by volume of cobbles & boulders with size description and appropriate rock classification
  - Other pertinent information from the exploratory program should be recorded, if it would be useful from a biddability/constructability perspective. The conditions that should be listed include caving or sloughing, difficulty in drilling and groundwater infiltration.

SOIL DESCRIPTIONS

Generally, soil descriptions collected during most investigations are not intended for civil engineering (construction) purposes, but rather for hydrogeologic and contaminant transport purposes. As such, the ASTM visual-manual assessments are somewhat limited in that they are only performed in order to indicate important information about potential hydraulic properties of a soil. Soil descriptions should be concise, stressing major constituents and characteristics, and should be given in a consistent order and format. The following order is recommended:

- Soil name. The basic name of the predominant grain size and a single-word modifier indicating the major subordinate grain size (i.e., mostly clay with some silt). The terms representing percentages of grain size to be used include:
    - Trace – particles are present, but estimated to be less than 5%
    - Few – 5 to 10 %
    - Little – 30 to 45%
    - Some – 30 to 45%
    - Mostly – 50 to 100%
- Color (using Munsell® charts) at moist condition, include mottling
- Field moisture condition;
- Gradation or Plasticity. Granular soils (i.e., sands or gravels) should be described as well-graded, poorly graded, uniform, or gap-graded, depending on the gradation of the minus 3-inch fraction. Cohesive soils (i.e., silts and clays) should be described as non-plastic, low, medium, or high, depending on the results of the manual evaluation for plasticity (see Descriptive Terms section of this FOP).
- Consistency/Density. An estimate of consistency of a cohesive soil or density of a granular soil, usually based on the SPT results (see Descriptive Terms section of this FOP);

- Soil Structure or Mineralogy. Description of discontinuities, inclusions, and structures, including joints, fissures, and slickensides.
- Other important geologic information such as consolidation, gravel size and shape, visible internal structure, root holes, mica, odors, etc.

The first step when describing soil is to determine if the sample is predominantly fine-grained or coarse-grained (see Figures 3 and 4). Coarse-grained soils are relatively easy to identify, however descriptions of fine-grained soils can be more difficult, requiring additional field tests to assist the field geologist arrive at the proper soils classification. These tests are explained in detail in the ASTM Standard D2488. Generally, the differentiation between silt and clay is based on plasticity and "texture". However, tests for dry strength and dilatency, along with plasticity, can be very helpful and are recommended in the ASTM Standard. If additional tests are performed, in addition to plasticity, to classify the fines, record them with the soil description on the logs. Doing this will assist the reader (i.e., Project Manager) to follow the logic used to describe a soil (e.g., medium plasticity, <u>low</u> dry strength = elastic silt [MH]; not a lean clay [CL]).

Fines described in the classification should be modified by their plasticity (e.g., nonplastic fines, low plasticity fines, etc.) reserving the words "silt" and "clay" for the soil name.

In summary, adhering to the ASTM Standard and the guidelines outlined in this FOP will provide uniformity in soil descriptions provided by all field personnel. Prior to mobilization to the field, field staff should make sure to have laminated copies of the ASTM Standard flow charts and tables as well as this FOP (as necessary). Some examples of complete soil descriptions are as follows:

Coarse-grained Soil

POORLY GRADED FINE SAND w/ some SILT: dark grey with some iron-stained mottling, wet, low plasticity fines, laminated

Fine-grained Soil

CLAY w/ little SILT: dark reddish/brown, moist, medium plasticity, firm, root holes.

BORING AND MONITORING WELL INSTALLATION LOGS

Currently, Benchmark utilizes WinLoG software to construct subsurface logs and a template of the log is included in this FOP as an example. One of the most important functions of a boring/monitoring well installation log, besides transmitting the soil description, is to indicate where the "data" (soil samples) were collected, giving the reader an idea of how reliable or representative the description is. On each sample log, depths of attempted and recovered or non-recovered interval are shown. Odor, if noted, should be considered subjective and not necessarily indicative of specific compounds or concentrations.

Remember: all field logs should be NEAT, ACCURATE, and LEGIBLE. Don't forget that the well completion diagram completed for each well requires details of the surface completion (i.e., flush-mount, stick-up etc.). It is the responsibility of the field staff to double-check each log (i.e., soil names, classifications, well construction details etc.) prior to implementing into a final report. A registered professional (i.e., professional engineer, PE or professional geologist, PG) must review each log and will be ultimately responsible for its content and accuracy.

REQUIRED EQUIPMENT

- Knife
- Engineer's rule/measuring tape
- Permanent marker
- Pre-cleaned wide-mouth sample jars (typically provided by the driller)
- Pre-cleaned wide-mouth laboratory sample jars (provided by the laboratory)
- Stainless steel sampling equipment (i.e., spoons, spatulas, bowls etc.)
- 10x hand lens
- Hydrochloric acid
- ASTM D2488 flow charts (preferably laminated)
- ASTM D2488 test procedures (Tables 1 through 12) (preferably laminated)
- Camera (disposable, 35 mm or digital)
- Munsell soil color chart
- Project Field Book/field forms

ATTACHMENTS

Figure 1; Field Guide for Soil and Stratigraphic Analysis
Figure 2; USCS Soil Classification Flow Chart (modified from ASTM D2488)
Figure 3; Illustration of Particle Sizes

Field Borehole Log (sample)

REFERENCES

American Society for Testing and Materials, 2000. *ASTM D2488: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).*

