Quality Assurance Project Plan

for Remedial Investigation Work Plan

Buffalo Development Corporation Hotel Site Buffalo, New York

July 2006

0099-003-100

Prepared For:

Buffalo Development Corporation

Prepared By:



Buffalo Development Corporation Site

Table of Contents

1.0	INTRODUCTION		
	1.1	Background	1
	1.2	QAPP Preparation Guidelines	2
	1.3	Scope of the QAPP	2
	1.4	Project Description	4
		1.4.1 Project Objectives	
		1.4.2 Project Overview	
	1.5	Project Schedule	
2.0	PROJECT ORGANIZATION AND RESPONSIBILITY		
2.0	2.1	Management Responsibilities	6
	2.1	2.1.1 NYSDEC and NYSDOH	
		2.1.2 Benchmark Environmental Engineering and Science, PLLC	
	2.2	Quality Assurance (QA) Responsibilities	8
	2.3	Field Responsibilities	(
	2.4	Laboratory Responsibilities	(
	2.4	Other Subcontractor Personnel	
	2.3	2.5.1 Independent Third-Party Data Validator	
		2.5.2 Drilling Subcontractors	
	2.6	Project Organization Chart	
	2.7	Special Training Requirements and Certifications	
	2.1	2.7.1 Training Requirements and Certifications	
		2.7.2 Data Validator Certification	1
	2.8	Contacts	
	2.0	Contacts	
3.0	Q UA	ALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA	1
	3.1	Precision	
	3.2	Accuracy	10
	3.3	Completeness	1′
	3.4	Data Representativeness	1
	3.5	Comparability	
	3.6	Level of QC Effort for Sample Parameters	
			24
4.0		IPLING AND ANALYSIS PLAN	
	4.1	Field Investigation Activities	20
		4.1.1 Supplemental Soil Investigation	
		4.1.2 Sub-grade Vapor Sampling	
		4.1.3 Supplemental Groundwater Investigation	
		4.1.3.1 Piezometer/Monitoring Well Installation	2

Buffalo Development Corporation Site

Table of Contents

		4.1.3.2 Well Development	23
		4.1.3.3 Groundwater Sample Collection	
		4.1.3.4 Groundwater Sample Analyses	
		4.1.4 Field Specific Quality Assurance/Quality Control Sampling	26
	4.2	Investigative Derived Waste (IDW)	
	4.3	Site Mapping	27
5.0	CUSTODY PROCEDURES		28
	5.1	Field Custody Procedures	28
	5.2	Laboratory Custody Procedures	
		5.2.1 Sample Receipt	
		5.2.2 Sample Storage	
		5.2.3 Sample Custody	31
		5.2.4 Sample Tracking	
		5.2.5 Sample Disposal	33
	5.3	Project File	33
6.0	CAL	CALIBRATION PROCEDURES AND FREQUENCY	
	6.1	Field Instrument Calibration	
	6.2	Laboratory Instrument Calibration	
7.0	ANALYTICAL PROCEDURES		
	7.1	Field Analytical Procedures	36
	7.2	Laboratory Analytical Procedures	
		7.2.1 Sample Preparation and Analytical Methods	
		7.2.2 Confirmation Analysis Methods	
		7.2.3 Method Validation	
8.0	INT	ERNAL QUALITY CONTROL CHECKS	39
	8.1	Field Quality Control Checks	39
	8.2	Laboratory Quality Control Checks	
9.0	DAT	TA REDUCTION, VALIDATION, AND REPORTING	41
		Data Reduction.	
	- • •	9.1.1 Field Data Reduction Procedures.	
		9.1.2 Laboratory Data Reduction Procedures	41
	9.2	Data Usability Evaluation	
		9.2.1 Procedures Used to Evaluate Field Data Usability	
		9.2.2 Procedures Used to Evaluate Laboratory Data Usability	
	9.3	Data Reporting	

Buffalo Development Corporation Site

Table of Contents

		9.3.1 Field Data Reporting	44
		9.3.2 Laboratory Data Reporting	44
10.0	PERF	FORMANCE SYSTEM AUDITS AND FREQUENCY	45
		Field Performance and System Audits	
		10.1.1 Internal Field Audits	
		10.1.2 External Field Audits	45
	10.2	Laboratory System Audits	45
		10.2.1 Internal Laboratory Audits	
		10.2.2 External Laboratory Audits	
	10.3	Laboratory Performance Audits	
		10.3.1 Internal Performance Audit	
		10.3.2 External Performance Audit.	49
11.0	PREV	/ENTATIVE MAINTENANCE	50
		Field Instrument Preventative Maintenance	
		Laboratory Instrument Preventative Maintenance	
		Inspection/Acceptance Requirements for Supplies and Consumables	
		11.3.1 Field Supplies and Consumables	
		11.3.2 Laboratory Supplies and Consumables	
12.0	DATA PRECISION, ACCURACY, AND COMPLETENESS EVALUATION		53
	12.1	Accuracy Assessment	53
		Precision Assessment	
		Completeness Assessment	
		Assessment of Data	
13 N	CORI	RECTIVE ACTION	57
20.0		Field Corrective Action.	
		Laboratory Corrective Action	
		Data Validation & Assessment Corrective Action	
110	Otta	A MANA CONTRACTOR DE PROPERTO TO MANA CONTRACTOR	(0
14.0	-	LITY ASSURANCE REPORTS TO MANAGEMENT	
		Contents of Project QA Reports	
		Frequency and Distribution of QA Reports	
	14.3	Individuals Receiving/Reviewing QA Reports	61
15.0	REFE	ERENCES	62

Buffalo Development Corporation Site

Table of Contents

LIST OF TABLES

Analytical Parameters for Soil Samples
Analytical Parameters for Groundwater Samples
Project Goals for Precision, Accuracy, and Completeness for Laboratory Measurements
Project Goals for Precision, Accuracy, and Completeness of Field Measurements
Data Measurement Units for Field and Laboratory Parameters
Analytical Program Quality Assurance/Quality Control Summary
Summary of Field Operating Procedures
Sample Container, Volume, Preservative and Holding Time Requirements
LIST OF FIGURES
Site Location and Vicinity Map
Site Plan
RI Sampling Locations
RI Project Schedule
Project Responsibilities Flow Chart
ATTACHMENTS

Appendix A	Field Operating Procedures
Appendix B	Laboratory Certifications and Quality Assurance Manual
Appendix C	Résumés

iv



1.0 Introduction

This Quality Assurance Project Plan (QAPP) presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the proposed scope of work for the investigation described in the Remedial Investigation (RI) Work Plan to be implemented at 275-277 Franklin Street, 279 Franklin Street and 432 Pearl Street (see Figure 1). The RI is being performed by Benchmark Environmental Engineering & Science, PLLC (Benchmark) on behalf of Buffalo Development Corporation in accordance with New York State Department of Environmental Conservation (NYSDEC) DER-10 guidance. A Sampling and Analysis Plan 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 RI is presented in Section 4.0 of this QAPP.

1.1 Background

The Site encompasses three parcels in the City of Buffalo, New York identified as 275-277 Franklin Street (~0.13 acres), 279 Franklin Street (~0.12 acres), and 432 Pearl Street (~0.44 acres) (see Figure 2). The Site is bounded by a restaurant and surface parking lot to the north and east, Pearl Street to the east, a surface parking lot and apartment building to the south and west and Franklin Street to the west.

The Site has been used for various purposes since the late 1800s. 275-277 Franklin Street was used as a dry cleaner from at least 1951 through the early 2000s. 279 Franklin Street was used for residential purposes from the late 1800s through at least 1951 and a parking lot from at least 1981 to the present. 432 Pearl Street was developed with various residential and commercial structures from the late 1800s through 1981 and has apparently been used as a surface parking lot since 1981. Of note, "Martin Fischer and Sons Hot Air Heaters" was noted on this portion of the Site in 1925 (Ref. 2).

A Limited Environmental Investigation was performed at 275-277 Franklin Street by Nature's Way Environmental Consultants & Contractors, Inc. in September 2004 (Ref. 3). The results of that investigation indicated that Site soils and groundwater have been impacted by tetrachloroethene (PCE), a chlorinated volatile organic compound (VOC), typically associated with dry cleaning operations.

1



In March 2006, Benchmark performed a Preliminary Site Investigation at 275-277 Franklin Street, 279 Franklin Street, 432 Pearl Street, and 470 Pearl Street (Refs. 4 and 5). The Preliminary Site Investigation was performed to assess soil/fill materials and soil vapor on-site and to ascertain if subsurface environmental conditions on these parcels were likely to impact Site redevelopment. The results of the investigation indicate that Site soils have been impacted by semi-volatile organic compounds (SVOCs), mercury, and lead. In addition, soil vapor samples collected from 279 Franklin Street and 432 Pearl Street contained several chlorinated VOCs.

1.2 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.

1.3 Scope of the QAPP

This QAPP was prepared to provide quality assurance (QA) guidelines to be implemented during the RI 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 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 QA/QC 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 to applicable codes and design specifications). QA is an overview monitoring of the performance of QC activities through audits rather than first time inspections.

3



1.4 Project Description

1.4.1 Project Objectives

For sites entering the BCP at the point of investigation, NYSDEC requires completion of an RI to delineate the nature and extent of contamination on the property and potentially impacted off-site areas. The primary objectives of the RI are to:

- Collect additional groundwater and soil/fill samples, under strict quality assurance/quality control criteria, as necessary to confirm previous investigation results and fill data gaps.
- Determine if the concentrations of constituents of concern in site soil and/or groundwater pose potential unacceptable risks to human health and the environment.

1.4.2 Project Overview

Field team personnel will collect environmental samples in accordance with the rationale and protocols described in Section 4.0 and Appendix A (Field Operating Procedures) of this QAPP. NYSDEC-approved sample collection and handling techniques will be used. Samples for chemical analysis will be analyzed in accordance with NYSDEC ASP-2000 CLP methodology to meet the definitive-level data requirements. Laboratory analyzed water quality parameters and/or samples analyzed for other non-characterization purposes (e.g., to facilitate evaluation of treatability) will be performed by a laboratory using NYSDEC/USEPA-approved standard methods as identified in USEPA Methods for Chemical Analysis of Water and Wastes (40 CFR Part 136) or USEPA (SW 846) protocols. Analytical results will be evaluated by a qualified third-party data validation expert.



0099-003-100 4

1.5 Project Schedule

RI activities are expected to begin at the site in August 2006 and be completed within 2-3 weeks. Laboratory results should be available within three weeks after sample submittal. A draft RI report should be submitted to the NYSDEC and the NYSDOH approximately two months after completion of the field activities. Figure 3 presents a tentative project schedule for the major tasks to be performed in support of the RI.

5

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The principal organizations involved in verifying achievement of RI goals for the Site include: the NYSDEC, 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 RI 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 the remedial investigation and to confirm that the QA Plan was followed.

• NYSDEC Representative(s):

Martin Doster, P.E., Project Manager Gene Melnyk, P.E., Project Engineer

• NYSDOH Representative:

Cameron O'Connor, Project Manager

2.1.2 Benchmark Environmental Engineering and Science, PLLC

Benchmark Environmental Engineering and Science, PLLC (Benchmark) is the prime consultant on this project and is responsible for the performance of all services required to implement the RI 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 Benchmark'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 QA, field, laboratory and management responsibilities of key project personnel are defined below.



• <u>Benchmark Project Manager (PM):</u>

Patrick Martin, P.E.

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

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

- o Define daily develop work activities.
- o Orient field staff concerning the project's special considerations.

7

o Monitor and direct subcontractor personnel.



- o Review the work performed on each task to ensure its quality, responsiveness, and timeliness.
- o 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 Appendix C 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 Benchmark 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.

• <u>Project QA Officer:</u>

Lori E. Riker, P.E.

Specific function and duties include:

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

8

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



2.3 Field Responsibilities

Benchmark field personnel for this project are drawn from a pool of qualified resources. The Project Manager will utilize 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

Severn Trent Laboratories, Inc. (STL), the environmental laboratory retained by Benchmark located at 10 Hazelwood Drive, Amherst, New York 14228, is an independent, NY State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified facility approved to perform the analyses prescribed herein. STL also has NYSDOH Contract Laboratory Program (CLP) certification while maintaining ASP accreditation. Results of recent CLP proficiency test data are provided in Appendix B. STL 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.

• <u>STL Client Services Manager:</u> 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.

• STL Laboratory Director:

Chris Spencer

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

o Provide technical, operational, and administrative leadership.

9

- o Allocation and management of personnel and equipment resources.
- o Quality performance of the facility.
- o Certification and accreditation activities.
- o Blind and reference sample analysis.



STL Quality Assurance Director (QA Director):

Verl Preston

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

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

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

• STL Sample Management Office:

Ken Kinecki

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

- o Receiving and inspecting the incoming sample containers.
- o Recording the condition of the incoming sample containers.
- o Signing appropriate documents.
- o Verifying chain-of-custody.
- o Notifying laboratory manager and laboratory supervisor of sample receipt and inspection.
- o Assigning a unique identification number and customer number, and entering each into the sample-receiving log.
- o With the help of the laboratory manager, initiating transfer of the samples to appropriate lab sections.
- o Controlling and monitoring access/storage of samples and extracts.

STL Technical Staff (TS):

The TS will be responsible for sample analyses and identification of corrective actions. The staff will report directly to the 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 Benchmark, 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:

<u>Data Usability:</u>

Judy Harry, Data Validation Services

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

- o Completeness of the data package as defined under the requirements of NYSDEC ASP-2000 CLP methodology Category B.
- o Compliance with required holding times.
- o Sample chain-of-custody forms
- o QC analysis data, including blanks, instrument tunings, calibrations, spikes, surrogate recoveries, duplicates, laboratory controls and sample data.
- o 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 QC problems encountered. Data deficiencies, analytical method protocol deviations, and QC 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).



2.5.2 Drilling Subcontractors

Earth Dimensions and TREC Environmental, the drilling subcontractors retained by Benchmark, will be responsible for assisting in performing well installation, sample collection, and investigation activities as directed by Benchmark.

• Earth Dimensions Drilling Project Manager:

Brian Bartron

TREC Environmental Drilling Project Manager:

Keith Hambley

2.6 Project Organization Chart

The lines of authority specific to this investigation are presented in Figure 5. 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 subject investigation. 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 analyses that require specialized training.

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

12



<u>Data validation:</u> 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 most current methods and quality control criteria from USEPA's Contract Laboratory Program (CLP) National Functional Guidelines for Organic and Inorganic Data Review and USEPA Region 2 guidelines.

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:

Robert Knoer, Esq.:

Counsel to volunteer

Knoer, Crawford & Bender, LLP 14 Lafayette Square, Suite 1700

Buffalo, New York 14203 Office: (716) 855-1675

Patrick Martin, P.E:

Project Manager

Benchmark Environmental Engineering and Science

726 Exchange Street Buffalo, New York 14210 Office: (716) 856-0599 Mobile: (716) 864-1730

Lori Riker, P.E.:

Benchmark Environmental Engineering and Science

Project Quality Assurance Officer

726 Exchange Street Buffalo, New York 14210 Office: (716) 856-0599

<u>Iim Stellrecht:</u>

Laboratory Client Services Manager

Severn Trent Laboratories, Inc. 10 Hazelwood Drive, Suite 106 Amherst, New York 14228

(716) 691-2600

Martin Doster:

NYSDEC Project Manager

NYSDEC

Department of Environmental Remediation

270 Michigan Avenue Buffalo, NY 14203 (716) 851-7220



QAPP FOR RI WORK PLAN BUFFALO DEVELOPMENT CORPORATION HOTEL SITE

Mr. Cameron O'Connor: NYSDOH Project Manager

NYSDOH Western Regional Office 584 Delaware Ave. Buffalo, NY 14202 (716) 847-4385



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 groundwater 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 Severn Trent Laboratories, Inc. (STL) under NYSDEC CLP analytical methods.

Analytical methods and detection/reporting limits for chemical parameters to be analyzed during the RI for soil and groundwater are listed in Tables 1 and 2. Water levels and select water quality parameters (i.e., pH, turbidity, specific conductance, temperature) will be measured in the field as described in the FOPs (see Appendix A).

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 QA objectives are presented in the analytical laboratory's QA/QC Plan (see Appendix B). STL is the analytical laboratory selected to analyze environmental samples for this RI.