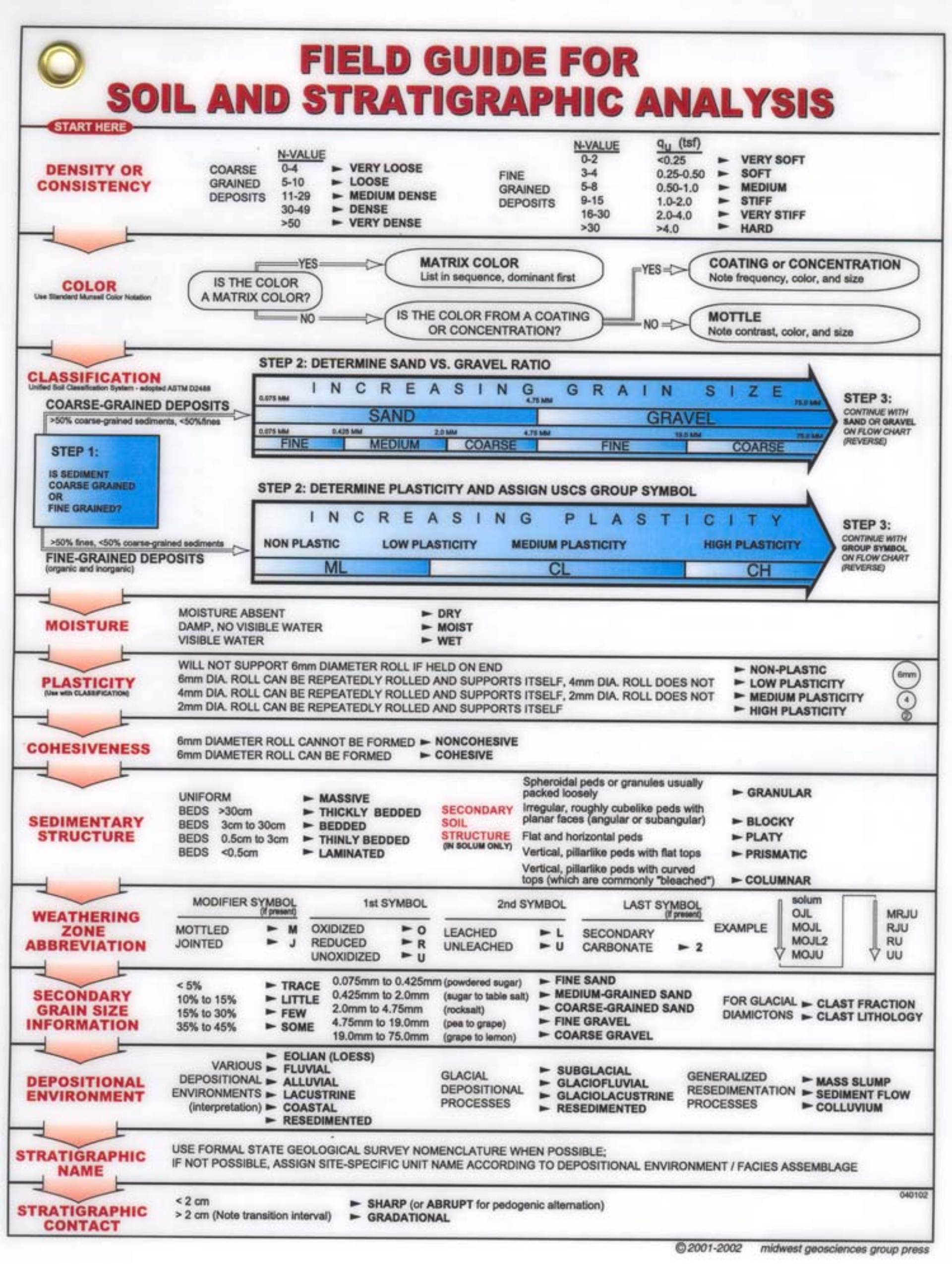
State of California, Department of Transportation, Engineering Service Center, Office of Structural Foundations, August 1996. *Soil & Rock Logging Classification Manual (Field Guide), by Joseph C. de Larios.*

Benchmark FOPs:

010	*Calibration and Maintenance of Portable Flame Ionization Detector*
011	*Calibration and Maintenance of Portable Photoionization Detector*
015	*Documentation Requirements for Drilling and Well Installation*
025	*Hand Augering Procedures*
032	*Management of Investigation-Derived Waste*
046	*Sample Labeling, Storage and Shipment Procedures*
047	*Screening of Soil Samples for Organic Vapors During Drilling Activities*
058	*Split-Spoon Sampling Procedures*
065	*Test Pit Excavation and Logging Procedures*

FIGURE 1

FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS



FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS

START HERE

DENSITY OR CONSISTENCY

COARSE GRAINED DEPOSITS

N-VALUE	
0-4	► VERY LOOSE
5-10	► LOOSE
11-29	► MEDIUM DENSE
30-49	► DENSE
>50	► VERY DENSE

FINE GRAINED DEPOSITS

N-VALUE	q_u (tsf)	
0-2	<0.25	► VERY SOFT
3-4	0.25-0.50	► SOFT
5-8	0.50-1.0	► MEDIUM
9-15	1.0-2.0	► STIFF
16-30	2.0-4.0	► VERY STIFF
>30	>4.0	► HARD

COLOR
Use Standard Munsell Color Notation

IS THE COLOR A MATRIX COLOR?
YES ▷ MATRIX COLOR — List in sequence, dominant first
NO ▷ IS THE COLOR FROM A COATING OR CONCENTRATION?
YES ▷ COATING or CONCENTRATION — Note frequency, color, and size
NO ▷ MOTTLE — Note contrast, color, and size

CLASSIFICATION
Unified Soil Classification System - adopted ASTM D2488

STEP 1:
IS SEDIMENT COARSE GRAINED OR FINE GRAINED?

COARSE-GRAINED DEPOSITS
>50% coarse-grained sediments, <50%fines

STEP 2: DETERMINE SAND VS. GRAVEL RATIO

INCREASING GRAIN SIZE

0.075 MM – 4.75 MM	4.75 MM – 75.0 MM
SAND	GRAVEL

0.075 MM	0.425 MM	2.0 MM	4.75 MM	19.0 MM – 75.0 MM
FINE	MEDIUM	COARSE	FINE	COARSE

STEP 3: CONTINUE WITH SAND OR GRAVEL ON FLOW CHART (REVERSE)

FINE-GRAINED DEPOSITS
(organic and inorganic)
>50% fines, <50% coarse-grained sediments

STEP 2: DETERMINE PLASTICITY AND ASSIGN USCS GROUP SYMBOL

INCREASING PLASTICITY

NON PLASTIC	LOW PLASTICITY	MEDIUM PLASTICITY	HIGH PLASTICITY
ML		CL	CH

STEP 3: CONTINUE WITH GROUP SYMBOL ON FLOW CHART (REVERSE)

MOISTURE

MOISTURE ABSENT	► DRY
DAMP, NO VISIBLE WATER	► MOIST
VISIBLE WATER	► WET

PLASTICITY
(Use with CLASSIFICATION)

WILL NOT SUPPORT 6mm DIAMETER ROLL IF HELD ON END	► NON-PLASTIC
6mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 4mm DIA. ROLL DOES NOT	► LOW PLASTICITY
4mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 2mm DIA. ROLL DOES NOT	► MEDIUM PLASTICITY
2mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF	► HIGH PLASTICITY

6mm
4
2

COHESIVENESS

6mm DIAMETER ROLL CANNOT BE FORMED	► NONCOHESIVE
6mm DIAMETER ROLL CAN BE FORMED	► COHESIVE

SEDIMENTARY STRUCTURE

UNIFORM		► MASSIVE
BEDS	>30cm	► THICKLY BEDDED
BEDS	3cm to 30cm	► BEDDED
BEDS	0.5cm to 3cm	► THINLY BEDDED
BEDS	<0.5cm	► LAMINATED

SECONDARY SOIL STRUCTURE (IN SOLUM ONLY)

Spheroidal peds or granules usually packed loosely	► GRANULAR
Irregular, roughly cubelike peds with planar faces (angular or subangular)	► BLOCKY
Flat and horizontal peds	► PLATY
Vertical, pillarlike peds with flat tops	► PRISMATIC
Vertical, pillarlike peds with curved tops (which are commonly "bleached")	► COLUMNAR

WEATHERING ZONE ABBREVIATION

MODIFIER SYMBOL (if present)		1st SYMBOL		2nd SYMBOL		LAST SYMBOL (if present)	
MOTTLED	► M	OXIDIZED	► O	LEACHED	► L	SECONDARY CARBONATE	► 2
JOINTED	► J	REDUCED	► R	UNLEACHED	► U		
		UNOXIDIZED	► U				

EXAMPLE
solum
OJL
MOJL
MOJL2
MOJU

MRJU
RJU
RU
UU

SECONDARY GRAIN SIZE INFORMATION

< 5%	► TRACE
10% to 15%	► LITTLE
15% to 30%	► FEW
35% to 45%	► SOME

0.075mm to 0.425mm	(powdered sugar)	► FINE SAND
0.425mm to 2.0mm	(sugar to table salt)	► MEDIUM-GRAINED SAND
2.0mm to 4.75mm	(rocksalt)	► COARSE-GRAINED SAND
4.75mm to 19.0mm	(pea to grape)	► FINE GRAVEL
19.0mm to 75.0mm	(grape to lemon)	► COARSE GRAVEL