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 calculation of relative standard deviations (RSD) for three or more replicate samples. The equations to be used to verify precision for this investigation are found in Section 12.1 of this QAPP. General precision goals are provided in Table 3.

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 and field duplicate samples. Precision for field parameters, including pH, turbidity, specific conductance, and temperature will be determined through duplicate analysis of 1 in every 20 samples. Precision control limits for field measured parameters are provided in Table 4.

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. One trip blank will accompany each batch of water matrix sample containers shipped to the laboratory for VOC analysis. Laboratory accuracy is assessed through the analysis of a MS/MSD samples (1 per 20), 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.

Accuracy for field measured parameters including pH, turbidity, specific conductance, and temperature will be assessed through instrument calibration standards discussed in instrument calibration and maintenance FOPs (see Section 4.0). Accuracy control limits for field measured parameters are provided in Table 4.



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 Sections 3.1, 3.2, and 9.0 to ensure that the data collected are valid and significant.

As shown on Table 3, the laboratory completeness objectives for this investigation 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. An ASP CLP Category B deliverables package will be required in support of third-party data review.

3.4 Data Representativeness

Data representativeness expresses the degree to which data accurately and precisely represents 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.

Performance System Audits (see Section 10.0) and the proper execution of field activities are the main mechanisms for ensuring data representativeness. Representativeness in the laboratory is ensured through the use of 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 (see 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.

Environmental samples will be analyzed by STL using consistent protocols for sample preservation, holding times, sample preparation, analytical methodology, and QC as described in NYSDEC ASP-2000.

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, trip 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 and summarized in Table 6.

- Field (equipment) blank samples are analyzed to check for potential crosscontamination if improperly cleaned/non-dedicated sampling equipment is used.
- Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage.
- 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.

19

4.0 SAMPLING AND ANALYSIS PLAN

The selection and rationale for the RI sampling program is discussed in the RI Work Plan. Methods and protocol to be used to collect environmental samples (i.e., soil, soil vapor and groundwater) for this investigation are described in the Benchmark Field Operating Procedures (FOPs) presented in Appendix A of this QAPP. Table 7 is a summary of the FOPs to be used during this investigation.

The number and type of environmental samples to be collected, parameter lists, required detection limits, and sample container requirements for each matrix (i.e., groundwater and soil samples) are summarized in Tables 1, 2, 6, and 8. The sampling program and related site activities are discussed below. To the extent allowed by existing physical conditions at the facility, sample collection efforts will adhere to the specific methods presented herein. If alternative sampling locations or procedures are implemented in response to facility specific constraints, each will be selected on the basis of meeting data objectives. Such alternatives will be approved by NYSDEC before implementation and subsequently documented for inclusion in the project file.

4.1 Field Investigation Activities

4.1.1 Supplemental Soil Investigation

A supplemental soil investigation will be completed to delineate VOC-impact on-site Figure 3 depicts planned soil boring locations. The soil investigation will employ both direct-push and hollow-stem auger drilling techniques. Ten soil borings will be advanced to approximately 16 fbgs. However, soil borings will continue if field observations suggest VOC impact within soils at 16 fbgs. Soil samples will be collected from all soil borings as described below. All soil samples will be field screened for the presence of VOCs using a field photoionization detector (PID) as a procedure for ensuring the health and safety of personnel at the Site and to identify potentially impacted soil samples for laboratory analysis. Upon reaching the completion depth of each boring, PID and visual/olfactory results will be reviewed. The sample interval identified as the most impacted (i.e., greatest PID scan result and/or evidence of visual/olfactory impact) will be selected for analysis. In the event that either the impacts are ubiquitous from grade to final depth or no impacts were identified, the soil/fill horizon above the native soils will be selected for analysis.



Soil samples will be collected using dedicated stainless steel sampling tools. Representative soil samples will be placed in pre-cleaned laboratory provided sample bottles, cooled to 4°C in the field, and transported under chain-of-custody command to Severn Trent Laboratories, Inc. (STL), located in Amherst, New York, a New York State Department of Health (NYSDOH) ELAP-certified analytical laboratory. Each soil sample will be analyzed for TCL VOCs in accordance with NYSDEC ASP CLP methodology.

4.1.2 Sub-grade Vapor Sampling

Two samples will be collected and analyzed for sub-grade vapors. These samples will be used to evaluate whether VOC vapors from the former drycleaner have migrated to the area of planned building locations. As shown on Figure 3, the samples will be collected from 432 Pearl Street.

At each location, Benchmark personnel will drill an approximately 3/4-inch diameter hole through the asphalt (est. 4-6 inches thick) using a hand-held drill. Approximately 6 inches of soil will then be drilled from beneath the hole. An appropriately sized silicone stopper fitted with a ½-inch hollow Teflon tube will then be inserted into the core hole and sealed using modeling clay. A 6-liter Summa canister fitted with an 8-hour regulator will be attached to the opposite end of the Teflon tubing. Three volumes will be purged from the sampling line before initiating Summa canister sampling. Purging will be performed with a vacuum pump or syringe. Traffic cones will be used to mark and protect the canisters.

Concurrent with the sub-grade vapor samples, one outdoor field-located air sample will be collected from a ground level location upwind of the properties, as determined on the day of sub-grade vapor sampling field activities.

All Summa canister valves will remain closed until the borings are complete, purged, and all of the canisters are in their respective positions. The valves will then be opened for the 8-hour collection period. Following sample collection, the Summa canisters will be shipped to an NYSDOH-approved laboratory for analysis of USEPA Target Compound List (TCL) Volatile Organic Compounds in accordance with USEPA Method TO-15. All openings will be repaired with asphalt cold patch.

4.1.3 Supplemental Groundwater Investigation

Previous investigations indicated that soil and shallow groundwater has been impacted by PCE. Based on the concentrations in shallow groundwater (i.e., up to 137,000



ug/L) and depth of PCE impact in soil (i.e., 10-12 fbgs), it is possible that PCE and/or its chemical degradation products (e.g., trichloroethylene, dichloroethylene, etc.) are present at deeper locations than previously investigated (i.e., up to 12 fbgs). As such, Benchmark will assess groundwater at varying depths.

Three new groundwater monitoring wells, designated as MW-1, MW-2 and MW-3, and eight new piezometers, designated as PZ-1 – PZ-8, will be installed at the locations shown on Figure 3. The new monitoring wells and piezometers will provide groundwater flow information as well as groundwater quality information. Monitoring well installation, well development, and groundwater sample collection are discussed in the following sections.

4.1.3.1 Piezometer/Monitoring Well Installation

Eight piezometers will be installed to better delineate the VOC-impact identified during previous investigations and to estimate shallow groundwater flow direction. Piezometers will be constructed of one-inch, flush-joint PVC fitted with a 10-foot, 0.10-inch well screen, and a riser cap. The piezometers will be installed using a direct-push drill rig to advance an approximate two-inch borehole approximately five to seven feet below first encountered groundwater, designed to straddle the groundwater table. Each well screen and attached riser will be placed at the bottom of each borehole and a silica sand filter pack (size #0) will be installed from the base of the well to a maximum of 2 feet above the top of the screen. A minimum 2-foot thick bentonite chip seal will then be installed. The newly installed piezometers will be completed with a riser cap and a six-inch diameter steel flush mounted road box. Water levels will be measured in the piezometers upon completion. As described in Section 3.3, a groundwater isopotential map will be prepared to illustrate groundwater flow direction.

Three additional soil borings will be advanced using hollow stem auger technology to facilitate installation of three groundwater monitoring wells, designated as MW-1 through MW-3 as shown on Figure 3. The newly installed monitoring wells will be used to assess groundwater at greater depths than the piezometers.

Based on a previous investigation, which identified chlorinated VOC-impact at 10-12 fbgs within saturated soils, deeper groundwater may be impacted. Each hollow-stem auger boring location will be advanced to the top of bedrock, estimated at approximately 30 fbgs, using hollow stem auger drilling methods. A 2-inch diameter, 2-foot long split spoon



sampler will be advanced ahead of the auger string with a standard 140-pound hammer falling freely over a 30-inch fall until 24 inches have been penetrated or 50 blows applied. Recovered samples will be described in the field by qualified Benchmark personnel using the Unified Soil Classification System (USCS), scanned for total volatile organic vapors with a calibrated PID equipped with a 10.6 eV lamp (or equivalent), and characterized for impacts via visual and/or olfactory observations. All non-dedicated drilling tools and equipment will be decontaminated between boring locations using potable tap water and a phosphate-free detergent (e.g., Alconox).

Subsequent to boring completion, a 2-inch diameter flush-joint Schedule 40 PVC monitoring well will be installed at boring locations MW-1, MW-2, and MW-3. Each well will be constructed with a 10-foot flush-joint Schedule 40 PVC, 0.010-inch machine slotted well screen. Each well screen and attached riser will be placed at the bottom of each borehole and a silica sand filter pack (size #0) will be installed from the base of the well to a maximum of 2 feet above the top of the screen. A bentonite chip seal will then be installed and allowed to hydrate sufficiently to mitigate the potential for downhole grout contamination. Cement/bentonite grout will be installed to approximately one-foot below ground surface via pressure tremie-pipe procedures. The newly installed monitoring wells will be completed with keyed alike locks, a lockable J-plug, and an 8-inch diameter steel flush mounted road box anchored within a 2-foot by 2-foot by 1-foot square concrete pad.

4.1.3.2 Well Development

Upon installation, but not within 24 hours, newly installed monitoring wells and piezometers will be developed in accordance with Benchmark and NYSDEC protocols. Development of the monitoring wells will be accomplished with dedicated disposable polyethylene bailers via surge and purge methodology. Field parameters including pH, temperature, turbidity and specific conductance will be measured periodically (i.e., every well volume or as necessary) during development. Field measurements will continue until they became relatively stable. Stability will be defined as variation between measurements of approximately 10 percent or less with no overall upward or downward trend in the measurements. A minimum of 10 well volumes will be evacuated from each monitoring well. Development water from the seven monitoring wells will be contained in 55-gallon steel drums.



4.1.3.3 Groundwater Sample Collection

Prior to sample collection, static water levels will be measured and recorded from all on-site monitoring wells and piezometers. Following water level measurement, Benchmark personnel will purge and sample monitoring wells MW-1, MW-2, MW-3 and piezometers PZ-1 through PZ-8 using a peristaltic pump and dedicated pump tubing following low-flow/minimal drawdown purge and sample collection procedures. Prior to sample collection, groundwater will be evacuated from each well at a low-flow rate (typically less than 0.1 L/min). Field measurements for pH, specific conductance, temperature, turbidity, and water level as well as visual and olfactory field observations will be periodically recorded and monitored for stabilization. Purging will be considered complete when pH, specific conductivity and temperature stabilize and when turbidity measurements fall below 50 Nephelometric Turbidity Units (NTU), or become stable above 50 NTU. Stability is defined as variation between field measurements of 10 percent or less and no overall upward or downward trend in the measurements. Upon stabilization of field parameters, groundwater samples will be collected and analyzed as discussed below.

Upon arrival at each monitoring well, field personnel will visually inspect the monitoring well for defects and/or vandalism. Following location and inspection of each well, the static water level and total depth will be recorded and one standing well volume will be calculated. The following bulletized list describes each sample collection method that may be implemented during the RI.

Peristaltic Pump with Dedicated Pump Tubing

Wells less than 20 fbgs will be purged and sampled using a peristaltic pump and dedicated pump tubing following low-flow (minimal drawdown) purge and sample collection procedures in a manner similar to that described in the previous section. However, the pump will not require decontamination because all components are dedicated to each monitoring well. In addition, groundwater samples collected for VOC analysis will not be sampled directly through the peristaltic pump due to potential degassing (i.e., loss of VOCs) of the groundwater sample. Instead, prior to collection of VOC samples, the pump will be turned off and the pressure on the flexible walled tubing within the pump head will be maintained in order to prevent water within the collection tubing from escaping. The tubing will be removed from the well and

24



coiled to prevent any contact with the ground surface. Upon removal of the tubing and prior to re-activating the pump, the pump flow direction will be reversed. Upon pump re-activation, the pumping rate will be slowly increased; positively displacing groundwater within the tubing allowing it to flow, without disturbance and degassing, into the appropriate VOC sample jars.

• Polyethylene Disposable Bailer

In the event of a pump malfunction, wells of any depth (up to 100 fbgs) may be purged and sampled using a polyethylene disposable bailer via direct grab. In general, a bottom filling dedicated polyethylene bailer is attached to a length of dedicated hollow-braid polypropylene rope and lowered into the well smoothly and slowly as not to agitate the groundwater or damage the well. Purging continues 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 are recorded following removal of each well volume. The well is purged until the readings for indicator parameters stabilize or the well is purged to dryness.

Prior to and immediately following collection of groundwater samples, field measurements for pH, specific conductance, temperature, turbidity, Eh, dissolved oxygen, and water level as well as visual and olfactory field observations will be recorded. All collected groundwater samples will be placed in pre-cleaned, pre-preserved laboratory provided sample bottles, cooled to 4°C in the field, and transported under chain-of-custody command to STL for analysis

4.1.3.4 Groundwater Sample Analyses

All groundwater samples will be analyzed for Target Compound List (TCL) VOCs in accordance with NYSDEC ASP CLP methodology. In addition, three newly installed monitoring wells or piezometers (biased to wells/piezometers with VOC-impact) will be analyzed for total and dissolved iron and manganese, as well as COD, nitrate and sulfate. These additional inorganic and water quality analyses will allow for evaluation of enhanced in-situ bioremediation as a potential remedial alternative. All TCL VOC samples analyses will be reported with an ASP Category B deliverables package to allow for third party data usability assessment.



0099-003-100 25

4.1.4 Field Specific Quality Assurance/Quality Control Sampling

In addition to the soil/fill and groundwater samples described above, field-specific quality assurance/quality control (QA/QC) samples will be collected and analyzed to ensure the reliability of the generated data as described in the QAPP (provided under separate cover) and to support the required third-party data usability assessment effort. Site-specific QA/QC samples will include matrix spikes, matrix spike duplicates, blind duplicates, and trip blanks.

- Trip Blanks A sufficient number of trip blanks for VOC analysis will be prepared by the laboratory and delivered to the sampling team prior to a sampling event. One sealed blank will be carried into the field per day along with the sample containers for each day that aqueous volatile organic samples are collected. Trip blanks will be transported and handled in the same manner as the actual samples. The results of the trip blank analysis will be reviewed to evaluate if the potential for sample contamination during transportation and handling exists. The trip blanks will be analyzed for TCL VOCs in accordance with NYSDEC ASP CLP methodology.
- Blind Duplicate One blind duplicate will be collected and analyzed per 20 samples collected for the site-specific parameters per matrix (i.e., groundwater, soil). The location of the sample collection point will not be disclosed to the analytical laboratory, therefore the field sample containers will be returned to the laboratory identified only as the "blind duplicate". The well or sample location will be recorded in the Project Field Book and on the respective Water Sample Collection Log and the results will be compared to review analytical precision.
- Matrix spike/matrix spike duplicate (MS/MSD) A sufficient volume of sample will be collected at one sampling location per sampling event for MS/MSD analysis for the site-specific parameters per matrix (i.e., groundwater, soil). The laboratory will report the results of the MS/MSD analysis, which will be reviewed for sampling and analysis precision and accuracy.

Dedicated sampling equipment will be used to minimize field decontamination time and avoid the need for equipment blanks. QA/QC field sampling requirements are detailed in Table 6.



4.2 Investigative Derived Waste (IDW)

During installation of the monitoring wells, excess soil cuttings will be containerized in 55-gallon drums. Groundwater from well development and purging will be separately containerized in 55-gallon drums. Drums will be labeled with regard to contents, origin, and date of generation using a paint stick marker on two sides and the top of each drum. The drums will be staged on-site pending soil and groundwater analyses and remedial measures assessment.

4.3 Site Mapping

A site map will be developed during the field investigation. All sample points and relevant site features, including buildings, will be located on the site map. Benchmark will employ a Trimble GeoXT handheld GPS unit to identify the locations of all existing and newly installed wells relative to State planar grid coordinates. Monitoring well elevations will be measured by Benchmark's surveyor. An isopotential map showing the general direction of groundwater flow will be prepared based on water level measurements relative to USGS vertical datum. The maps will be provided with the RI report.



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. STL's laboratory chain-of-custody procedures are discussed in the STL Quality Assurance Manual located in Appendix B.