FOR GLACIAL DIAMICTONS
► CLAST FRACTION
► CLAST LITHOLOGY

DEPOSITIONAL ENVIRONMENT

VARIOUS DEPOSITIONAL ENVIRONMENTS (interpretation)
► EOLIAN (LOESS)
► FLUVIAL
► ALLUVIAL
► LACUSTRINE
► COASTAL
► RESEDIMENTED

GLACIAL DEPOSITIONAL PROCESSES
► SUBGLACIAL
► GLACIOFLUVIAL
► GLACIOLACUSTRINE
► RESEDIMENTED

GENERALIZED RESEDIMENTATION PROCESSES
► MASS SLUMP
► SEDIMENT FLOW
► COLLUVIUM

STRATIGRAPHIC NAME

USE FORMAL STATE GEOLOGICAL SURVEY NOMENCLATURE WHEN POSSIBLE;
IF NOT POSSIBLE, ASSIGN SITE-SPECIFIC UNIT NAME ACCORDING TO DEPOSITIONAL ENVIRONMENT / FACIES ASSEMBLAGE

STRATIGRAPHIC CONTACT

< 2 cm	► **SHARP** (or **ABRUPT** for pedogenic alternation)
> 2 cm (Note transition interval)	► GRADATIONAL

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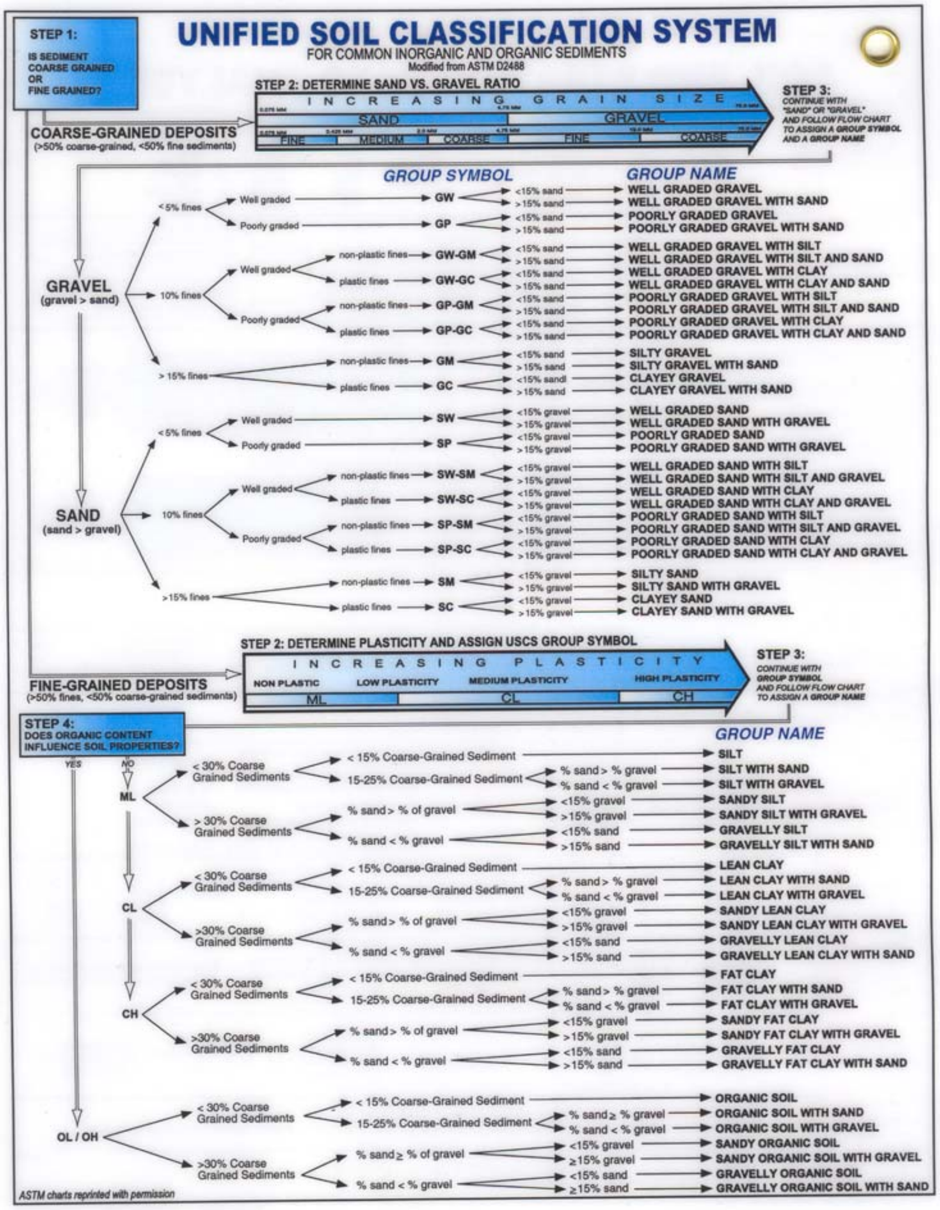
FIGURE 2

USCS SOIL CLASSIFICATION FLOW CHART (MODIFIED FROM ASTM D2488)