5.1 Field Custody Procedures

Field logbooks provide the means of recording data collection 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 are bound field survey books or notebooks. Logbooks are 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, including compass and distance measurements or latitude/longitude information (e.g., obtained by using a global positioning system) the location information will 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 is 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.

29



• 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 and groundwater 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 (COC) 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 STL, and for shipment of samples to subcontracted laboratories.

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



0099-003-100 30

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, \pm 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 an occurrence of any of the following:

- It is in someone's actual possession.
- It is in someone's view after being in his or her physical possession.

31



- 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 COC 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.

32



0099-003-100

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 in accordance with formal procedures outlined in STL'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 COC 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 STL.

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. Benchmark 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 Benchmark project manager. Information generated during this study by will be retained by Benchmark 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 reports
- Data 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 groundwater sampling include pH, turbidity, specific conductance, temperature, and depth to groundwater. Quantitative water level measurements will be obtained with an electronic sounder or steel tape, which require no calibration. Quantitative field data to be obtained during soil sampling include screening for the presence of VOCs using a photoionization detector (PID).

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 Logbook.

6.2 Laboratory Instrument Calibration

All equipment and instruments used at STL 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 STL's QA Manual (Appendix B).



7.0 ANALYTICAL PROCEDURES

Groundwater, soil and soil vapor samples collected during the RI activities will be analyzed by Severn Trent Laboratories, Inc. (STL), 10 Hazelwood Drive, Amherst, New York 14228, (716) 691-2600.

7.1 Field Analytical Procedures

Field procedures for collecting and preserving 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 NYSDEC ASP-2000, CLP methodology. Analytical methods, method detection limits, and reporting limits selected for use in this investigation are listed in Tables 1 (soil) and 2 (groundwater). Sample container, preservation and holding time requirements are presented in Table 8. STL 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. General laboratory analytical procedures and sample handling procedures are presented in STL'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 NYSDEC ASP-2000 CLP methodology and 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 NYSDEC ASP-2000 and 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. STL performs 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.
- <u>Instrument Detection Limit (IDL)</u> 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 to obtain the IDL.
- <u>Practical or Estimated Quantitation Limit</u> (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



QAPP FOR RI WORK PLAN BUFFALO DEVELOPMENT CORPORATION HOTEL SITE

PQL (EQL) is a nominal value selected at a level between 3 and 10 times the MDL.

• <u>Contract Required Quantitation Limit</u> (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

The QC criteria for each field measurement are provided in Table 6 of this QAPP. 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 and groundwater samples will be collected to allow determination of analytical precision. One duplicate soil and groundwater sample will be collected for every 20 samples or per sampling event if less than 20 samples are collected. Duplicate sample aliquots for soil and groundwater 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. A VOC travel blank (a.k.a., "trip blank") will be included in each cooler containing water matrix samples to be analyzed for VOCs and sent to the laboratory for analysis.

8.2 Laboratory Quality Control Checks

The internal QC checks for laboratory analyses of soil and groundwater 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 NYSDEC ASP-2000 CLP methodology. The checks include internal QC methods covering surrogate spikes, duplicates, preparation blanks, calibration, lab quality control samples and reagent checks. A site-specific 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. Acceptable QC limits for the



0099-003-100

QAPP FOR RI WORK PLAN BUFFALO DEVELOPMENT CORPORATION HOTEL SITE

MS/MSD samples are found in NYSDEC ASP-2000. 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 pH, turbidity, temperature, specific conductance, water level and 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 5. 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 Benchmark'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 QA/QC records for at least five years. Original laboratory reports will be stored in the Benchmark 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, Benchmark has requested a complete validatable data package (Category B deliverables), which fulfills all deliverable requirements as specified in the NYSDEC ASP-2000 CLP Statement of Work. 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 STL 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 Benchmark 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.

44

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 STL's 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 STL (internal), or by clients, regulatory agencies, or accreditation bodies (external).

10.2.1 Internal Laboratory Audits

The STL 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.
- Identify opportunities for improvement.

The STL 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
- 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 STL, so that any questionable data can be discussed with the staff.

Following the audit, the QA 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 QA Coordinator initiates the corrective action process for each finding and is responsible for ensuring timely corrective action. The QA 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 QA 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 QA or the local laboratory manager.

The QA 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 STL to minimize the occurrence of instrument failure and other system malfunctions. The analysts regularly perform 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 STL 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 STL through SOPs 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 STL's QA Manual provided in Appendix B of this QAPP.

50



11.3 Inspection/Acceptance Requirements for Supplies and Consumables

11.3.1 Field Supplies and Consumables

For this investigation, Benchmark 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.



QAPP FOR RI WORK PLAN BUFFALO DEVELOPMENT CORPORATION HOTEL SITE

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. Factors considered during this investigation 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.).

Once these goals and objectives are evaluated and chosen, analytical data quality will be assessed to determine if the objectives have been met. 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:



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

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:

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:

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

$$S_1 + S_2$$

Where $S_1 = \text{sample result}$

 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. For data generated in the field, the precision goals are summarized in Table 4.

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 investigation 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:

% completeness =
$$\underline{A}$$
 x 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

55

QAPP FOR RI WORK PLAN BUFFALO DEVELOPMENT CORPORATION HOTEL SITE

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 QC 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 QA 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 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 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/less 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 less 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 that directly impacts project DQOs, the NYSDEC Project Coordinator will be notified immediately.

13.2 Laboratory Corrective Action

Corrective actions may be initiated if the QA 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 Officer's 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.



0099-003-100

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

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- 2. United States Department of Agriculture, Soil Conservation Service. Soil Survey of Erie County, New York. 1978.
- 3. U.S. Environmental Protection Agency. Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5). October 1998.
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- 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.







ANALYTICAL PARAMETERS FOR SOIL SAMPLES

QAPP for RI Buffalo Development Corporation Site Buffalo, New York

Analyte	CAS	Analytical	CRQL	MDL
,	Number	Method ¹	7	
TCL VOCs: (53 compounds) (ug/kg)				
1,1,1-Trichloroethane	71-55-6	OLM04.3	10	0.69
1,1,2,2-Tetrachloroethane	79-34-5	OLM04.3	10	1.12
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	OLM04.3	10	0.97
1,1,2-Trichloroethane	79-00-5	OLM04.3	10	0.92
1,1-Dichloroethane	75-34-3	OLM04.3	10	1.02
1,1-Dichloroethene	75-35-4	OLM04.3	10	0.61
1,2,3-Trichlorobenzene	87-61-6	OLM04.3	10	1.11
1,2,4-Trichlorobenzene	120-82-1	OLM04.3	10	0.93
1,2-Dibromo-3-chloropropane	96-12-8	OLM04.3	10	1.03
1,2-Dibromoethane	106-93-4	OLM04.3	10	0.78
1,2-Dichlorobenzene	95-50-1	OLM04.3	10	0.57
1,2-Dichloroethane	107-06-2	OLM04.3	10	0.88
1,2-Dichloropropane	78-87-5	OLM04.3	10	0.95
1,3-Dichlorobenzene	541-73-1	OLM04.3	10	0.58
1,4-Dichlorobenzene	106-46-7	OLM04.3	10	0.57
2-Butanone (MEK)	78-93-3	OLM04.3	10	3.49
2-Hexanone	591-78-6	OLM04.3	10	4.72
4-Methyl-2-pentanone (MIBK)	108-10-1	OLM04.3	10	4.21
Acetone	67-64-1	OLM04.3	10	2.10
Benzene	71-43-2	OLM04.3	10	0.81
Bromochloromethane	74-97-5	OLM04.3	10	0.92
Bromodichloromethane	75-27-4	OLM04.3	10	0.72
Bromoform	75-25-2	OLM04.3	10	1.13
Bromomethane	74-83-9	OLM04.3	10	1.47
Carbon Disulfide	75-15-0	OLM04.3	10	1.24
Carbon Tetrachloride	56-23-5	OLM04.3	10	0.84
Chlorobenzene	108-90-7	OLM04.3	10	0.60
Chloroethane	75-00-3	OLM04.3	10	0.84
Chloroform	67-66-3	OLM04.3	10	1.26
Chloromethane	74-87-3	OLM04.3	10	0.73
cis-1,2-Dichloroethene	156-59-2	OLM04.3	10	1.19
cis-1,3-Dichloropropene	10061-01-5	OLM04.3	10	0.79
Cyclohexane	110-82-7	OLM04.3	10	0.88
Dibromochloromethane	124-48-1	OLM04.3	10	0.91
Dicholorodifluoromethane	75-71-8	OLM04.3	10	1.15
Ethylbenzene	100-41-4	OLM04.3	10	0.62
Isopropylbenzene	98-82-8	OLM04.3	10	0.57
Methyl Acetate	79-20-9	OLM04.3	10	1.95
Methyl tert-Butyl Ether	1634-04-4	OLM04.3	10	0.55
Methylcyclohexane	108-87-2	OLM04.3	10	0.92
Methylene Chloride	75-09-2	OLM04.3	10	4.42
Styrene	100-42-5	OLM04.3	10	1.20



ANALYTICAL PARAMETERS FOR SOIL SAMPLES

QAPP for RI Buffalo Development Corporation Site Buffalo, New York

Analyte	CAS Number	Analytical Method ¹	CRQL	MDL
TCL VOCs: (53 compounds) (ug/kg	r) (cont'd)			
Tetrachloroethene	127-18-4	OLM04.3	10	0.80
Toluene	108-88-3	OLM04.3	10	1.62
trans-1, 2-dichloroethene	156-60-5	OLM04.3	10	1.43
trans-1,3-Dichloropropene	10061-02-6	OLM04.3	10	0.96
Trichloroethene	79-01-6	OLM04.3	10	0.64
Trichlorofluoromethane	75-69-4	OLM04.3	10	0.94
Vinyl Chloride	75-01-4	OLM04.3	10	0.78
m-Xylenes	108-38-3	OLM04.3	NA	NA
p-Xylenes	106-42-3	OLM04.3	NA	NA
o-Xylenes	95-47-6	OLM04.3	NA	NA
T. Xylenes	1330-20-7	OLM04.3	30	6.32

Notes

1. Analytical methods refer to analytical procedure numbers used in accordance with NYSDEC ASP-2000 protocol, CLP methodology with Category B deliverables package.

Acronyms/Abbreviations:

CAS = Chemical Abstracts Service registry number.

CRQL = Contract Required Quantitation Limit

MDL = Method Detection Limit provided by STL

mg/kg = milligrams per kilogram

VOCs = volatile organic compounds

TCL = Target Compound List

NA = not applicable

NTU = nephelometric turbidity unit



ANALYTICAL PARAMETERS FOR GROUNDWATER SAMPLES

QAPP for RI Buffalo Development Corporation Site Buffalo, New York

1	CAS	Analytical		
Analyte ¹	Number	Method ²	CRQL	MDL
TCL VOCs: (53 compounds) (ug/L)				
1,1,1-Trichloroethane	71-55-6	OLM04.3	10	0.26
1,1,2,2-Tetrachloroethane	79-34-5	OLM04.3	10	0.48
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	OLM04.3	10	0.55
1,1,2-Trichloroethane	79-00-5	OLM04.3	10	0.42
1,1-Dichloroethane	75-34-3	OLM04.3	10	0.27
1,1-Dichloroethene	75-35-4	OLM04.3	10	0.29
1,2,3-Trichlorobenzene	87-61-6	OLM04.3	10	0.39
1,2,4-Trichlorobenzene	120-82-1	OLM04.3	10	0.41
1,2-Dibromo-3-chloropropane	96-12-8	OLM04.3	10	0.47
1,2-Dibromoethane	106-93-4	OLM04.3	10	0.42
1,2-Dichlorobenzene	95-50-1	OLM04.3	10	0.40
1,2-Dichloroethane	107-06-2	OLM04.3	10	0.46
1,2-Dichloropropane	78-87-5	OLM04.3	10	0.33
1,3-Dichlorobenzene	541-73-1	OLM04.3	10	0.33
1,4-Dichlorobenzene	106-46-7	OLM04.3	10	0.37
2-Butanone (MEK)	78-93-3	OLM04.3	10	2.49
2-Hexanone	591-78-6	OLM04.3	10	2.39
4-Methyl-2-pentanone (MIBK)	108-10-1	OLM04.3	10	2.34
Acetone	67-64-1	OLM04.3	10	2.48
Benzene	71-43-2	OLM04.3	10	0.35
Bromochloromethane	74-97-5	OLM04.3	10	0.40
Bromodichloromethane	75-27-4	OLM04.3	10	0.39
Bromoform	75-25-2	OLM04.3	10	0.26
Bromomethane	74-83-9	OLM04.3	10	0.28
Carbon Disulfide	75-15-0	OLM04.3	10	0.48
Carbon Tetrachloride	56-23-5	OLM04.3	10	0.27
Chlorobenzene	108-90-7	OLM04.3	10	0.32
Chloroethane	75-00-3	OLM04.3	10	0.32
Chloroform	67-66-3	OLM04.3	10	0.34
Chloromethane	74-87-3	OLM04.3	10	0.35
cis-1,2-Dichloroethene	156-59-2	OLM04.3	10	0.37
cis-1,3-Dichloropropene	10061-01-5	OLM04.3	10	0.36
Cyclohexane	110-82-7	OLM04.3	10	0.53
Dibromochloromethane	124-48-1	OLM04.3	10	0.32
Dicholorodifluoromethane	75-71-8	OLM04.3	10	0.29
Ethylbenzene	100-41-4	OLM04.3	10	0.34
Isopropylbenzene	98-82-8	OLM04.3	10	0.32
Methyl Acetate	79-20-9	OLM04.3	10	0.45
Methyl tert-Butyl Ether	1634-04-4	OLM04.3	10	0.48
Methylcyclohexane	108-87-2	OLM04.3	10	0.50
Methylene Chloride	75-09-2	OLM04.3	10	0.44



ANALYTICAL PARAMETERS FOR GROUNDWATER SAMPLES

QAPP for RI Buffalo Development Corporation Site Buffalo, New York

Analyte ¹	CAS Number	Analytical Method ²	CRQL	MDL
TCL VOCs (cont d): (53 compounds) (ug		Method		
Styrene	100-42-5	OLM04.3	10	0.31
Tetrachloroethene	127-18-4	OLM04.3	10	0.36
Toluene	108-88-3	OLM04.3	10	0.35
trans-1, 2-dichloroethene	156-60-5	OLM04.3	10	0.37
trans-1,3-Dichloropropene	10061-02-6	OLM04.3	10	0.33
Trichloroethene	79-01-6	OLM04.3	10	0.37
Trichlorofluoromethane	75-69-4	OLM04.3	10	0.32
Vinyl Chloride	75-01-4	OLM04.3	10	0.36
m-Xylenes	108-38-3	OLM04.3	NA	NA
p-Xylenes	106-42-3	OLM04.3	NA	NA
o-Xylenes	95-47-6	OLM04.3	NA	NA
T. Xylenes	1330-20-7	OLM04.3	30	3.06
Total and Dissolved Metals: (2 parameter		1	in the	
Iron	7439-89-6	6010B	100	17.0
Manganese	7439-96-5	6010B	15	0.16
Groundwater Quality Parameters: (3 para	meters) (mg/L)			and the second
Chemical Oxygen Demand (COD)	NA	410.4	10.0	1.1
Nitrate	14797-55-8	353.2	1	0.02
Sulfate	14808-79-8	375.4	5.0	0.64
Field Parameters: (5 compounds) (units a	s identified below)	Marine Here in	Mar Mar	professional and the second se
pH (units)	NA	field	NA	NA
Temperature (°C)	NA	field	NA	NA
Specific Conductance (uS/mS)	NA	field	NA	NA
Turbidity (NTU)	NA	field	NA	NA
Dissolved Oxygen (ppm)	NA	field	NA	NA
Water Level (fbTOR))	NA	field	NA	NA

Notes:

1. Analytical methods refer to analytical procedure numbers used in accordance with NYSDEC ASP-2000 protocol, CLP methodology with Category B deliverables package.

Acronyms/Abbreviations:

CAS = Chemical Abstracts Service registry number.

CRQL = Contract Required Quantitation Limit

MDL = Method Detection Limit provided by laboratory

mg/L = milligrams per liter

mS = milli-Siemans

ug/L = micrograms per liter

uS = micro-Siemans

TCL = Target Compound List

VOCs = volatile organic compounds

NA = not applicable

NTU = nephelometric turbidity unit

fb TOR = feet below top of riser



PROJECT GOALS FOR PRECISION, ACCURACY & COMPLETENESS FOR LABORATORY MEASUREMENTS

QAPP for RI Buffalo Development Corporation Site Buffalo, New York

Analytical Method	Precision Goal (% RPD)	Accuracy Goal (% R)	Completeness Goal (%)
NYSDEC ASP-2000-CLP	+/- 30	+/- 30	90%
NYSDEC ASP-2000-6010/7470	+/- 30	+/- 30	90%

Notes:

1. Precision goals vary depending on the compound being analyzed; the precision goals presented are general in nature.



PROJECT GOALS FOR PRECISION, ACCURACY & COMPLETENESS FOR FIELD MEASUREMENTS

QAPP for RI Buffalo Development Corporation Site Buffalo, New York

Measurement	Units	Precision Goal	Accuracy Goal	Completeness Goal
рН	pH units	+/- 0.2 unit	+/- 0.2 unit	90%
Temperature	degrees Celsius (°C)	+/- 0.2 deg. C	+/- 0.4 deg. C	90%
Turbidity	NTU	+/- 0.05 NTU	+/- 0.05 NTU	90%
Specific Conductance	μS/cm at 25°C mS/cm at 25°C	+/- 100 uS/cm +/- 0.1 mS/cm	+/- 100 uS/cm +/- 0.1 mS/cm	90%
Water Level	fbTOR	+/- 0.01 unit	+/- 0.01 unit	90%

Notes:

1. Precision goals vary depending on the compound being analyzed; the precision goals presented are general in nature.

Acronyms/Abbreviations:

fbTOR = feet below top of riser

mS = milli-Siemans

NTU = nephelometric turbidity unit

ug/L = micrograms per liter



DATA MEASUREMENT UNITS FOR FIELD & LABORATORY PARAMETERS

QAPP for RI Buffalo Development Corporation Site Buffalo, New York

Parameter	Units
Water Level	feet below top of riser (fbTOR)
рН	pH units
Temperature	degrees Celsius (°C)
Turbidity	Nephelometric Turbidity Unit (NTU)
Specific Conductance	microsiemens per centimeter at 25°C (µS/cm) millisiemens per centimeter at 25°C (mS/cm)
Concentration of parameter in soil sample	milligrams per kilogram (mg/kg) micrograms per kilogram (ug/kg)
Concentration of parameter in groundwater sample	micrograms per liter (μ g/L) organic milligrams per liter (mg/L) inorganic
Photoionization Detector (PID)	parts per million by volume (ppmv)



ANALYTICAL PROGRAM QUALITY ASSURANCE/ QUALITY CONTROL SUMMARY

Buffalo Development Corporation Site Buffalo, New York QAPP for RI

				Estimated	Estimated Number of QC Samples	C Samples		
Matrix	Parameter ¹	No. Samples	Trip Blank ²	Matrix Spike ³	Matrix Spike Equipment Duplicate ³ Blank ⁴	Equipment Blind Blank ⁴ Duplicate ³	Blind Duplicate ³	Total
Soil/Fill	TCL VOCs	13	1	₩	-		1	17
Sub-Grade Vapor	TCL VOCs	2						2
Groundwater	TCL VOCs	11	1	1	1		Ţ	15
	COD, Total & Dissolved Iron, Total & Dissolved Manganese, Nitrate, Sulfate	3						3
	Field Parameters: DO, pH, Eh, Turbidity, Conductance, Temperature	11	- 100.01					11

- 1. VOC analyses will be performed via NYSDEC ASP-2000 protocol, CLP methodology w/ Category B deliverables package. Remaining analyses to follow USEPA SW-846 or 40 CFR Part 136. Vapor samples will be analyzed via USEPA Method TO-15.
 - 2. Trip blanks will be submitted to the laboratory each day aqueous volatile organic samples are collected.
 - 3. Blind duplicate and MS/MSD samples will be collected at a frequency of 1 per 20 samples collected. 4. Dedicated sampling equipment will be used for groundwater and soil/fill sample collection.



SUMMARY OF FIELD OPERATING PROCEDURES

QAPP for RI Buffalo Development Corporation Site Buffalo, New York

QAPP FOP No.	BM FOP No.	Procedure
1	001.0	Abandonment of Borehole Procedures
2	008.0	Calibration and Maintenance of Portable Field pH, Eh Meter
3	009.0	Calibration and Maintenance of Portable Field Turbidity Meter
4	011.0	Calibration and Maintenance of Portable Photoionization Detector (PID)
5	012.0	Calibration and Maintenance of Portable Specific Conductance Meter
6	015.0	Documentation Requirements for Drilling and Well Installation
7	017.0	Drill Site Selection Procedure
8	018.0	Drilling and Excavation Equipment Decontamination Procedures
9	022.0	Groundwater Level Measurement
10	023.0	Groundwater Purging Procedures Prior to Sample Collection
11	024.0	Groundwater Sample Collection Procedures
12	026.0	Hollow Stem Auger Drilling Procedures
13	031.0	Low-Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedures
14	032.0	Management of Investigative-Derived Waste
15	033.0	Monitoring Well Construction for HAS Boreholes
16	036.0	Monitoring Well Development Procedures
17	040.0	Non-Disposable and Non-Dedicated Sampling Equipment Decontamination
18	041.0	Overburden Casing Installation Procedure
19	073.0	Real-Time Air Monitoring During Intrusive Activities
20	046.0	Sample Labeling, Storage and Shipment Procedures
21	047.0	Screening of Soil Samples for Organic Vapors During Drilling Activities
22	054.0	Soil Description Procedures Using the USCS
23	058.0	Split-spoon Sampling
24	063.0	Surface and Subsurface Soil Sampling Procedures
25	070.0	Well/Piezometer Construction Materials and Design



SAMPLE CONTAINER, VOLUME, PRESERVATION & HOLDING TIME REQUIREMENTS

QAPP for RI Buffalo Development Corporation Site Buffalo, New York

Matrix	Parameter ¹	Container Type	Minimum Volume	Preservation (Cool to 4 °C for all samples)	Holding Time
Soil/Fill	JCL VOCs	glass	4 oz.	Cool to 4°C, Zero Headspace	Analyze within 10 days of VTSR
Sub-Grade Vapors	TCL VOCs	Summa Cannister	6 liters	None	Analyze within 14 days of sample date of collection
	TCL VOCs	glass vial	2-40 ml	HCl to pH<2, Zero Headspace	Analyze within 10 days of VTSR
	Sulfate	Plastic/glass	4 oz.	Cool to 4°C	26 days
Groundwater	Dissolved & Total Mn, Fe	Plastic/glass	8 oz.	HNO, to pH<2	6 months
	COD, Nitrate	Plastic/glass	16 oz.	Cool to 4°C, H ₂ SO ₄ to pH<2	26 days

1. NYSDEC ASP, CLP Methodology, 2000. The list of analytes, laboratory method and the method detection limit for each parameter are included in Tables 1 and 2.

Acronyms:

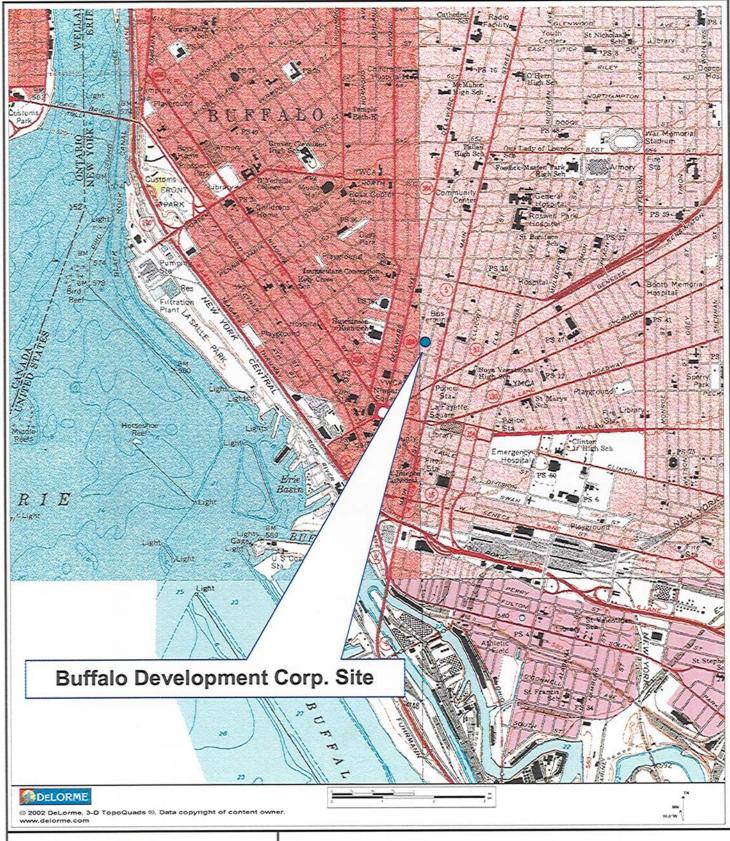
VOCs = Volatile Organic Compounds SVOCs = Semi-Volatile Organic Compounds

TAL = Target Analyte List

TCL = Target Compound List
COD = Chemical Oxygen Demand
VTSR = Validated Time of Sample Receipt, required within 2 days of collection

FIGURES







726 EXCHANGE STREET

PROJECT NO .: 0099-003-100

DATE: JUNE 2006 DRAFTED BY: BCH

ENVIRONMENTAL BUFFALO, NEW YORK 14210

SITE LOCATION AND VICINITY MAP

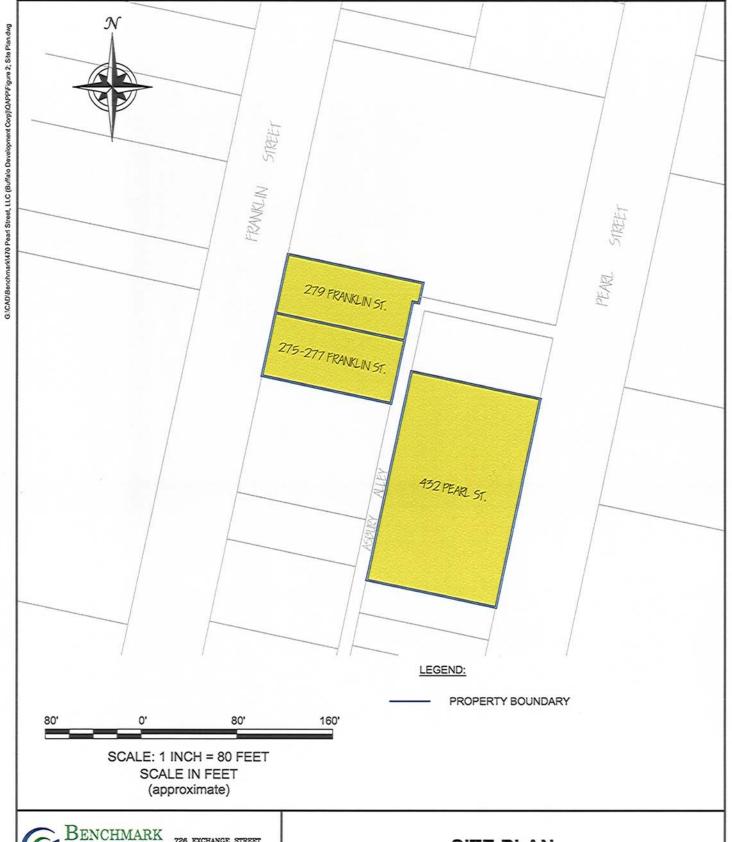
RI WORK PLAN - QAPP

BUFFALO DEVELOPMENT CORP. SITE BUFFALO, NEW YORK

PREPARED FOR

BUFFALO DEVELOPMENT CORPORATION

FIGURE 2





726 EXCHANGE STREET SUITE 624

PROJECT NO .: 0099-003-100

DATE: JUNE 2006

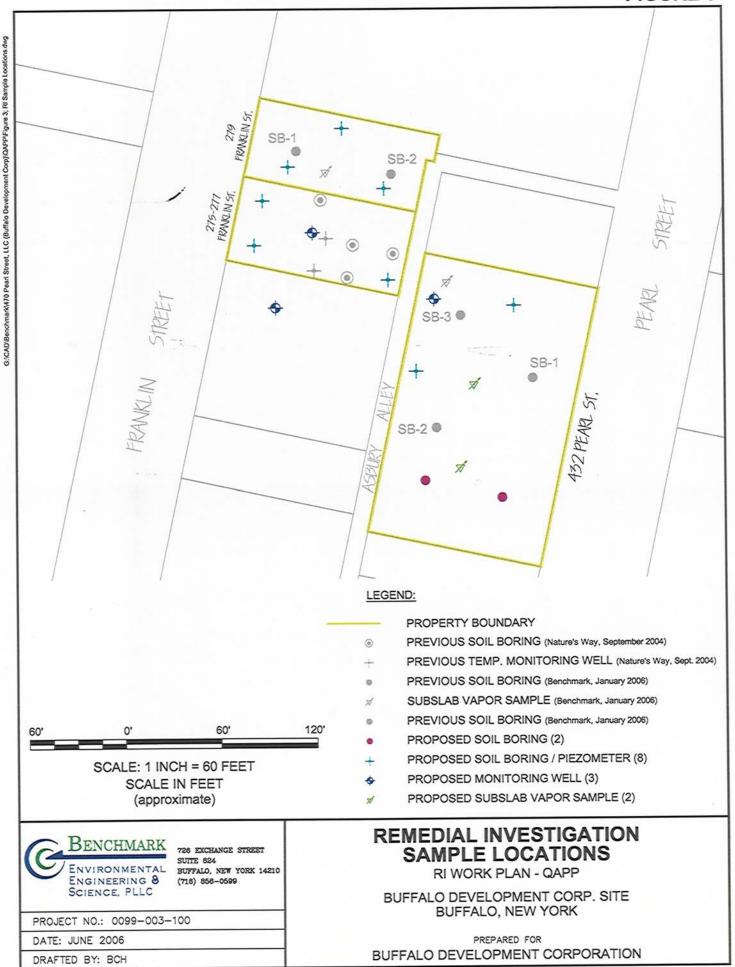
DRAFTED BY: BCH

SITE PLAN

RI WORK PLAN - QAPP

BUFFALO DEVELOPMENT CORP. SITE BUFFALO, NEW YORK

PREPARED FOR **BUFFALO DEVELOPMENT CORPORATION**



		2006	-					-			-
Task Name	May	Jun Jul	l Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
BCP Pre-Application Meeting		4									
Submit Application w/ RI Work Plan & CP Plan		4									
NYSDEC Review, Fact Sheet Preparation		PHINT: FIRST									
Application Deemed Complete			4								
Advertise BCP Appln, Distribute Fact Sheet											
BC Agreement Issued				4							
BC Agreement Reviewed/Executed											
Sampling & Analysis					mineral .						
Data Review & Validation											
Data Summary/Interpretation											
Draft RI Report Preparation											
NYSDEC Report Review/Revisions								0.00		***************************************	
Prepare RD Report with Remedial Alts Assessment	#										
RD Report Review/Revisions						[men]					
Issue Fact Sheet							4				-
Public Comment Period									(5933)		
Remedy Construction											
Engineering Report											
Institutional Control Fact Sheet (if required)											

PROJECT SCHEDULE

RI WORK PLAN - QAPP

SUITE 624 BUFFALO, NEW YORK 14210 (716) 856-0599 726 EXCHANGE STREET

ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

PROJECT NO.: 0099-003-100

DRAFTED BY: BCH DATE: JULY 2006

FIGURE 4

BUFFALO DEVELOPMENT CORP. SITE BUFFALO, NEW YORK

PREPARED FOR

BUFFALO DEVELOPMENT CORPORATION

BENCHMARK 726 EXCHANGE STREET SUITE 624 ENVIRONMENTAL BUFFALO, NEW YORK 14210 (716) 856-0599

PROJECT NO .: 0099-003-100

ENGINEERING 8

SCIENCE, PLLC

DATE: JUNE 2006 DRAFTED BY: BCH NYSDEC

Martin Doster, P.E. - Project Manager Gene Melnyk, P.E. - Project Engineer NYSDOH

Cameron O'Connor - Project Manager

BUFFALO DEVELOPMENT CORPORATION:

Mark Croce

QUALITY ASSURANCE OFFICER:

Lori E. Riker, P.E.