ASTM charts reprinted with permission

FIGURE 3

ILLUSTRATION OF PARTICLE SIZES

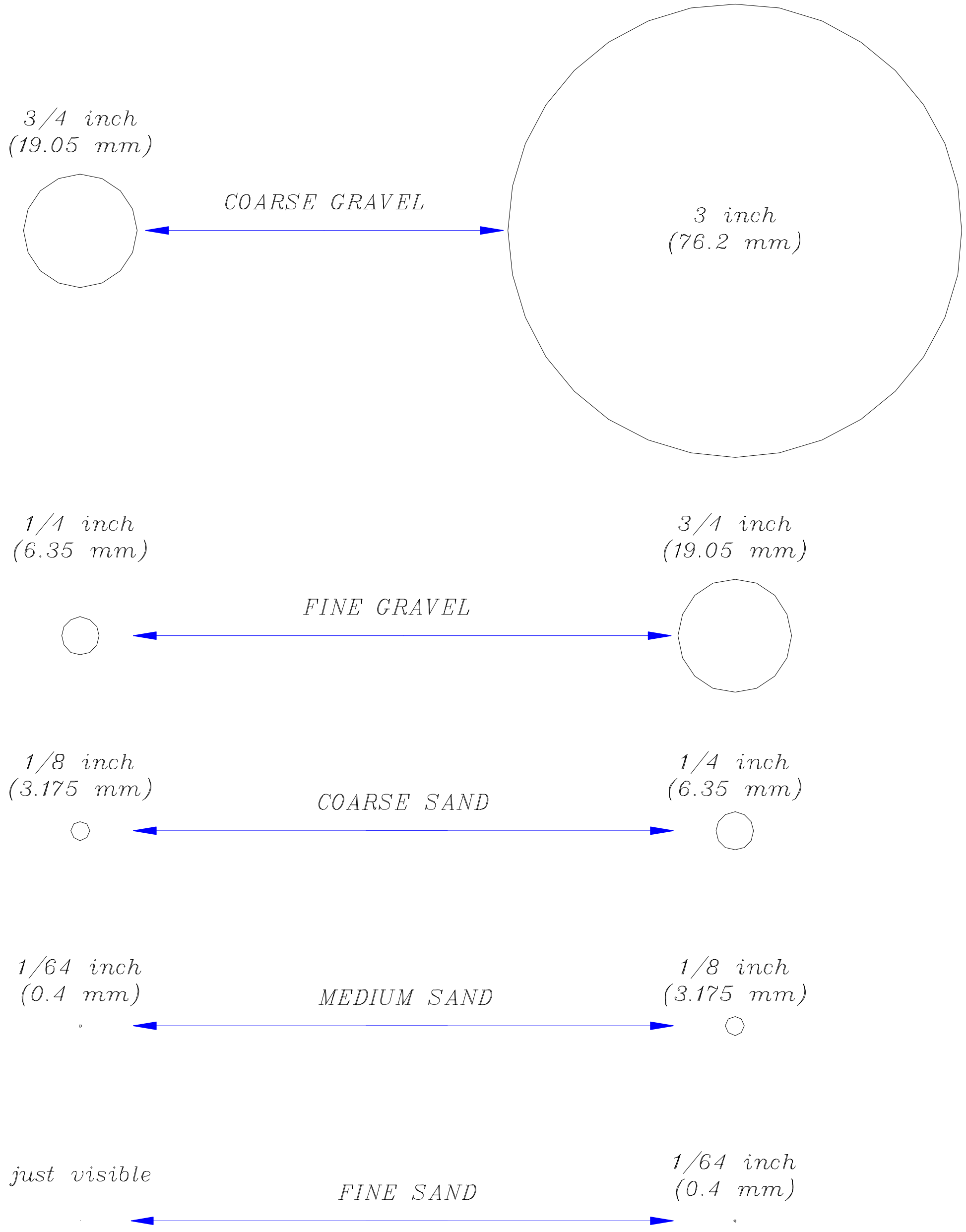


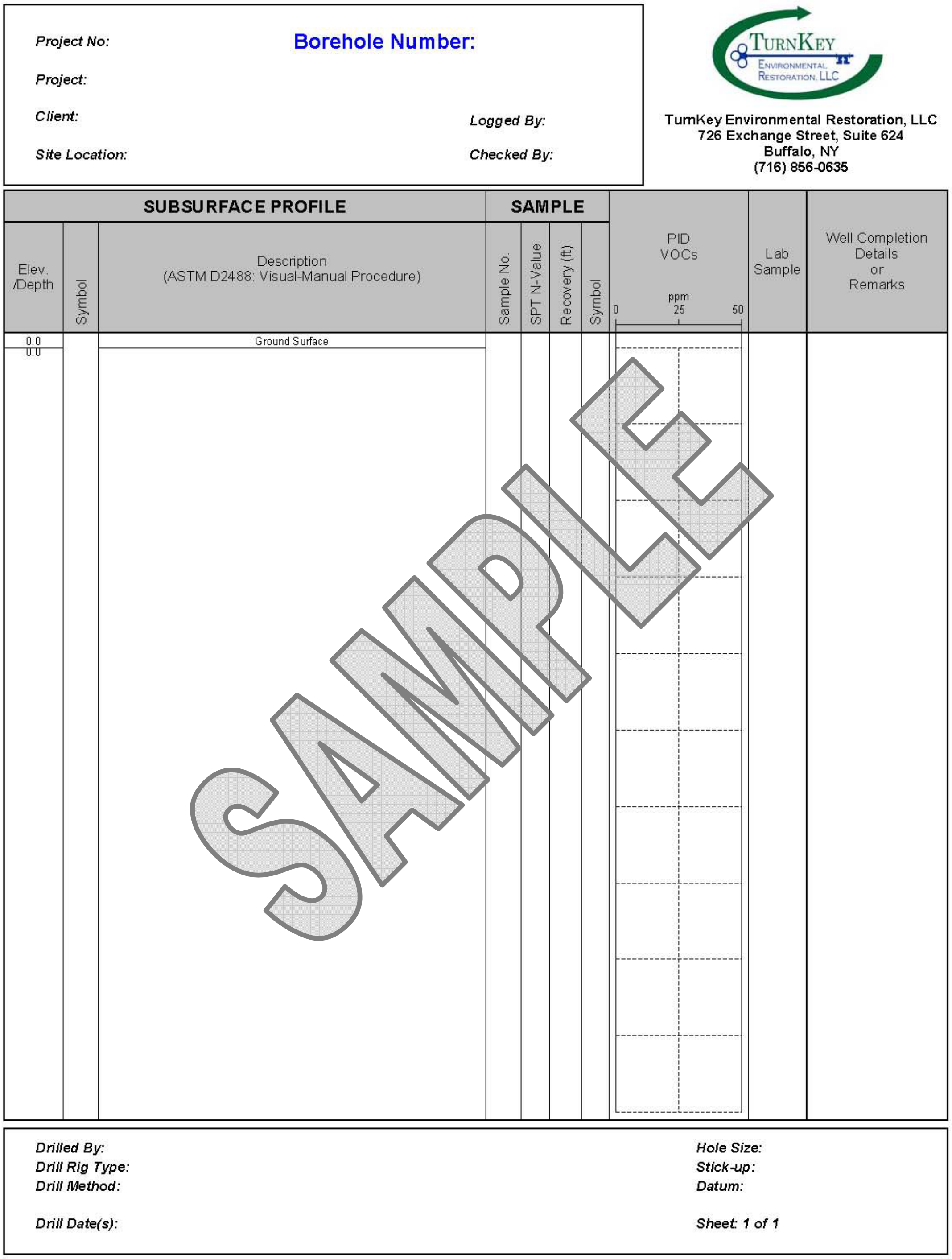
FIGURE 4

GRAIN-SIZE SCALE (MODIFIED WENTWORTH SCALE)

Grain size refers to the physical dimensions of particles of rock or other solid. This is different from the crystallite size, which is the size of a single crystal inside the solid (a grain can be made of several single crystals). Grain sizes can range from very small colloidal particles, through clay, silt, sand, and gravel, to boulders. Size ranges define limits of classes that are given names in the Wentworth scale used in the United States. The Krumbein *phi* (φ) scale, a modification of the Wentworth scale created by W. C. Krumbein, is a logarithmic scale computed by the equation: $\varphi = -\log_2(\text{grain size in mm})$.

φ scale	Size range (metric)	Size range (approx. inches)	Aggregate name (Wentworth Class)
< −8	> 256 mm	> 10.1 in	Boulder
−6 to −8	64–256 mm	2.5–10.1 in	Cobble
−5 to −6	32–64 mm	1.26–2.5 in	Very coarse gravel
−4 to −5	16–32 mm	0.63–1.26 in	Coarse gravel
−3 to −4	8–16 mm	0.31–0.63 in	Medium gravel
−2 to −3	4–8 mm	0.157–0.31 in	Fine gravel
−1 to −2	2–4 mm	0.079–0.157 in	Very fine gravel
0 to −1	1–2 mm	0.039–0.079 in	Very coarse sand
1 to 0	½–1 mm	0.020–0.039 in	Coarse sand
2 to 1	¼–½ mm	0.010–0.020 in	Medium sand
3 to 2	125–250 µm	0.0049–0.010 in	Fine sand
4 to 3	62.5–125 µm	0.0025–0.0049 in	Very fine sand
8 to 4	3.90625–62.5 µm	0.00015–0.0025 in	Silt
> 8	< 3.90625 µm	< 0.00015 in	Clay
<10	< 1 µm	< 0.000039 in	Colloid

In some schemes "gravel" is anything larger than sand (>2.0 mm), and includes "granule", "pebble", "cobble", and "boulder" in the above table. In this scheme, "pebble" covers the size range 4 to 64 mm (−2 to −6 φ).