PROJECT MANAGER:

Patrick T. Martin, P.E.

KEY PROJECT STAFF:

Bryan C. Hann - Field Team Leader / SSHO Richard L. Dubisz - Senior Technician Thomas A. Behrendt - Staff Gelogist

SUBCONTRACTORS:

Laboratory:

Data Validation / Usability:

Drilling:

Severn Trent Labratories, Inc.

Data Validation Services, Inc. Earth Dimensions

Trec Environmental

PROJECT RESPONSIBILITIES FLOW CHART

RI WORK PLAN - QAPP

BUFFALO DEVELOPMENT CORP. SITE BUFFALO, NEW YORK

PREPARED FOR

BUFFALO DEVELOPMENT CORPORATION

APPENDIX A

FIELD OPERATING PROCEDURES (FOPS)





APPENDIX A

SUMMARY OF FIELD OPERATING PROCEDURES

QAPP for RI Buffalo Development Corporation Site Buffalo, New York

QAPP FOP No.	BM FOP No.	Procedure
1	001.0	Abandonment of Borehole Procedures
2	008.0	Calibration and Maintenance of Portable Field pH, Eh Meter
3	009.0	Calibration and Maintenance of Portable Field Turbidity Meter
4	011.0	Calibration and Maintenance of Portable Photoionization Detector (PID)
5	012.0	Calibration and Maintenance of Portable Specific Conductance Meter
6	015.0	Documentation Requirements for Drilling and Well Installation
7	017.0	Drill Site Selection Procedure
8	018.0	Drilling and Excavation Equipment Decontamination Procedures
9	022.0	Groundwater Level Measurement
10	023.0	Groundwater Purging Procedures Prior to Sample Collection
11	024.0	Groundwater Sample Collection Procedures
12	026.0	Hollow Stem Auger Drilling Procedures
13	031.0	Low-Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedures
14	032.0	Management of Investigative-Derived Waste
15	033.0	Monitoring Well Construction for HAS Boreholes
16	036.0	Monitoring Well Development Procedures
17	040.0	Non-Disposable and Non-Dedicated Sampling Equipment Decontamination
18	041.0	Overburden Casing Installation Procedure
19	073.0	Real-Time Air Monitoring During Intrusive Activities
20	046.0	Sample Labeling, Storage and Shipment Procedures
21	047.0	Screening of Soil Samples for Organic Vapors During Drilling Activities
22	054.0	Soil Description Procedures Using the USCS
23	058.0	Split-spoon Sampling
24	063.0	Surface and Subsurface Soil Sampling Procedures
25	070.0	Well/Piezometer Construction Materials and Design

Abandonment of Borehole Procedures

ABANDONMENT OF BOREHOLE PROCEDURE

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.



ABANDONMENT OF BOREHOLE PROCEDURE

- 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 preexisting 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



ABANDONMENT OF BOREHOLE PROCEDURE

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.

ABANDONMENT OF BOREHOLE PROCEDURE

PR	OJEC	T:						1	A.F.	
во	RING	LOCA	ATION:				<u> </u>	Log of Boring	No.:	
DR	LING	G CÓI	VTRAC	TOR		··		DATE STARTED:		
									DATE FINISH	ED:
R	LLING	G ME1	THOD:					TOTAL DEPTH:	SCREEN INTE	RVAL:
			JIPME					DEPTH TO FIRST: WATER:	COMPL.: CASING:	
			THOD					LOGGED BY:		
IA!	MER	WE	GHT:				DROP:	RESPONSIBLE PROFESS	IONAL:	REG. N
			AMPL			(ma	SAM	PLE DESCRIPTION		
	Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery	PID Scan (ppm)	USCS Classification: Color, Moist Fabric, Bedding, V	ture Condition, % of Soil Type Weathering/Fracturing, Odos	ity, REMAR	RKS
	ő	L	Bio	S	æ	ы	SURFACE ELEVATION (FMSL):			
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A	NDON	MEN	T:							
_						t requi		3 = gallons	borehole depth =	
_						t instal		gallons	borehole diameter =	
H			of grou plain re				yes no		borehole radius =	



Calibration and Maintenance of Portable Field pH/Eh Meter

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 \pm 0.2 pH unit, over the temperature range of \pm 0.2 C.

Eh \pm 0.2 millivolts (mV) over the range of \pm 399.9 mV, otherwise \pm 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.



CALIBRATION AND MAINTENANCE OF PORTABLE FIELD pH/Eh METER

- 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)



CALIBRATION AND MAINTENANCE OF PORTABLE FIELD pH/Eh METER

- 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)



CALIBRATION AND MAINTENANCE OF PORTABLE FIELD pH/Eh METER

(Ca	BENCHMARK								
	ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC						EQUIPM	IENT CALIB	RATION
PROJ	ECT INFORMATIO	N:							
	t Name:					Date:			
Projec									
Client						Instrument	Source: B	вм	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		
				Hach 2100P			< 0.4		_
	Turbidity meter	NTU		Turbidimeter	970600014560		100	 	-
							800		1
	Sp. conductance meter	uS/mS		Myron L Company Ultra Meter 6P	606987		µS @ 25 °C		
П	PID	ppm		Photovac 2020 PID			open air zero		MIBK re
		PP			Z(Z)	$\Sigma \times Z$	ppm Iso. Gas		factor
	Particulate meter	mg/m³					zero air		
	Oxygen	%				•	open air		
	Hydrogen sulfide	ppm					open air		
	Carbon monoxide	ppm					open air		
	LEL	%	Alleran				open air		1
	Radiation Meter	uR/I					background area		
									T
ADDI	TIONAL REMARK	S:	27.00	DIV					/
PREP	ARED BY:				DATE:				

DATE:



Calibration and Maintenance of Portable Field Turbidity Meter

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 \pm 2% of reading below 499 NTU or \pm 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 StablCalTM Stabilized Standards or formazin standards.



CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER

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)



CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER

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



CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER

Note: The turbidity of the dilution water can be "forced" to zero by pressing \rightarrow rather than reading the dilution water. The display will show "S0 NTU" and the \uparrow 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



CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER

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 \(\tau\) 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 11 of 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



CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER

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)

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER



EQUIPMENT CALIBRATION

-	ECTINFORMATIC)N:							
	t Name:			Date:					
Projec									
Client	:					Instrument	Source: I	ЗМ 🗀	Rental
	METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
	pH meter	units	Myron L Company Ultra Meter 6P	Myron I. Company			4.00		—
				606987		7.00			
	Turbidity meter	NTU			970600014560		< 0.4	 	·
				Hach 2100P Turbidimeter		$K \times A$	20	f	
						XX,	100		
		 		Myron L Company			800	<u> </u>	ļ
	Sp. conductance meter	uS/mS		Ultra Meter 6P	606987		μS @ 25 °C		1
	PID	ppm		Photovac 2020 PID			open air zero		MIBK re
		+					ppm Iso. Gas	<u> </u>	factor :
	Particulate meter	mg/m³					zero air		
	Oxygen	%					open air		
	Hydrogen sulfide	ppm]			>	open air		
	Carbon monoxide	ppm	Ī				open air		
	LEL	%					open air		
	Radiation Meter	uR/I				-	background area		
ADDI	TIONAL REMARKS	:		ON					L
PREPARED BY: DATE:									

Calibration and
Maintenance of
Portable
Photoionization
Detector (PID)

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



CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

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 °C 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 \pm 10% or \pm 2 ppm. Response time is less than three seconds to 90 percent of full-scale. The operating temperature range is 0 to 40° 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



CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

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)



CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

- 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	<u> </u>
Acetophenone	9.27	
Acetyl bromide	10.55	
Acetyl chloride	11.02	X
Acetylene	11.41	X
Acrolein	10.1	
Acrylamide	9.5	<u> </u>
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	
В		
1,3-Butadiene (butadiene)	9.07	1
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	<u> </u>
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	<u> </u>
Bromoform	10.48	
Butane	10.63	X
Butyl mercaptan	9.15	
cis-2-Butene	9.13	
m-Bromotoluene	8.81	<u> </u>
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	<u> </u>
t-Butyl amine	8.64	
t-Butyl benzene	8.68	
trans-2-Butene	9.13	
C	3,13	<u> </u>



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	T 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	1
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	~ <u> </u>
Cyclo-octatetraene	7.99	<u> </u>
Cyclopentadiene	8.56	
Cyclopentane	10.53	
Cyclopentanone	9.26	
Cyclopentene	9.01	1



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	1
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	1
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	7.00	4
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)	10.23	X
Ethyl disulfide	8.27	- A



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	Х
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	

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

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	
Isobutyriormate	9.74	
Isobutyric acid	10.02	
Isopentane	10.32	
Isophorone	9.07	1
Isoprene	8.85	
Isopropyl acetate	9.99	<u> </u>
Isopropyl alcohol	10.16	
Isopropyl ancolor 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		<u> </u>
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	<u> </u>
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	<u> </u>
Monomethyl aniline	7.32	
Monomethyl hydrazine	7.67	
Morpholine	8.2	
n-Methyl acetamide	8.9	
N	0.5	
1-Nitropropane	10.88	X
2-Nitropropane	10.71	X
Naphthalene	8.12	A
Nickel carbonyl	8.27	
Nitric oxide, (NO)	9.25	
Nitrobenzene	9.92	
Nitroethane	10.88	X
Nitrogen	15.58	X
Nitrogen dioxide	9.78	<u> </u>
Nitrogen trifluoride	12.97	X
Nitromethane	11.08	X
Nitrotoluene	9.45	Δ
p-Nitrochloro benzene	9.96	



TABLE 1
SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
0		
Octane	9.82	T
Oxygen	12.08	X
Ozone	12.08	X
P	12.00	A
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	<u> </u>
Phenyl isothiocyanate	8.52	
Phenylene diamine	6.89	
Phosgene	11.77	
Phosphine	9.87	X
Phosphorus trichloride	9.91	
Phthalic anhydride	10	
Propane	11.07	
Propargyl alcohol		X
Propiolactone	10.51 9.7	
Propionaldehyde		
Propionic acid	9.98	
Propionitrile	10.24	
Propyl acetate	11.84	X
Propyl alcohol	10.04	
Propyl amine	10.2	
Propyl benzene	8.78	ļ
Propyl ether	8.72 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	T
Propylene dichloride	10.87	X
Propylene imine	9	†
Propylene oxide	10.22	
Propyne	10.36	
Pyridine	9.32	
Pyrrole	8.2	<u> </u>
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	<u> </u>
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	

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

6	BENCHMARK
	ENVIRONMENTAL ENGINEERING &
	SCIENCE, PLLC

EQUIPMENT CALIBRATION

	ECTINFORMATIC)N:							
	t Name:			<u> </u>		Date:			
Projec				~		_			
Client						Instrument	Source:	ВМ	Rental
	METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
				Myron L Company			4.00		
	pH meter	units		Ultra Meter 6P	606987		7.00]
							10.01		ļ
		1	}	Hach 2100P			20		-
	Turbidity meter	NTU		Turbidimeter	970600014560	N.M.	100		1
							800		†
	Sp. conductance meter	uS/mS		Myron L Company	606987		μS @ 25 °C		1
	*			Ultra Meter 6P			<i></i>		
	PID .	ppm		Photovac 2020 PID			open air zero	ļ	MIBK re
	D 1.	, 3					ppm Iso. Gas		factor :
	Particulate meter	mg/m³					zero air		i
	Oxygen	%					open air		
	Hydrogen sulfide	ppm					open air		
	Carbon monoxide	ppm	k				open air		
	LEL	%					open air		
	Radiation Meter	uR/I					background area		<u> </u>
					*				
ADDI	TIONAL REMARKS	3:		SIV			<u> </u>	<u> </u>	L
PREP	ARED BY:				DATE:				
					DATE:				

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Calibration and Maintenance of Portable Specific Conductance Meter

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 \pm 1 percent of full-scale, with repeatability of \pm 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.

CALIBRATION AND MAINTENANCE OF PORTABLE SPECIFIC CONDUCTANCE METER

- 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 \uparrow /MS or MR/ \downarrow 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



CALIBRATION AND MAINTENANCE OF PORTABLE SPECIFIC CONDUCTANCE METER

- 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.

CALIBRATION AND MAINTENANCE OF PORTABLE SPECIFIC CONDUCTANCE METER

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

PROJ	ECT INFORMATIO	N:							
Projec	t Name:					Date:			
Projec			,						
Client:						Instrument	Source: B	м [Rental
	METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTT
	pH meter	units		Myron L Company Ultra Meter 6P	606987		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		/4S @ 25 °C		. 100
	PID	ppm		Photovac 2020 PID	(AA)		open air zero ppm Iso. Gas		MIBK re factor :
	Particulate meter	mg/m³					zero air	- 100	
	Oxygen	%					open air		
	Hydrogen sulfide	ppm				>	ореп аіг		
	Carbon monoxide	ppm					open air		
	LEL.	%					open air		
	Radiation Meter	uR/I	ightharpoonup				background area		
ADDI	TIONAL REMARKS	S:		N					
PREP	ARED BY:				DATE:				

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		•

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. Benchmark 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 Benchmark 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.



DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

- 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 Benchmark field person overseeing the drilling. At a minimum, these forms will include:

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



DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

- 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 Benchmark 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.



DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

• 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 Benchmark field supervisor and the driller's representative, and provided to the Benchmark Field Team Leader.



DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

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)



DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION



	90	DATE		
l	DAILYL	NO.		
ĺ	DA	SHEET	 OF	

FIELD ACTIVITY DAILY LOG

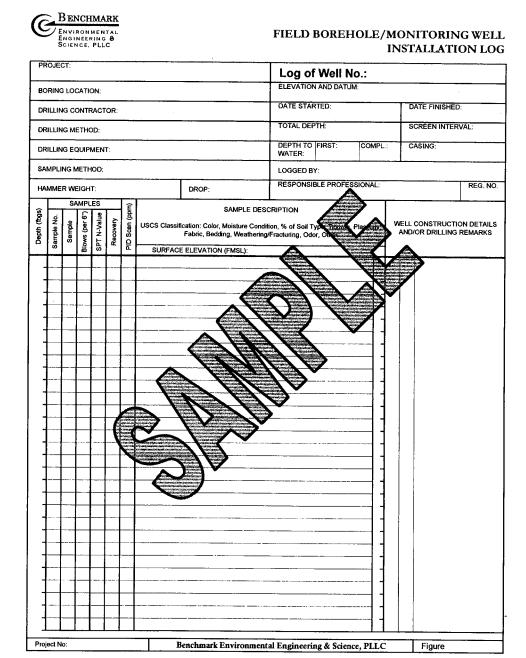
PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND E	EVENTS:
TIME	DESCRIPTION
	The state of the s
	Contraction of the Contraction o
Control of the Contro	
ISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND
	OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
EATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
A.M.:	
P.M.:	
M/TK PERSONNEL ON SITE:	
GNATURE	DATE
	DATE:

DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

BENCHMARK FINVIRONMENTAL ENGINEERING & SCIENCE, PLLC	FIEL	D BOREHOLE LOC
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 FIRST: COMPL.: WATER:	CASING:
SAMPLING METHOD:	LOGGED BY:	
HAWMER WEIGHT: DROP:	RESPONSIBLE PROFESSIONAL:	REG. NO.
SAMPLES E SAMPLE DESC	RIPTION	
SAMPLE DESC SAMPLE DESC SAMPLE DESC Ed O Z e plant display and the state of the	on, % of Soil Type, Tenta 30 Licity, Fracturing, Odor, Office	REMARKS
SURFACE ELEVATION (FMSL):		
		The state of the s
ABANDONMENT: Volume of cement/bentonite grout required: V = πr² x 7.48 =		rehole depth = ft.
Volume of cement/bentonite grout installed: Has bridging of grout occurred?		rehole radius = ft.
If yes, explain resolution:	DO	rehole radius = ft.
Method of installation:		
	al Engineering & Science, PLLC	Figure

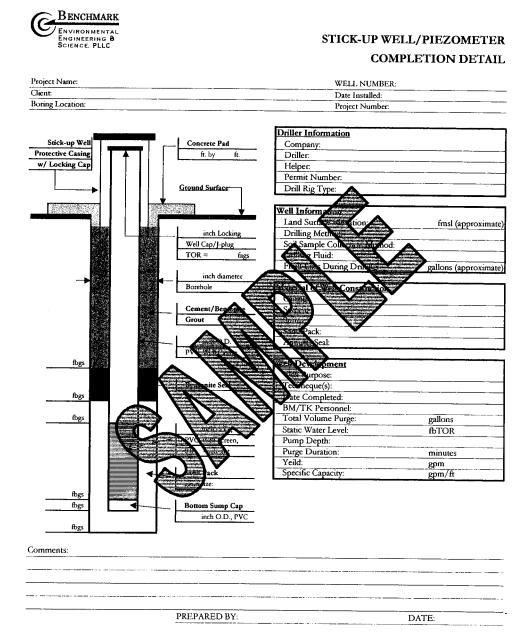


DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION



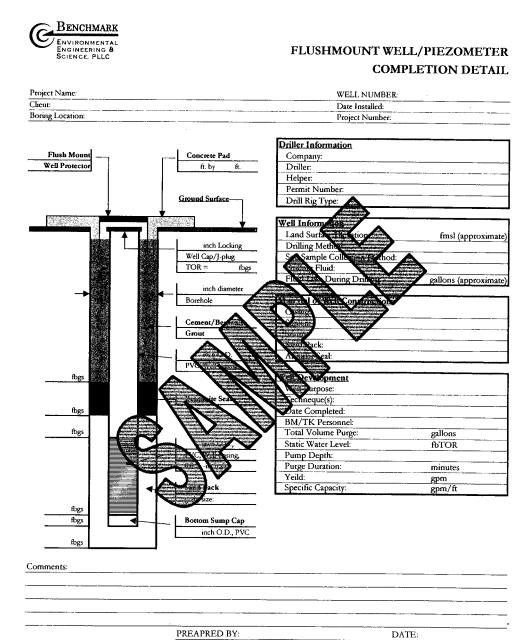


DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION





DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION



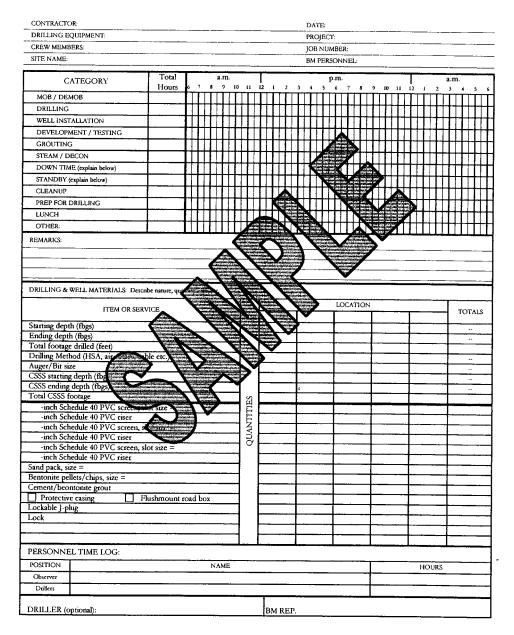


FOP 015.0

DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION



DAILY DRILLING REPORT



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





Drilling and 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.



FOP 018.0

DRILLING AND EXCAVATION EQUIPMENT DECONTAMINATION PROCEDURES

- 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 Benchmark Field Operating Procedure for Management of Investigation-Derived Waste.

ATTACHMENTS

none





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 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. 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.



FOP 022.0

GROUNDWATER LEVEL MEASUREMENT

- 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

Benchmark FOPs:

040 Non-Disposable and Non-Dedicated Sampling Equipment Decontamination

FOP 022.0

GROUNDWATER LEVEL MEASUREMENT



WATER LEVEL MONITORING RECORD

Project Name:			Client:			
Project No.:				Location:		
Field Personnel:				Date:		
Weather:						
Well No.	Time	Top of Riser Elevation	Static Depth to Water	Groundwater Elevation	Total Depth	Last Total Depth Measurement
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Groundwater Purging Procedures Prior to Sample Collection

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 Well Purge & Sample Collection Log and/or Groundwater Well Inspection Form (samples



GROUNDWATER PURGING PROCEDURES PRIOR TO SAMPLE COLLECTION

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.

- 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,



GROUNDWATER PURGING PROCEDURES PRIOR TO SAMPLE COLLECTION

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:
 - Bailer 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.
 - Well Wizard Purge Pump (or similar) 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.



GROUNDWATER PURGING PROCEDURES PRIOR TO SAMPLE COLLECTION

■ WaterraTM 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
РН	± 0.1 unit

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



GROUNDWATER PURGING PROCEDURES PRIOR TO SAMPLE COLLECTION

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



GROUNDWATER PURGING PROCEDURES PRIOR TO SAMPLE COLLECTION

and describing any alternative equipment and procedures used to purge a well and collect samples.

ATTACHMENTS

Groundwater Well Purge & Sample Collection Log 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

GROUNDWATER PURGING PROCEDURES PRIOR TO SAMPLE COLLECTION

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Project Nu	nber:				Sample M					
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GROUNDWATER PURGING PROCEDURES PRIOR TO SAMPLE COLLECTION



GROUNDWATER WELL INSPECTION FORM

Project:	WELL I.D.;
Client:	WELL I.D.;
Job No.:	
Date:	
Time:	
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EXTE	ERIOR INSPECTION
Protective Casing:	And the Control of th
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Other:	
omments/Corrective Actions:	

PREPARED BY:

DATE:



Groundwater Sample Collection Procedures

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 Benchmark 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



GROUNDWATER SAMPLE COLLECTION PROCEDURES

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 Benchmark 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 Benchmark 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 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.
- 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 Benchmark 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).



GROUNDWATER SAMPLE COLLECTION PROCEDURES

- 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 Benchmark 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:



GROUNDWATER SAMPLE COLLECTION PROCEDURES

Parameter	Units
Dissolved Oxygen	parts per million (ppm)
Specific Conductance	μ mhos/cm or μ S or mS
pН	pH units
Temperature	°C or °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 Benchmark 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.



GROUNDWATER SAMPLE COLLECTION PROCEDURES

- 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 Benchmark 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)



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GROUNDWATER SAMPLE COLLECTION PROCEDURES

- 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.

GROUNDWATER SAMPLE COLLECTION PROCEDURES

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.



GROUNDWATER SAMPLE COLLECTION PROCEDURES

- 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.



GROUNDWATER SAMPLE COLLECTION PROCEDURES

- 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

Benchmark FOPs:

- 007 Calibration and Maintenance of Portable Dissolved Oxygen Meter
 008 Calibration and Maintenance of Portable Field pH/Eh Meter
- 008 Calibration and Maintenance of Portable Field pH/Eh Meter 009 Calibration and Maintenance of Portable Field Turbidity Meter
- 009 Calibration and Maintenance of Portable Field Turbidity Meter
 011 Calibration and Maintenance of Portable Photoionization Detect
- 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 SAMPLE COLLECTION PROCEDURES



GROUNDWATER WE PURGE & SAMPLE COLLECTION L

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	Volumes Purg						urged to dryg				yes
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PREPARED BY:



FIELD OPERATING PROCEDURES

Hollow Stem Auger 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 Benchmark'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 Benchmark'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 Benchmark's FOP: Drilling and Excavation Equipment Decontamination Procedures.
- 6. Mobilize the auger rig to the site and position over the borehole.
- 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.



HOLLOW STEM AUGER (HSA) DRILLING PROCEDURES

- 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 Benchmark field supervisor.
- 10. Collect soil samples via split spoon sampler in accordance with Benchmark'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 bit (not center plug) in place.
- 13. Plug and abandon boreholes not used for well installation in accordance with Benchmark'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 Benchmark 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 Benchmark field supervisor.



HOLLOW STEM AUGER (HSA) DRILLING PROCEDURES

ATTACHMENTS

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

REFERENCES

Benchmark FOPs:

001	Abandonment of Borehole Procedures
010	Calibration and Maintenance of Portable Flame Ionization Detecto
011	Calibration and Maintenance of Portable Photoionization Detector
017	Drill Site Selection Procedure
018	Drilling and Excavation Equipment Decontamination Procedures
758	Stilt Stoon Sampling Procedures



HOLLOW STEM AUGER (HSA) DRILLING PROCEDURES



DRILLING SAFETY CHECKLIST

Project: Supplemental Phase II RFI/ICM Project No.: 0041-009-500	S Date: Drilling Company:		
Client: RealCo., Inc.	Drill Rig Type:	·····	
	2211 108 2790.		
ITEMS TO C	CHECK	ОК	ACTION
"Kill switches" installed by the manufacturer are the drill site are familiar with their location and h	in operable condition and all workers at ow to activate them?		
"Kill switches" are accessible to workers on be Optional based on location and number of switch	oth sides of the rotating stem? NOTE: hes provided by the manufacturer.		
Cables on drill rig are free of kinks, frayed wi sections?	ires, "bird cages" and worn or missing		
Cables are terminated at the working end with Coupling or using cable clamps?	ith a proper eye splice, either sware		
Cable clamps are installed with the saddle on the alternated and should be of the correct size and installed. Clamps are complete with no missing p	number for the cable size to which		
Hooks installed on hoist cables are the safety accidental separation?	type with a functional prevent		
Safety latches are functional and completely spar positive action to close the throat except when disconnecting a load?			· · · · · · · · · · · · · · · · · · ·
Drive shafts, belts, chain drives and universa accidental insertion of hands and fingers or tool	al joins in be intrinsic o prevent		
Outriggers shall be extended prior to and w Hydraulic outriggers must maintain pressure to drill rig even while unattended.	ed (File cradle, and a file cradle) and a file cradle the		
Outriggers shall be properly supported soil.	and street of court settling into the		
Controls are properly lal and one over fix the blocked or locked in an all and presion.	o annuary on the controls should not be		· · · · · ·
Safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties on any device share and safeties of the safeties of	sed.		
Controls shall be operated smoothly and care- operated erratically to overcome research	notafting devices shall not be jerked or		
Slings, chokers and lifting devices are order? Damaged units are removed from service	and are properly tagged?		
Shackles and clevises are in proper working orde before placing under a load?			
High-pressure hoses have a safety (chain, cable o to prevent whipping in the event of a failure?			
Rotating parts of the drill string shall be free of s entrap clothing or foreign objects?	harp projections or hooks, which could		
Wire ropes should not be allowed to bend around			
The exclusion zone is centered over the borehole the boom height?	and the radius is equal or greater than		

		T
ITEMS TO CHECK	OK	ACTION
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HOLLOW STEM AUGER (HSA) DRILLING PROCEDURES



DRILLING SAFETY CHECKLIST

Project: Supplemental Phase II RFI/ICMs	Date:	
Project No.: 0041-009-500	Drilling Company:	
Client: RealCo., Inc.	Drill Rig Type:	
		ACTION

ITEMS TO CHECK	ок	ACTION NEEDED
The work area around the borehole shall be kept dear 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 shall have received annual training on proper use of the fire extinguisher.		
29 CFR 1910.333 © (3) Except where electrical distribution and transmission lines		
energized and visibly grounded, drill rigs will be operated proximate ander, by, or the very	A	ļ
lines only in accordance with the following:	=	į
.333 © (3) (ii) 50 kV or less -minimum clearance is 1		
For 50 kV or over - 10ft. Plus ½ in. For each add		
Benchmark Policy: Maintain 20 feet clearant		
29 CFR 1910.333 © (3) (iii) While the rig is in		
dearance from energized power lines will be maint and allowed the dearance from energized power lines will be maint and allowed the dearance from energized power lines will be maint and allowed the dearance from energized power lines will be maint and allowed the dearance from the		
Less than 50 kV - 4 feet		
50 to 365 kV - 10 feet		
365 to 720 kV - 16 feet		
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HOLLOW STEM AUGER (HSA) DRILLING PROCEDURES



TAILGATE SAFETY MEETING FORM

Project Name:		Date:		Time:	
Project Number:		Client:			
Work Activities:					
HOSPITAL INFOR	MATION:				
Name:					
Address:	City:		State:	Zip:	
Phone No.:		Ambulance	Phone No.		
SAFETY TOPICS PR	PESENTED:				"
Chemical Hazards:					
Physical Hazards:	Slips, Trips, Falls)	
	54p3, 111p3, 1445			A	
				Y	
PERSONAL PROTE	CTIVE EQUIPMENT:				
Activity:			New 78	С	D
Activity:			A B	C	D
Activity:			A B	C	D
Activity:			A B	C	D
Activity:			<u>A</u> <u>B</u>	C	D
New Equipment:					
Other Safety Topic (s):	En ser ental surri (ag	Assive fauna)			
Omer Sujery Topic (s).		acco products is prohi	bited in the Exch	sion Zone (EZ)	
				Done (EE)	
	AT	TTENDEES	··		
Name	Printed		Signature	·e	
					
Meeting conducted by	<i>7</i> :				



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

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 Benchmark's Groundwater Level Measurement FOP and decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the Benchmark'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



LOW FLOW (MINIMAL DRAWDOWN) GROUNDWATER PURGING & SAMPLING PROCEDURES

instrumentation should be followed as specified in Benchmark'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 Benchmark'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 Benchmark'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



LOW FLOW (MINIMAL DRAWDOWN) GROUNDWATER PURGING & SAMPLING PROCEDURES

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



LOW FLOW (MINIMAL DRAWDOWN) GROUNDWATER PURGING & SAMPLING PROCEDURES

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 Benchmark'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



LOW FLOW (MINIMAL DRAWDOWN) GROUNDWATER PURGING & SAMPLING PROCEDURES

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



LOW FLOW (MINIMAL DRAWDOWN) GROUNDWATER PURGING & SAMPLING PROCEDURES

- 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.

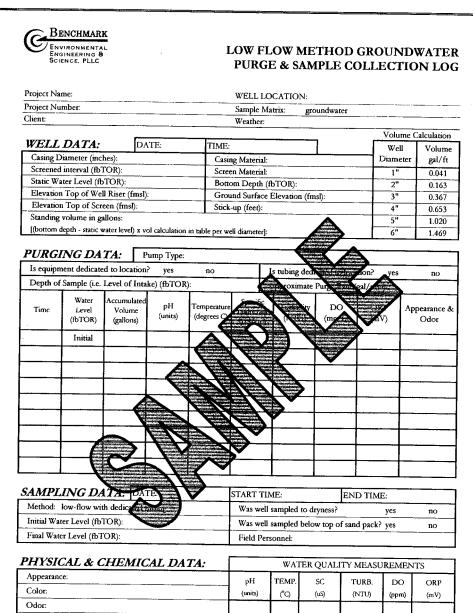


LOW FLOW (MINIMAL DRAWDOWN) GROUNDWATER PURGING & SAMPLING PROCEDURES

Benchmark 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 (MINIMAL DRAWDOWN) GROUNDWATER PURGING & SAMPLING PROCEDURES



BENCHMARK

PREPARED BY:



Sediment Present?

REMARKS:

	-	

FIELD OPERATING PROCEDURES

Management of Investigative-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.



MANAGEMENT OF INVESTIGATION-DERIVED WASTE (IDW)

- 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 Benchmark 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 Benchmark'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



MANAGEMENT OF INVESTIGATION-DERIVED WASTE (IDW)

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



MANAGEMENT OF INVESTIGATION-DERIVED WASTE (IDW)



INVESTIGATION DERIVED WASTE CO!

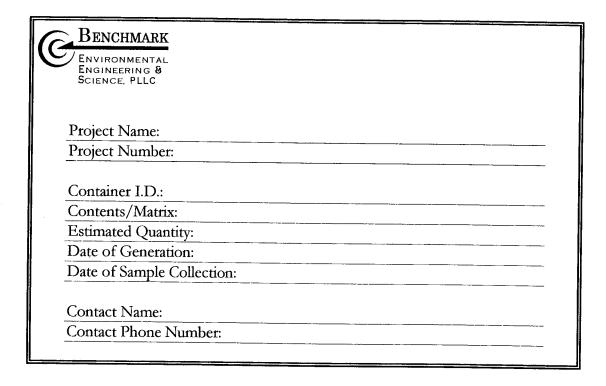
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					Prepared By:		

Signed:



MANAGEMENT OF INVESTIGATION-DERIVED WASTE (IDW)

IDW Container Label (sample):



FIELD OPERATING PROCEDURES

Monitoring Well Construction for Hollow Stem Auger Boreholes

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 Benchmark'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 Benchmark'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.)