Project No: **Borehole Number:**

Project:

Client: ***Logged By:***

Site Location: ***Checked By:***

TurnKey Environmental Restoration, LLC
726 Exchange Street, Suite 624
Buffalo, NY
(716) 856-0635

SUBSURFACE PROFILE			SAMPLE				PID VOCs	Lab Sample	Well Completion Details or Remarks
Elev. /Depth	Symbol	Description (ASTM D2488: Visual-Manual Procedure)	Sample No.	SPT N-Value	Recovery (ft)	Symbol	ppm 0 25 50		
0.0		Ground Surface							
0.0									

SAMPLE

Drilled By:
Drill Rig Type:
Drill Method:

Drill Date(s):

Hole Size:
Stick-up:
Datum:

Sheet: 1 of 1

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Surface and Subsurface Soil Sampling Procedures

FOP 063.1

SURFACE AND SUBSURFACE SOIL SAMPLING PROCEDURES

PURPOSE

This procedure describes the methods for sampling surface soil and subsurface soil samples for physical and chemical laboratory analysis during intrusive activities such as test pitting, hand augering, drilling, surface soil sampling etc. Typical health and safety related issues should be addressed in the Project Health and Safety Plan.

PRE-SAMPLING PROCEDURES

1. Review project objectives and the Project Health and Safety Plan (HASP).
2. Commence intrusive activities in accordance with specific TurnKey's FOPs (test pitting, hand augering, drilling etc.) or as directed by the Project Work Plan.
3. Conduct tailgate health and safety meeting with project team and/or subcontractor(s) by completing the Tailgate Safety Meeting Form (sample attached).
4. Calibrate air-monitoring equipment in accordance with the appropriate TurnKey's Field Operating Procedures or manufacturers recommendations for calibration of field meters.
5. Conduct air monitoring as required by the HASP, Project Work Plan or TurnKey's FOP Real-Time Air Monitoring During Intrusive Activities. Record all results on the Real Time Air Monitoring Log (sample attached).
6. Decontaminate all <u>non-dedicated</u> stainless steel (or Pyrex glass) equipment in accordance with TurnKey's Non-disposable and Non-dedicated Sampling Equipment Decontamination procedures.
7. Collect soil samples in accordance with the following sections.

SURFACE SOIL/FILL SAMPLING PROCEDURES

Collection of surface soil/fill samples facilitates the evaluation of potential health risks to current site receptors that may be exposed to soil/fill via direct contact, incidental ingestion, or inhalation of airborne particulates. The following procedure is in accordance with NYSDEC sampling protocol of surface soil/fill material. Volatile organic analysis of surface soil/fill utilizing this method will yield negatively biased results and should not be performed.

1. Collect all soil samples using dedicated (or decontaminated non-dedicated) sampling tools (i.e., spoons, trowels, bowls etc.), preferably constructed of stainless steel.

2. If the sample area is vegetated, then collect the surface soil sample from 0 to 2 inches below ground surface (bgs) following removal of the sod.

3. If there is no soil present within the sample area (i.e., only slag, concrete, mixed with fines), excavate an area 12 inches by 12 inches by 6 inches deep, screen the material to less than 1/8 inch (No. 4 sieve), and submit the screened material for analysis. If there is not enough material to completely fill the sample jar, then expand the excavation 3 inches in all four directions screening the additional material. Expand the excavation in this manner until sufficient sample volume is obtained.

SURFACE/SUBSURFACE SOIL SAMPLING PROCEDURES

1. Collect all soil samples using dedicated (or decontaminated non-dedicated) sampling tools (i.e., spoons, trowels, bowls etc.), preferably constructed of stainless steel.

   Surface soil samples are typically collected from 0 to 6 inches below ground surface (bgs). Subsurface soils are typically sampled from varying depths greater than 6-inches bgs based on field observations and as directed by the Project Work Plan.

2. Transfer samples for chemical (VOC, SVOC, Metals etc.) and physical (i.e., Atterberg Limits, Grain Size, Permeability etc.) analytical testing by direct grab (i.e., directly from the bucket of the excavation equipment, split-spoon sampler, hand auger etc.) using the dedicated (or decontaminated non-dedicated) sampling tools into appropriate laboratory-supplied containers and seal. The chemical or physical laboratory selected to perform the analysis should determine minimum sample volume for analysis.

3. Prepare collected samples in accordance with TurnKey's FOP: Sample Labeling, Storage and Shipment Procedures. Do not allow the chemical soil samples to freeze during storage and shipping. It should be noted, ice is not required for physical soil samples and all physical soil samples should be kept at the collected soil moisture by securing with a tight sealing lid. Do not allow physical soil samples to gain or lose moisture from the collected soil moisture prior to analysis.

4. Record all sampling details (i.e., depth and location) in the Project Field Book; appropriate TurnKey log sheets depending on method of intrusion (i.e., drilling, test pitting, hand augering etc.); and on the Soil/Sediment Sample Collection Summary Log (sample attached).

PARAMETER-SPECIFIC PROCEDURES

1. Volatile Organic Compound (VOCs): Transfer sufficient soil volume to fill the laboratory-supplied container (typically 4 ounces) by packing the soil sample with the sampling tool to the top of the container leaving no headspace. At no time should a gloved hand (i.e., latex, nitrile etc.) be used to pack the sample into the sample container as the sample may be compromised via cross-contamination.

2. All Other Parameters: All other parameters include, but are not limited to, Semi-VOCs (SVOCs), polychlorinated biphenyls (PCBs), herbicides,

pesticides, total metals etc. Transfer sufficient soil volume to fill the laboratory-supplied container by packing the soil sample with the sampling tool to the top of the container. Unless otherwise indicated by the laboratory or the Project Work Plan, the sample jar for all other parameters does not have to be packed completely leaving no headspace as with the VOC containers.

ATTACHMENTS

Tailgate Safety Meeting Form (sample)
Soil/Sediment Sample Collection Summary Log (sample)
Real Time Air Monitoring Log (sample)

REFERENCES

TurnKey FOPs:

006	*Calibration and Maintenance of Combustible Gas/Oxygen Meter*
010	*Calibration and Maintenance of Portable Flame Ionization Detector*
011	*Calibration and Maintenance of Portable Photoionization Detector*
040	*Non-disposable and Non-dedicated Sampling Equipment Decontamination*
046	*Sample Labeling, Storage and Shipment Procedures*
073	*Real-Time Air Monitoring During Intrusive Activities*

TurnKey Environmental Restoration, LLC

TAILGATE SAFETY MEETING FORM

Project Name: Date: Time:
Project Number: Client:
Work Activities:

HOSPITAL INFORMATION:

Name:
Address: *City:* *State:* *Zip:*
Phone No.: *Ambulance Phone No.*

SAFETY TOPICS PRESENTED:

Chemical Hazards:

Physical Hazards: Slips, Trips, Falls

PERSONAL PROTECTIVE EQUIPMENT:

Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D

New Equipment:

Other Safety Topic (s): Environmental Hazards (aggressive fauna)
Eating, drinking, use of tobacco products is prohibited in the Exclusion Zone (EZ)

ATTENDEES

Name Printed	**Signatures**

Meeting conducted by:

SAMPLE

SOIL/SEDIMENT
SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Depth (feet)		Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, depth changes, important matrix observations or description, gravel thickness, etc.)
			from	to						

Equipment Rinsate Blanks *- Pour clean deionized water over or through decontaminated sampling equipment into sample containers. Collect at a frequency of 1 per sampling method per day. Analyze for all those parameters analyzed for in the samples collected the same day. HSL Metals can be substituted by only the Metals analyzed for that day (except Hexavalent Chromium which needs separate container). Match equipment used for constituents of concern to rinsate analyte. Note deionzied water lot # or distilled water can be substit info & date.*

MS/MSD/MSB *- Collect at a frequency of 1 per 20 samples of each matrix per day. Analyze for all those parameters analyzed for the samples collected the same day.*

Field Blank *- Pour clean deionized water (used as final decon rinse water) into sample containers while at the sampling site. Collect field blanks at a frequency of 1 per lot of deionized water. Note water lot number and dates in use for decon in 'Comments' section.*

Investigation Derived Waste (IDW) Characterization samples *- One composited sample from all drums of decon fluids and soil. Please note number of drums and labels on collection log.*

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. HDPE - high density polyethylene bottle.
4. MS/MSD/MSB - Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blank.
5. BD - Blind Duplicate - indicate location of duplicate.

SAMPLE

REAL TIME AI

Date:
Project Name:
Project Number:
Project Location:
Client:
Purpose of Air Monitoring:

WEATHER CONDITIONS:

Time of Day:	A.M.
Ambient Air Temp.:	
Wind Direction:	
Wind Speed:	
Precipitation:	

Date	Personnel	Time	Air Monitoring Meter Measurement (Units)							Locatio
			PID (ppm)	LEL (%)	H2S (ppm)	O2 (%)	CO (ppm)	Particulates (mg/m^3)	Other	

SAMPLE

NOTE: SEE EQUIPMENT CALIBRATION LOG FOR DESCRIPTION OF EQUIPMENT TYPE.

Prepared By:

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Surface Water
Sampling Procedures

FOP 064.0

SURFACE WATER SAMPLING PROCEDURES

PURPOSE

This procedure describes a method for collecting surface water samples. Sediment samples typically are collected in conjunction with surface water samples as dictated by the site-specific work plan. It should be noted, however, sediment sample collection procedures are not presented herein and TurnKey's sediment sampling FOPs 049 and 050 should be reviewed prior to sediment sample collection. This surface water sampling method incorporates the use of the laboratory provided sample bottle for collecting the sample, which eliminates the need for other equipment and hence, reduces the risk of introducing other variables into a sampling event.

PROCEDURE

1. Locate the surface water sample location.

2. Calibrate all field meters (i.e., pH/Eh, turbidity, specific conductance, dissolved oxygen, PID etc.) in accordance with the TurnKey's Field Operating Procedure for Calibration and Maintenance of the specific field meter.

3. Wearing appropriate protective gear (i.e., latex gloves, safety glasses), as required in the Project Health and Safety Plan, prepare sample bottles for use.

4. If samples are to be collected from a stream, creek or other running water body, collect downstream samples first to minimize impacts on sample quality.

5. Surface water samples should be collected during a dry (non-precipitation) event to avoid any dilution effect from precipitation.

6. Pre-label all sample bottles in the field using a waterproof permanent marker in accordance with the TurnKey's Sample Labeling, Storage and Shipment FOP. The following information, at a minimum, should be included on the label:

- Project Number;
- Sample identification code (as per project specifications);
- Date of sample collection (mm, dd, yy);
- Time of sample collection (military time only) (hh:mm);
- Specify "grab" or "composite" sample type;
- Sampler initials;
- Preservative(s) (if applicable); and
- Analytes for analysis (if practicable).

7. Collect the surface water sample from the designated location by slowly submerging each sample bottle with minimal surface disturbance. If the sample location cannot be sampled in this manner due to shallow water conditions, a small depression can be created with a standard shovel to deepen the location to facilitate sample collection by direct grab. It should be noted, prior to disturbing sediment at any location for this purpose, all required sediment samples should be collected. All sediment cuttings will be removed from the area and the surface water allowed to flow through the depression for several minutes prior to collecting samples until clear (i.e., no visible sediment).

8. Collect samples from near shore. If water body is over three feet deep, check for stratification. Check each stratum for contamination using field measured water quality parameters. Collect samples from each stratum showing evidence of impact. If no stratum shows signs of impact, collect a composite sample having equal parts of water from each stratum.

9. Collect samples into pre-cleaned bottles provided by the analytical laboratory with the appropriate preservative(s) added based on the volatilization sensitivity or suite of analytical parameters required, as designated below:

   - Volatile Organic Compounds (VOCs)
   - Total Organic Halogens (TOX)
   - Total Organic Carbon (TOC)
   - Extractable Organic Compounds (i.e., BNAs, SVOCs, etc.)

- Total metals (Dissolved Metals)
- Total Phenolic Compounds
- Cyanide
- Sulfate and Chloride
- Turbidity
- Nitrate and Ammonia
- Radionuclides

10. For pre-preserved bottles, avoid completely submerging the bottle and overfilling to prevent preservative loss. Pre-preserved VOC vials should be filled from a second, unpreserved, pre-cleaned glass container. Never transfer samples from dissimilar bottle types (i.e., plastic to glass or glass to plastic).

11. Collect a separate sample of approximately 200 ml into an appropriate container prior to collecting the first and following the last surface water sample collected to measure the following field parameters:

Parameter	Units
Dissolved Oxygen	parts per million (ppm)
Specific Conductance	mmhos/cm or mS or mS
pH	pH units
Temperature	°C or °F
Turbidity	NTU
Eh (*optional*)	mV
PID VOCs (*optional*)	ppm

Record all field measurements on a Surface Water Quality Field Collection Log form (sample attached).

12. Record available information for the pond, stream or other body of water that was sampled, such as its size, location and depth in the Project Field Book and on the Surface Water Quality Field Collection Log form (sample attached). Approximate sampling points should be identified on a sketch of the water body.

13. Label, store and ship all samples in accordance with the TurnKey's Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

ATTACHMENTS

Surface Water Quality Field Collection Log (sample)

REFERENCES

<u>TurnKey FOPs:</u>

007	*Calibration and Maintenance of Portable Dissolved Oxygen Meter*
008	*Calibration and Maintenance of Portable Field pH/Eh Meter*
009	*Calibration and Maintenance of Portable Field Turbidity Meter*
012	*Calibration and Maintenance of Portable Specific Conductance Meter*
046	*Sample Labeling, Storage and Shipment Procedures*

SURFACE WATER
QUALITY FIELD COLLECTION LOG

PROJECT INFORMATION

Project Name:
Project No.:
Client:

SAMPLE DESCRIPTION

I.D.:
Matrix:
Location:

SAMPLE INFORMATION

Date Collected:
Time Collected:
Date Shipped to Lab:
Collected By:
Sample Collection Method:

LABORATORY ANALYSIS

SAMPLING INFORMATION

Weather:
Air Temperature:
Depth of Sample:

Parameter	First	Last	Units
pH			units
Temp.			°C
Cond.			mS
Turbidity			NTU
Eh			mV
D.O.			ppm
Odor			olfactory
Appearance			visual

LOCATION SKETCH

(not to scale, dimensions are approximate)

SAMPLE

EXACT LOCATION (if applicable)

Northing (ft)	Easting (ft)	Surface Elevation (fmsl)

ADDITIONAL LABORATORY ANALYSIS:

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Well/Piezometer Construction Materials and Design

FOP 070.0

WELL/PIEZOMETER CONSTRUCTION MATERIALS AND DESIGN

PURPOSE

This guideline presents construction materials and design requirements for monitoring well/piezometer installations in accordance with NYSDEC recommended specifications (6NYCRR Part 360).