MONITORING WELL CONSTRUCTION FOR HOLLOW STEM AUGER BOREHOLES

- 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.



MONITORING WELL CONSTRUCTION FOR HOLLOW STEM AUGER BOREHOLES

- 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 Benchmark Field Operating Procedure for Monitoring Well Development.
- 18. Manage all waste materials generated during well installation and development as described in the Benchmark Field Operating Procedure for Management of Investigation Derived Waste.

ATTACHMENTS

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



MONITORING WELL CONSTRUCTION FOR HOLLOW STEM AUGER BOREHOLES

REFERENCES

Benchmark FOPs:

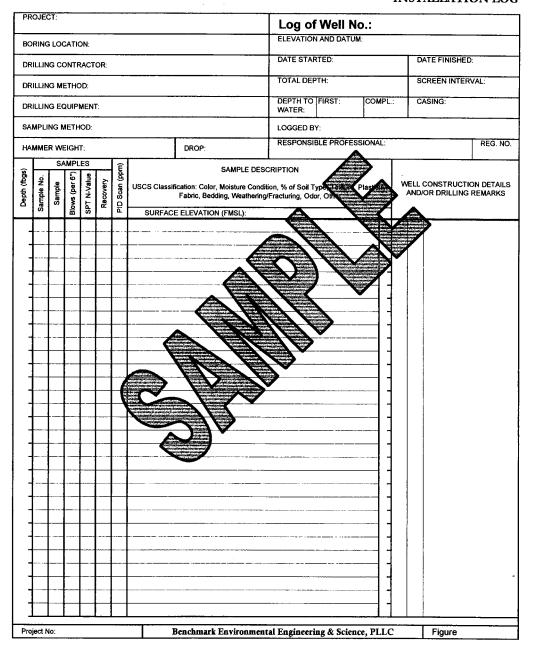
- 015 Documentation Requirements for Drilling and Well Installation
- 026 Hollow Stem Auger Drilling Procedures
- 032 Management of Investigation Derived Waste
- 036 Monitoring Well Development Procedures



MONITORING WELL CONSTRUCTION FOR HOLLOW STEM AUGER BOREHOLES

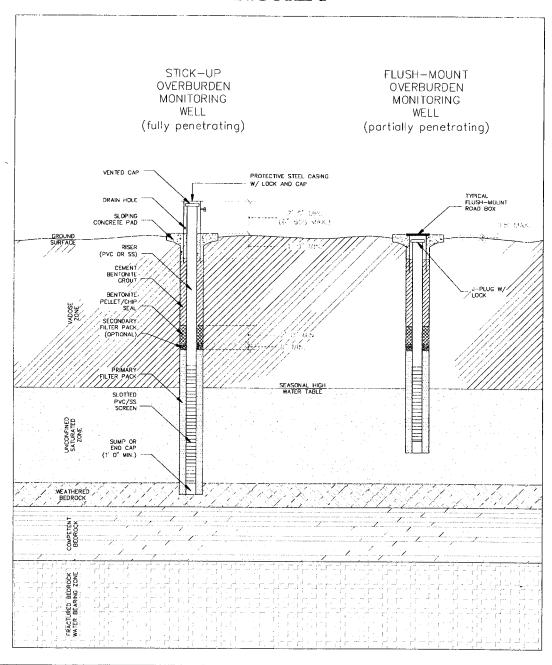


FIELD BOREHOLE/MONITORING WELL INSTALLATION LOG



MONITORING WELL CONSTRUCTION FOR HOLLOW STEM AUGER BOREHOLES

FIGURE 1



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 Benchmark 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 Benchmark 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



FOP 036.0

MONITORING WELL DEVELOPMENT PROCEDURES

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:
 - o Dissolved Oxygen: ± 0.3 mg/L
 - o Turbidity: ± 10%
 - o Specific Conductance: ± 3%
 - o ORP: $\pm 10 \text{ mV}$
 - o pH: \pm 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 Benchmark Groundwater Well Development Log (sample attached).

ATTACHMENTS

Groundwater Well Development Log (sample)

REFERENCES

Benchmark FOPs:

040 Non-Disposable and Non-Dedicated Sampling Equipment Decontamination



FOP 036.0

MONITORING WELL DEVELOPMENT PROCEDURES



GROUNDWATER WELL DEVELOPMENT LOG

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Project Number:					Sample Matrix:						
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Elevation T	op of Well R	iser (fmsl):				ound Surface:	Mean Sea Le	vel			
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PURGIN	IG DATA	4: D	ATE:	ST.	ART TIME:		END T	ME:			
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Non-Disposable and Non-Dedicated Sampling Equipment Decontamination

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:



NON-DISPOSABLE AND NON-DEDICATED SAMPLING EQUIPMENT DECONTAMINATION

- a. Rinse with potable-quality water;
- b. Rinsed with 10% nitric acid (HNO₃) solution ¹;
- c. Rinse with potable-quality water;
- d. Rinse with pesticide grade acetone or methanol ²;
- e. Rinse with pesticide grade hexane ²;
- f. Rinse with deionized water demonstrated analyte-free, such as distilled water;
- g. Air dry; and
- h. 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:

Hexane is not miscible with water (hydrophobic) and therefore, is not an effective rinsing agent unless the sampling equipment is dry.
 Isopropanol is extremely miscible in water (amphoteric), making it an effective rinsing agent on either wet or dry equipment.



Omit this step if metals are not being analyzed. For carbon steel split spoon samplers, a 1% rather than 10% HNO3 solution should be used.

² This solvent rinse can be omitted if organics are <u>not</u> being analyzed. Alternatively, if approval from the NYSDEC has been granted, use pesticide grade isopropanol as the cleaning solvent. Isopropanol is better suited as a cleaning solvent that acetone, methanol and hexane for the following reasons:

Acetone is a parameter analyzed for on the Target Compound List (TCL); therefore the detection of acetone in samples collected
using acetone rinsed equipment is suspect;

Almost all grades of methanol contain 2-butanone (Methyl Ethyl Ketone, MEK) contamination. As for acetone, 2-butanone is a
TCL compound. Thus, the detection of 2-butanone in samples collected using methanol rinsed equipment is suspect. In addition,
methanol is much more hazardous than either isopropanol or acetone.

NON-DISPOSABLE AND NON-DEDICATED SAMPLING EQUIPMENT DECONTAMINATION

- 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 Benchmark 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.



NON-DISPOSABLE AND NON-DEDICATED SAMPLING EQUIPMENT DECONTAMINATION

- 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 (HNO₃).
- 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.



NON-DISPOSABLE AND NON-DEDICATED SAMPLING EQUIPMENT DECONTAMINATION

ATTACHMENTS

None

REFERENCES

Benchmark FOPs:

032 Management of Investigation-Derived Waste



Overburden Casing Installation Procedure

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.



OVERBURDEN CASING INSTALLATION PRCEDURES

- 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.



OVERBURDEN CASING INSTALLATION PRCEDURES

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.

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

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



OVERBURDEN CASING INSTALLATION PRCEDURES

REFERENCES

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

Benchmark FOPs:

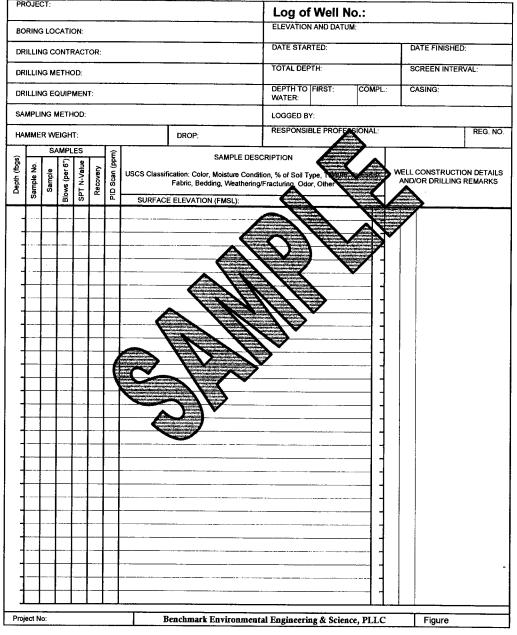
018 Drilling and Excavation Equipment Decontamination Protocols



OVERBURDEN CASING INSTALLATION PRCEDURES



FIELD BOREHOLE/MONITORING WELL INSTALLATION LOG



OVERBURDEN CASING INSTALLATION PRCEDURES

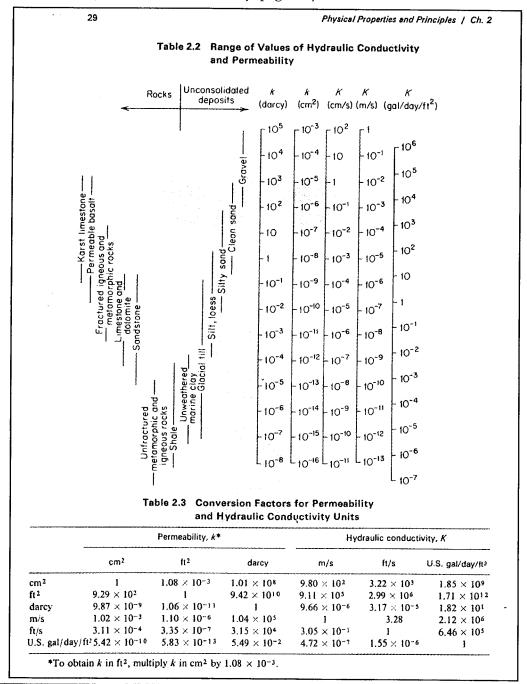


PIPE LEAKAGE TESTING LOG

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OVERBURDEN CASING INSTALLATION PRCEDURES

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



FIELD OPERATING PROCEDURES

Real-Time Air Monitoring During Intrusive Activities

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



REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

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.



REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

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



REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

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 <u>Major Vapor Emission Response Plan</u> 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



REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

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:



REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

- 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/m³) 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/m³ above the upwind level and provided that no visible dust is migrating from the work area.



REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

• If, after implementation of dust suppression techniques, sustained downwind PM-10 particulate levels are greater than 150 ug/m³ 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/m³ of the upwind level and in preventing visible dust migration.

Visual Assessment

In conjunction with the real-time monitoring program, Benchmark 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.



REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

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/m³ 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



REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

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

Benchmark 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 AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

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Sample Labeling, Storage, and Shipment Procedures

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:

San	Sample I.D. Example: GW051402047						
	Sample matrix						
GW	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.

SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES

- 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 Benchmark Field Team Leader until time of shipment. Periodically drain melt-water off coolers and replenish ice as necessary.



SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES

- 4. Ship samples on a daily basis, unless otherwise directed by the Benchmark 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.



SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES

- 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



SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES



SOIL/SEDIME SAMPLE COLLECTION SUMMARY I

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SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES



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SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES



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Wipe sample FDs taken adja	scent to original sam	ple at a ra	te Samples.					
10. EH : Extract and Hold	5		Committee Committee					



SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES

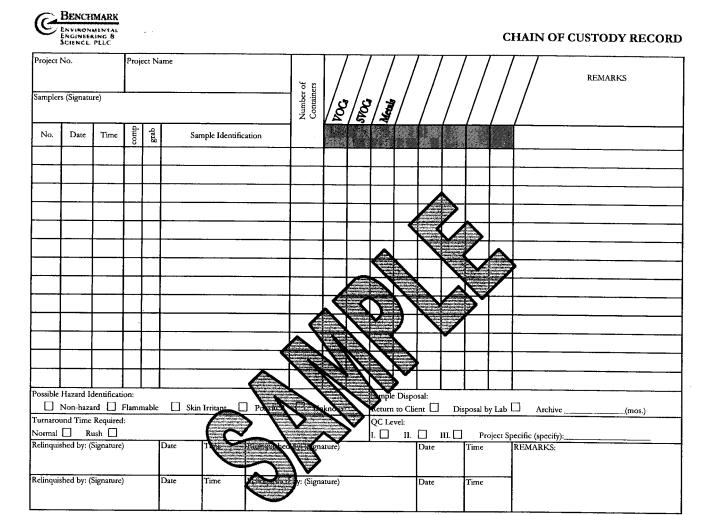


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SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES





Screening of Soil Samples for Organic Vapors During Drilling Activities

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 Benchmark's Field Operating Procedures or manufacturers recommendations for calibration of field meters.
- 2. Collect split-spoon (or other sampler) samples in accordance with Benchmark'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.



SCREENING OF SOIL SAMPLES FOR ORGANIC VAPORS DURING DRILLING ACTIVITIES

- 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

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
- 058 Split Spoon Sampling Procedures



SCREENING OF SOIL SAMPLES FOR ORGANIC VAPORS DURING DRILLING ACTIVITIES

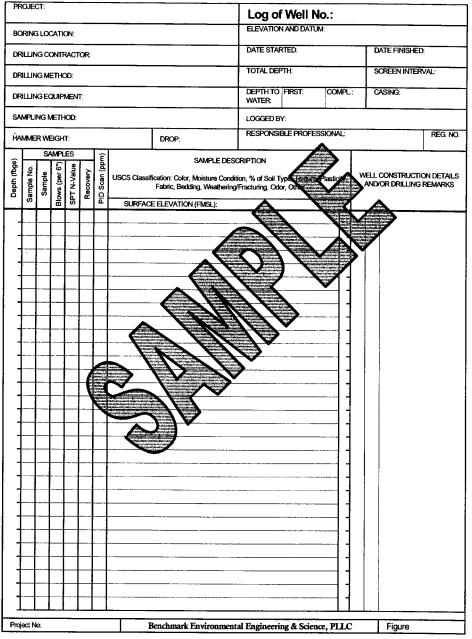
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SCREENING OF SOIL SAMPLES FOR ORGANIC VAPORS DURING DRILLING ACTIVITIES

(G	BENCHMARK
	ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC
PRO	JECT:

FIELD BOREHOLE/MONITORING WELL INSTALLATION LOG



Soil Description
Procedures Using the
Unified Soil
Classification System
(USCS)

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 observation in accordance with Bureau of Reclamation Standards as modified from the Unified Soil Classification System (USCS). This method of soil characterization describes soil types based on grain size and liquid and plastic limits and includes moisture content. This FOP is fairly consistent with ASTM Designation: D 2488 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)." 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.



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

- 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.



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

DESCRIPTIVE TERMS

All field soil samples will be classified in accordance with the Unified Soil Classification System (USCS) (modified from ASTM D2488) presented in Figures 1 and 2 (attached) and using the descriptive terms detailed in this section. 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 as well as the attached Figures.

Use the following descriptive terms when classifying soils:

- Group Name (USCS, see Figure 2)
- **Group Symbol** (USCS, see Figure 2)
- **Angularity** (ASTM D2488; Table 1)
 - Angular particles have sharp edges and relatively planar sides with unpolished surfaces
 - O Subangular particles are similar to angular description but have rounded edges
 - O Subrounded particles have nearly planar sides but have well-rounded corners and edges
 - o 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
 - o Flat and Elongated particles meet criteria for both flat and elongated
- Moisture Condition (ASTM D2488; Table 3)
 - O Dry absence of moisture, dusty, dry to the touch
 - o Moist damp, but no visible water



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

- O Wet visible free water, usually soil is below water table
- Reaction with Hydrochloric Acid (HCl) (ASTM D2488; Table 4)
 - o None no visible reaction
 - Weak some reaction, with bubbles forming slowly
 - o 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
 - O Soft easily molded by fingers; easily penetrated several inches by thumb
 - Firm molded by strong pressure of fingers; can be penetrated several inches by thumb with moderate effort
 - O Stiff dented by strong pressure of fingers; readily indented by thumb but can be penetrated only with great effort
 - Very stiff readily indented by thumbnail
 - o Hard indented with difficultly by thumbnail
- Cementation (ASTM D2488; Table 6)
 - Weak crumbles or breaks with handling or slight finger pressure
 - o Moderate crumbles or breaks with considerable finger pressure
 - o 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
 - O Stratified alternating layers of varying material or color with the layers less than 6 mm (0.23 inches) thick; note thickness
 - O Laminated alternating layers of varying material or color with the layers less than 6 mm (0.23 inches) thick; note thickness
 - o Fissured contains shears or separations along planes of weakness



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

- O Slickensided shear planes appear polished or glossy, sometimes striated
- O 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
- o Homogeneous same color and appearance throughout
- Inorganic Fine-Grained Soil Characteristics (ASTM D2488; Table 12)
 - o 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
 - o 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
 - o 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.