CONSTRUCTION MATERIALS

1. Well Screen and Riser – Only new flush threaded screen and riser materials will be used. Screen and riser materials, well dimensions, screen slot opening size and length to be determined based on formation characteristics and suspect water quality or as specified by the project geologist/hydrogeologist. A vented cap or J-plug should be placed over the riser. A V-slot cut in the riser or permanent marking, both placed on the north side of the riser, will act as a monitoring reference point.

2. Bentonite Well Seal – The bentonite should be from a commercial source free of chemical additives (granular or powdered for grout and pelletized for seal).

3. Concrete – Low heat of hydration concrete should be used for grout and cementing protective casing if well construction materials are composed of PVC (ASTM Type II or Type IV Portland Cement).

4. Water – Water should be from a potable source of known chemistry and free of chemical constituents which may compromise integrity of installation.

5. Grout – Mixture of bentonite, cement and water in accordance with the following specifications. Premix bentonite and water prior to adding cement.

   <u>Grout Slurry Composition (% Weight)</u>

   1.5 to 3.0% - Bentonite (Quick Gel)
   40 to 60 % - Cement (Portland Type I)
   40 to 60 % - Potable Water

6. Filter Pack – The filter pack should consist of clean, inert, siliceous, rounded to subrounded particles. Filter pack particle size is dependent on the formation and the slot size of the screen.

   A secondary filter about 6-inches thick may be placed between filter pack and the bentonite seal and potentially between the bentonite seal and the grout backfill, to minimize grout penetration of the seal. A uniformly graded fine sand (100% passing No. 30 sieve) should be used as a secondary filter.

7. Protective Casing, Locking Cap and Lock – Protective casing with a lockable cap should be cemented in place around the riser. The inside diameter of the protective casing should be a minimum of 2-inches larger than the outside diameter of the well riser. The annular space between the casing and the riser should be filled with pea gravel or coarse sand. A weep hole should be drilled near the base of the casing to facilitate drainage of standing water. If more than one well is installed, all locks should be keyed alike.

8. A sample of all cement, bentonite and sand used in well construction should be saved in a labeled, Teflon-sealed, precleaned glass jar.

REFERENCES

New York State Department of Environmental Conservation, July 1988, *Drilling and Monitoring Well Installation Guidance Manual.*

Driscoll, F.G., 1987, *Groundwater and Wells*, Johnson Division, St. Paul, Minnesota, p. 1089.

Sara, M. N., *Proposed Recommended Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers: ASTM Subcommittee D18.21.*

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Real-Time Air Monitoring During Intrusive Activities

FOP 073.0

REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

PURPOSE

This guideline presents requirements for real-time community air monitoring and required responses during all project required intrusive activities, such as drilling, test pitting, earthwork construction etc. This procedure is consistent with the requirements for community air monitoring for all intrusive projects, including projects conducted at remediation sites, as established by the New York State Department of Health (NYSDOH) and the New York State Department of Environmental Conservation (NYSDEC). Accordingly, this Field Operating Procedure (FOP) follows procedures and practices outlined under the NYSDOH's generic Community Air Monitoring Plan dated June 20, 2000 and NYSDEC Technical Assistance and Guidance Memorandum (TAGM) 4031: Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites.

This FOP requires real-time monitoring for constituents of concern (COC) (i.e., volatile organic compounds (VOCs), lower explosive limit (% LEL), particulates (i.e., dust) etc.) at the upwind and downwind perimeter as well as the exclusion zone of a project site during all intrusive activities. This FOP is not intended for use in establishing action levels for worker respiratory protection (see Project Health and Safety Plan (HASP) for worker protection action levels). Rather, its intent is to provide a measure of protection for the surrounding community from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The community, as referenced in this document, includes any off-site residences, public buildings/grounds and commercial or industrial establishments adjacent to the project site. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, this FOP helps to confirm that work activities did not spread contamination off-site through via air transport mechanisms. Community air monitoring shall be integrated with the construction worker personal exposure-monitoring program contained in the project and site-specific HASP.

MONITORING & MITIGATION PROCEDURE

Real-time air monitoring for COC levels at the upwind and downwind perimeter as well as the exclusion zone of the project site will be required. The perimeter locations of monitoring stations will be established based on the location of the exclusion zone (i.e., immediate work area) and wind direction. Where wind direction is shifting or winds are calm, the downwind monitoring location will default to the perimeter location nearest the most sensitive receptor (i.e., residential property). All downwind receptors being equal, the downwind monitoring location will default to the perimeter location downwind of the prevailing winds at the site. Real-time air monitoring will be required for all ground intrusive activities at a minimum of 30-minute intervals. Ground intrusive activities include, but are not limited to, soil/fill excavation and handling, test pitting or trenching, borehole advancement and monitoring well installation. Although additional site specific COCs may be monitored during real-time air monitoring activities, the most common COCs are discussed in this FOP, including organic vapors (i.e., VOCs), airborne particulates (i.e., fugitive dust) and combustible gases (i.e., methane) and oxygen.

ORGANIC VAPORS

Ambient organic vapor concentrations should be measured prior to commencing intrusive activities each workday and a minimum of every 30-minutes thereafter. Air monitoring activities should be performed using equipment appropriate to measure the types of COCs known or suspected to be present. The equipment should be calibrated daily for the COCs or for an appropriate surrogate. All organic vapor readings must be recorded in the Project Field Book and/or Real-Time Air Monitoring Logs (sample attached) and, if applicable, be made available for State (DEC and DOH) personnel to review.

Mitigation upon the detection of various action levels of organic vapors are presented below:

- If the sustained ambient air concentration of total organic vapors at the downwind perimeter of the site exceeds a reading of 5 parts per million (ppm) above background, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If sustained total organic vapor levels at the downwind perimeter of the site persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions and monitoring continued. Following organic vapor mitigation, work activities can resume provided that the sustained total organic vapor level 200 feet downwind of the exclusions zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less, (but in no case less than 20 feet) is below a sustained value of 5 ppm over background.

- If the sustained organic vapor level is above 25 ppm at the downwind perimeter of the site, the designated Site Safety and Health Officer must be notified and work activities shut down. The Site Safety and Health Officer will determine when re-entry of the work zone is possible and will implement downwind air monitoring to ensure vapor emissions do not impact the nearest off-site residential or commercial structure at levels exceeding those specified under the Major Vapor Emission Monitoring program described below.

Major Vapor Emission Monitoring

- If the sustained organic vapor level is greater than 5 ppm over background 200 feet downwind from the site or half the distance to the nearest off-site receptor (residential or commercial structure), whichever is less, all work activities must be halted. If, following the cessation of the work activities or as the result of an emergency, organic levels persist above 5 ppm above background 200 feet downwind or half the distance to the nearest off-site residential or commercial structure from the site perimeter, then the air quality must be monitored within 20 feet of the perimeter of the nearest off-site receptor (20-foot zone).

- If efforts to abate the emission source are unsuccessful and if organic vapor levels approach or exceed 5 ppm above background within the 20-foot zone for more than 30 minutes, or are sustained at levels greater than 10 ppm above background for longer than one minute, then the Major Vapor Emission Response Plan will automatically be placed into effect (see next section).

Major Vapor Emission Response Plan

Upon activation of Major Vapor Emission Response Plan, the following activities will be undertaken:

1. All Emergency Response Contacts as listed below and in the Site-Specific Health and Safety Plan will be contacted.

2. The local police authorities will immediately be contacted by the Site Safety and Health Officer and advised of the situation.

3. Frequent air monitoring will be conducted at 30-minute intervals within the 20-foot zone. If two successive readings below action levels are measured, air

monitoring may be halted or modified by the Site Safety and Health Officer.

4. The Site Safety and Health Officer will determine if site workers can safely undertake source abatement measures. Abatement measures may include covering the source area with clean fill or plastic sheeting, or consolidating contaminated materials to minimize surface area. The Site Safety and Health Officer will adjust worker personal protective equipment as necessary to protect workers from over-exposure to organic vapors.

The following personnel are to be notified by the Site Safety and Health Officer in the listed sequence if the Major Vapor Emission Response Plan is activated:

Contact	**Phone**
Police/Fire Department	911
New York State Dept. of Health	(716) 847-4502
New York State Dept. of Environmental Conservation	(716) 851-7220
State Emergency Response Hotline	(800) 457-7362

In addition, the Site Safety and Health Officer will provide these authorities with a description of the apparent source of the contamination and abatement measures being taken by the contractor, if any.

AIRBORNE PARTICULATES

Fugitive dust suppression and airborne particulate monitoring shall be performed during any intrusive activities involving disturbance or handling of site soil/fill materials. Fugitive dust suppression techniques will include the following minimum measures:

- Excavated stockpiles will be seeded or covered with clean soil or synthetic materials (e.g., tarps, membranes, etc.) whenever stockpiling activities cease for a period of longer than 90 days.

- Spraying potable water on all excessively dry work areas and roads.

- All fill materials leaving the site will be hauled in properly covered containers or haul trailers.

- Additional dust suppression efforts may be required as discussed below.

Particulate concentrations should be measured prior to commencing intrusive activities each workday and a minimum of every 30-minutes thereafter. The particulate monitoring should be performed using equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level and calibrated daily. In addition, fugitive dust migration should be visually assessed during all work activities. All air borne particulate readings must be recorded in the Project Field Book and/or Real-Time Air Monitoring Logs (sample attached) and, if applicable, be made available for State (DEC and DOH) personnel to review. Mitigation upon the detection of various action levels of airborne particulates are presented below:

- If the sustained downwind PM-10 particulate level is 100 micrograms per cubic meter (ug/m^3) greater than background (upwind perimeter) or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 ug/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, sustained downwind PM-10 particulate levels are greater than 150 ug/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures, such as those described the Supplemental Dust Suppression section below are employed and are successful in reducing the downwind PM-10 particulate concentration to within 150 ug/m^3 of the upwind level and in preventing visible dust migration.

Visual Assessment

In conjunction with the real-time monitoring program, TurnKey personnel and any subcontractors thereof will be responsible for visually assessing fugitive dust migration from the site. If airborne dust is observed leaving the site, the work will be stopped until supplemental dust suppression techniques are employed in those areas.

Supplemental Dust Suppression

Supplemental dust suppression techniques may include but are not necessarily limited to the following measures:

- Reducing the excavation size, number of excavations or volume of material handled.
- Restricting vehicle speeds.
- Applying water on buckets during excavation and dumping.
- Wetting equipment and excavation faces.
- Wetting haul roads.
- Restricting work during extreme wind conditions.

- Use of a street sweeper on paved haul roads, where feasible.

Work can resume using supplemental dust suppression techniques provided that the measures are successful in reducing the sustained downwind particulate concentration to below 150 ug/m^3 above background, and in preventing visible dust migration off-site.

COMBUSTIBLE GASES & OXYGEN

Ambient combustible gas and oxygen concentrations should be measured prior to commencing intrusive activities each workday and a minimum of every 30-minutes thereafter. Air monitoring activities should be performed using equipment appropriate to measure combustible gases in percent lower explosive limit (LEL) and percent oxygen and calibrated daily. All combustible gas and oxygen readings must be recorded in the Project Field Book and/or Real-Time Air Monitoring Logs (sample attached) and, if applicable, be made available for State (DEC and DOH) personnel to review.

Mitigation upon the detection of various action levels of organic vapors are presented below:

Combustible Gas:

- If the sustained ambient air concentration of combustible gas at the downwind perimeter of the site exceeds a reading of 10 to 25% LEL, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 10% LEL, work activities can resume with continued monitoring.

- If sustained combustible gas levels at the downwind perimeter of the site persist at levels in excess of 25% LEL, work activities must be halted, the source of explosion hazards identified, corrective actions taken to abate emissions and monitoring continued. Following combustible gas mitigation, work activities can resume provided that the sustained total organic vapor level 200 feet downwind of the exclusions zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less, (but in no case less than 20 feet) is below a sustained value of 10% LEL.

Oxygen:

- If the sustained ambient oxygen concentration at the downwind perimeter of the site measures a reading between 19.5% - 21% oxygen, work activities can continue with extreme caution, however attempts to determine the potential source of oxygen displacement must be conducted.
- If the sustained oxygen level readily decreases below 19.5% LEL, work activities should be discontinued and all personnel must leave the area immediately.
- If the sustained oxygen level at the downwind perimeter of the site persists at levels between 21-25%, work activities can resume with caution.
- If the sustained oxygen level at the downwind perimeter of the site persists at levels exceeding 25% (fire hazard potential), work activities should be discontinued and all personnel must leave the area immediately.

ATTACHMENTS

Real-Time Air Monitoring Log (sample)

REFERENCES

TurnKey FOPs:

006	*Calibration and Maintenance of Combustible Gas/Oxygen Meter*
010	*Calibration and Maintenance of Flame Ionization Detector*
011	*Calibration and Maintenance of Portable Photoionization Detector*
xxx	*Calibration and Maintenance of Portable Particulate Meter (as per Manufacturers Specifications)*

REAL TIME AI

Date:

Project Name:

Project Number:

Project Location:

Client:

Purpose of Air Monitoring:

WEATHER CONDITIONS:

Time of Day:	A.M.
Ambient Air Temp.:	
Wind Direction:	
Wind Speed:	
Precipitation:	

Date	Personnel	Time	Air Monitoring Meter Measurement (Units)							Locatio
			PID (ppm)	LEL (%)	H2S (ppm)	O2 (%)	CO (ppm)	Particulates (mg/m^3)	Other	

SAMPLE

NOTE: SEE EQUIPMENT CALIBRATION LOG FOR DESCRIPTION OF EQUIPMENT TYPE.

Prepared By:

APPENDIX B

LABORATORY CERTIFICATIONS & QUALITY ASSURANCE MANUAL

(PROVIDED ON REQUEST)

APPENDIX C

RÉSUMÉS

(PROVIDED ON REQUEST)