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

- 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)
 - O Nonplastic a 3 mm (0.12 inches) thread cannot be rolled at any water content
 - o 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
 - O 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

- O Very loose easily penetrated 30 cm (1.2 inches) with 13 mm (0.5 inch) rebar pushed by hand
- Loose easily penetrated several cm with 13 mm (0.5 inch) rebar pushed by hand
- o Medium dense easily to moderately penetrated with 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer
- O Dense penetrated 0.3 m (1 foot) with difficulty using 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer
- Very dense penetrated only a few cm with 13 mm (0.5 inch) rebar driven by
 2.3 kg (6 pound) hammer
- Color (use Munsel® Color System)
- **Particle Size** (see Figure 3)
 - o Boulder larger than a basketball
 - Cobble grapefruit, orange, volleyball
 - o Coarse Gravel tennis ball, grape
 - o Fine Gravel pea
 - Coarse Sand rock salt



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

- o Medium Sand opening in window screen
- o Fine Sand sugar, table salt
- o Fines (silt and clay) cannot visually determine size (unaided)

Gradation

- Well Graded (GW, SW) full range and even distribution of grain sizes present
- o Poorly-graded (GP, SP) narrow range of grain sizes present
- O Uniformly-graded (GP, SP) consists predominantly of one grain size
- O 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.
 - o PEAT 50 to 100 percent organics by volume, primary constituent
 - Organic (soil name) 15 to 50 percent organics by volume, secondary organic constituent
 - o (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.



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

• Other Constituents/Characteristics

- O 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 presented in this FOP are not intended for civil engineering (construction) purposes, but rather for hydrogeologic and contaminant transport purposes. As such, the visual-manual tests performed are somewhat limited in that they are only performed in order to indicate important information about potential hydraulic properties of a soil. Therefore, at a minimum, soil descriptions should include:

- Color (using Munsell® charts) at moist condition, include mottling
- Field moisture condition;



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

- Percentage estimates of various grain sizes present (fines, sand, gravel);
- Plasticity (see Descriptive Terms section of this FOP);
- Consistency/Density (see Descriptive Terms section of this FOP);
- Other important geologic information such as consolidation, gravel size and shape, visible internal structure, root holes, mica, odors, etc.

Based on these data, and in conjunction with the flow charts provided in the ASTM Standard (see Figure 2), the soil is given a USCS group name and a two-letter symbol. If fill is identified, indicate the word FILL after the soil description (parenthetically).

The first step in this FOP is to determine if the sample is predominantly fine-grained or predominantly coarse-grained (see Figure 3). 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. 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]).

SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

Fines described in the classification should be modified by the plasticity (e.g., nonplastic fines, low plasticity fines, etc.) reserving the words "silt" and "clay" for the USCS group name. This applies to fine-grained and coarse-grained soils.

According to a note in the ASTM Standard, percentage of grain size can be estimated in ranges using the words "few", "little", "some" and "mostly". This FOP discourages the use of these modifiers based on practical reasons: (1) the range of percentages in a given word may cross a name designation on the flow charts used for classification, and (2) these words are meaningless to someone who does not have the obscure table in front of them for reference. Accordingly, this FOP encourages estimating grain sizes in percentages or range of percentages (e.g., "about or approximately 10% fine sand"; or "20-25% nonplastic fines). When estimating percentages of grain sizes, make sure that all of the estimates add up to 100%. Keep in mind, the "break over" percentages for fines in a coarse-grained soil and for sand or gravel in a fine-grained soil (refer to Figure 2). For example, do not say "10 to 20% nonplastic fines" when the "break over" occurs into a new USCS group name at 15% fines.

In summary, adhering to the ASTM Standard and the guidelines outlined in this FOP will provide uniformity in soil descriptions of field personnel. Pertinent criteria and their appropriate order are provided at the top of each boring log field sheet. 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:

SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

Coarse-grained Soil

<u>CLAYEY GRAVEL</u> with <u>SAND</u> (<u>GC</u>): dark olive gray (5Y 3/2), wet, about 50% fine to coarse gravel, about 30% fine sand, about 20% low plasticity fines, subrounded gravel to 2-inch diameter of greenstone and chert.

Fine-grained Soil

LEAN CLAY with SAND (CL): dark olive gray (5Y 3/2), moist, about 80% fines, about 20% fine to medium sand, trace fine gravel, medium plasticity, firm, root holes.

BORING AND MONITORING WELL INSTALLATION LOGS

One of the most important functions of a boring/monitoring well installation log, besides transmitting the soil description, is to show where the "data" (soil samples) were collected, giving the reader an idea of how reliable or representative the description is. An example of a completed boring and monitoring well installation log is attached to this FOP.

On the example and sample logs, depths of attempted and recovered or non-recovered interval are shown. Do not include the "water level" symbol (inverted triangle) on the logs; instead, indicate the depth at which groundwater was first encountered and, as necessary, the depth to water at borehole/monitoring completion in the space provided on the log header. Also shown on the example and sample logs is the symbol for samples collected for chemical analysis and PID scan measurements. Odor, if noted, will be shown on the logs in the soil description; however, odor, if noted, is subjective and not necessarily indicative of specific compounds or concentrations. Also attached to this FOP is a disclaimer and log symbols used, which should be provided with each set of logs within the project final report.

SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

Remember: field borehole/monitoring well installation 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., percentages, 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



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

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 Explanation

Field Borehole Log (sample)

Field Borehole Log (completed example)

Field Borehole/Monitoring Well Installation Log Explanation

Field Borehole/Monitoring Well Installation Log (sample)

Field Borehole/Monitoring Well Installation Log (completed example)

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:

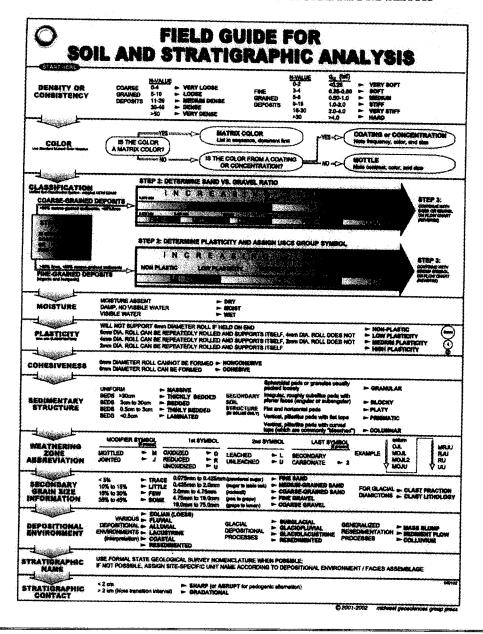
- 010 Calibration and Maintenance of Portable Flame Ionization Detector
- 011 Calibration and Maintenance of Portable Photoionization Detector
- 015 Documentation Requirements for Drilling and Well Installation
- 025 Hand Augering Procedures
- 032 Management of Investigation-Derived Waste
- 046 Sample 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



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

FIGURE 1

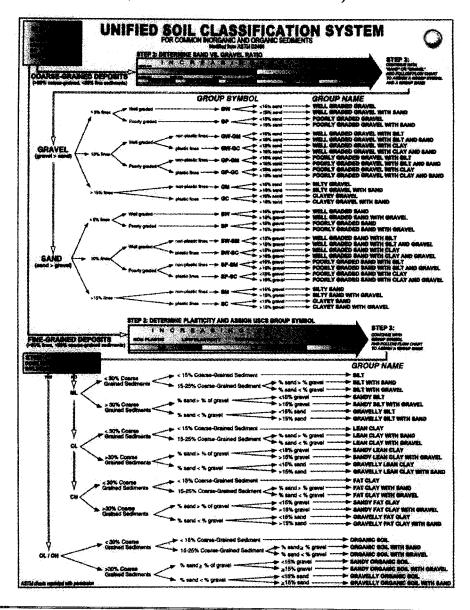
FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

FIGURE 2

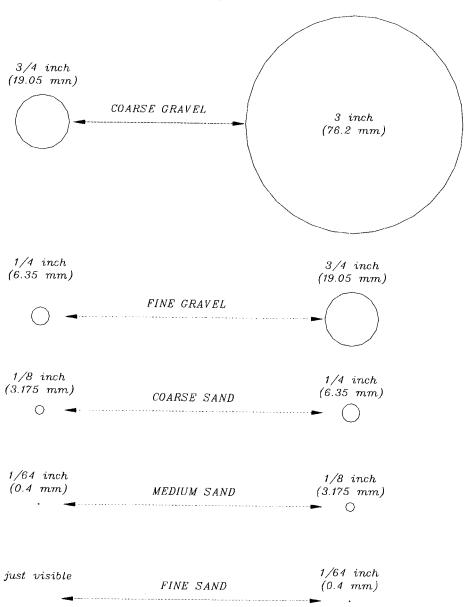
USCS SOIL CLASSIFICATION FLOW CHART (MODIFIED FROM ASTM D2488)



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

FIGURE 3

ILLUSTRATION OF PARTICLE SIZES



SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

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Benchmark Environmental Engineering & Science, PLLC

Method of installation: Project No:

SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

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SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

PROJECT: Chemical, I	nc.	Log of Bori	ing No. B-1
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Project No.			Figure

SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)



FIELD BOREHOLE/MONITORING WELL INSTALLATION LOG

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SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

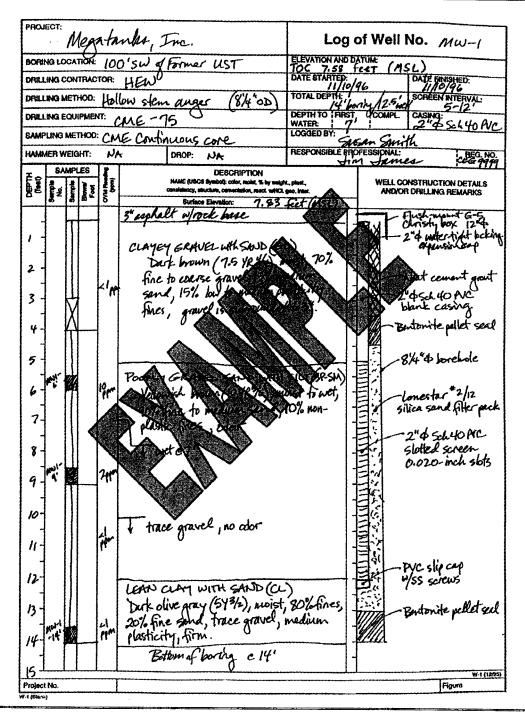
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Benchmark Environmental Engineering & Science, PLLC

Project No:

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SOIL DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)





BENCHMARK

Engineering & Science, PLLC

Split-Spoon Sampling Procedures

FOP 058.0

SPLIT-SPOON SAMPLING PROCEDURES

PURPOSE

This guideline presents the methods for using a split-spoon sampler for collecting soil samples from a boring and for estimating the relative in-situ compressive strength of subsurface materials (ASTM D 1586). Representative samples for lithologic description, geochemical analysis, and geotechnical testing will be collected from the subsurface materials using the split-spoon sampler.

PROCEDURE

- 1. Place plastic sheeting on a sturdy surface to prevent the split-spoon and its contents from coming in contact with the surface (several layers of sheeting may be placed on the surface so that they may be removed between each sample or as needed).
- 2. Lower the sampling string to the base of the borehole. Measure the portion of the sampling string that extends above surrounding grade (i.e. the stickup). The depth of sampling will equal the total length of the string (sampler plus rods) minus the stickup length.
- 3. Measure sampling depths to an accuracy of 0.1 feet. If field measurements indicate the presence of more than 0.3 feet of disturbed materials in the base of the borehole (i.e. slough), the sampler will be used to remove this material, after which a second sampling trip will be made.
- 4. Select additional sampler components as required (i.e., leaf spring core retainer for clays or a sand trap for non-cohesive sands). If a retainer or trap is not used, a spacer ring will be used to hold the liners in position inside the sampler.
- 5. For driving samples, attach the drive head sub and hammer to the drill rods without the weight resting on the rods. For pushing samples using the rig hydraulics, skip to Step 9.



FOP 058.0

SPLIT-SPOON SAMPLING PROCEDURES

- 6. Mark four 6-inch intervals on the drill rods relative to a reference point on the drill rig. With the sampler resting on the bottom of the hole, drive the sampler with the 140 lb. hammer falling freely over a 30-inch fall until 24 inches have been penetrated or 50 blows applied.
- 7. Record the number of blows per 6 inches. Determine the "N" value by adding the blows for the 6 to 12-inch and 12 to 18-inch intervals of each sample drive.
- 8. After penetration is complete, remove the sampling string. Avoid removing sampling string by hitting up on the string with the hammer as this can cause the sample to fall from the bottom of the split-spoon sampler. The sampling string should be removed via cable lifting or rig hydraulics. If sample retention has been poor, let the sampling string rest in place for at least 3 minutes, then rotate clockwise at least 3 times before removing from the borehole.
- 9. For pushed samples (i.e., using rig hydraulics), mark four 6-inch intervals on the drill rods relative to a reference point on the rig. Use the rig pull-down to press the sampler downward until 24 inches have been penetrated or no further progress can be made with the full weight of the rig on the sampler.
- 10. Remove the split-spoon sampler from the sampling string and place on the plastic-covered surface.
- 11. Open the split-spoon sampler only when the Benchmark field geologist is prepared to describe and manage the sample.
- 12. Describe the sample in accordance with the Unified Soil Classification System in accordance with the Benchmark FOP: Soil Description Procedures Using the Unified Soil Classification System (USCS).
- 13. Record all information in accordance with Benchmark's FOP: Documentation Requirements for Drilling and Well Installation.

FOP 058.0

SPLIT-SPOON SAMPLING PROCEDURES

- 14. Collect a portion of the sample for field screening as described in the Benchmark FOP: Screening of Soil Samples for Organic Vapors During Drilling Activities.
- 15. If applicable, collect soil samples for volatile organic constituents (VOCs). If applicable, collect sample for semi-volatile, metals, geotechnical, or other off-site analysis.
- 16. The samples will be labeled, stored and shipped in accordance with the Benchmark's FOP: Sample Labeling, Storage and Shipment Procedures.

ATTACHMENTS

none

REFERENCES

Benchmark FOPs:

- 015 Documentation Requirements for Drilling and Well Installation
- 046 Sample Labeling, Storage and Shipment Procedures
- 047 Screening of Soil Samples for Organic Vapors During Drilling Activities
- 054 Soil Description Procedures Using the Unified Soil Classification System (USCS)



Surface and Subsurface Soil Sampling Procedures

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 Benchmark 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 Benchmark'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 Benchmark'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 Benchmark's Non-disposable and Non-dedicated Sampling Equipment Decontamination procedures.
- 7. Collect soil samples in accordance with the following sections.



SURFACE AND SUBSURFACE SOIL SAMPLING PROCEDURES

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



SURFACE AND SUBSURFACE SOIL SAMPLING PROCEDURES

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 Benchmark'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 Benchmark 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. <u>Volatile Organic Compound (VOCs)</u>: 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. <u>All Other Parameters</u>: All other parameters include, but are not limited to, Semi-VOCs (SVOCs), polychlorinated biphenyls (PCBs), herbicides,



SURFACE AND SUBSURFACE SOIL SAMPLING PROCEDURES

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

Benchmark 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

SURFACE AND SUBSURFACE SOIL SAMPLING PROCEDURES

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SURFACE AND SUBSURFACE SOIL SAMPLING PROCEDURES



SOIL/SEDIMENT SAMPLE COLLECTION SUMMARY LOG

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SURFACE AND SUBSURFACE SOIL SAMPLING PROCEDURES

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NOTE: SEE EQUIPMENT CALIBRATION LOG FOR STATION OF EQUIPMENT TYPE.

Prepared By:

Date:

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.

Grout Slurry Composition (% Weight)

1.5 to 3.0% -

Bentonite (Quick Gel)

40 to 60 %

Cement (Portland Type I)

40 to 60 %

Potable Water



FOP 070.0

WELL/PIEZOMETER CONSTRUCTION MATERIALS AND DESIGN

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.



APPENDIX B

LABORATORY CERTIFICATIONS & QUALITY ASSURANCE MANUAL

(PROVIDED UPON REQUEST)



APPENDIX C

RÉSUMÉS

(PROVIDED UPON REQUEST)

