Superfund Records Center
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FIELD SAMPLING PLAN
SHALLOW GROUNDWATER REMEDY – GROUNDWATER ACTION AREA

Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island 02911

November 19, 2009

Prepared for

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An Employee Owned Company

Comm. No. 15RP901

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DRAWINGS

Drawing 1 Shallow Groundwater Remedy – Groundwater Action Area Site Plan

APPENDICES

Appendix A Loureiro Engineering Associates, Inc. Standard Operating Procedures

ACRONYMS

CFR	Code of Federal Regulations
ES	Environmental Standards
FSP	Field Sampling Plan
HASP	Health and Safety Plan
HDPE	High-density Polyethylene
JHA	Job Hazard Analysis
LEA	Loureiro Engineering Associates, Inc.
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NTUs	Nephalometric Turbidity Units
PE	Performance Evaluation
PVC	Polyvinyl Chloride
QC	Quality Control
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SOPs	Standard Operating Procedures
SOW	Statement of Work
TCRA	Time-Critical Removal Action
USEPA	United States Environmental Protection Agency

UNITS

ml/min	milliliters per minute

1. INTRODUCTION

1.1 Background

On behalf of Emhart Industries, Inc. (Emhart), Loureiro Engineering Associates, Inc. (LEA) has prepared this Field Sampling Plan (FSP) as a supplement to the Work Plan being implemented to fulfill the requirements of the Administrative Settlement Agreement and Order on Consent (Order), referenced as CERCLA Docket No. 01-2009-0086, the effective date of which is August 11, 2009. The Order outlines a Time-Critical Removal Action (TCRA) at the Groundwater Action Area of the Centredale Manor Restoration Project Superfund Site located in North Providence, Rhode Island (hereinafter referred to as the "site"). The Groundwater Action Area is shown in Drawing 1. The specific actions of the TCRA identified in the Statement of Work (SOW) provided as Appendix A to the Order include: (i) focused excavation limited to specified lines and grades and off-site disposal of potentially impacted soils and sediments; (ii) installing steel sheeting to control surface water during the construction activities; (iii) backfilling and re-grading the area of excavation; (iv) constructing an impermeable cap over the Groundwater Action Area; (v) installing groundwater monitoring points; and, (vi) conducting one round of groundwater monitoring. The Work Plan prepared by LEA was approved by the United States Environmental Protection Agency (USEPA) on September 10, 2009.

To date, the elements of the TCRA that have been completed include the focused excavation, the installation of steel sheeting, backfilling, construction of an impermeable cap, re-grading the area of excavation, and the installation of two groundwater monitoring points. The monitoring points were installed beneath the bed of the Woonasquatucket River (River). One monitoring point, MW-GWR-001, was installed upstream of the cap and one monitoring point, MW-GWR-002, was installed at the downstream extent of the cap, as shown in Drawing 1. The monitoring points were designed to obtain representative groundwater samples at these locations to assess whether dioxins/furans are being transported and discharged into the River.

1.2 Site Description

As described by the USEPA, the site includes two parcels, 2072 and 2074 Smith Street, encompassing approximately 9.7 acres, as well as certain sediments and floodplain areas of the River from Route 44 (Smith Street) southerly to Allendale Dam and further to an area just below Lyman Mill Dam. The 2072 Smith Street parcel is occupied by Brook Village Apartments, an eleven-story apartment building that houses approximately 135 elderly residents. A series of four paved parking lots extend to the south of this building. The area of the parcel surrounding

the building and parking lots includes landscaped areas and a paved driveway that provides access onto Smith Street. The parcel also includes a soil cap (Cap No. 2) located adjacent to the Woonasquatucket River. The parcel is bordered to the north by Smith Street, to the west by the Woonasquatucket River, to the east by a drainage ditch (former tailrace), and to the south by the 2074 Smith Street parcel. The location of the Brook Village property is shown in Drawing 1.

Centredale Manor Apartments occupies the 2074 Smith Street parcel and consists of an eight-story apartment building that houses approximately 130 elderly residents. Two paved parking lots are located on this parcel to the north and west of the building. The apartment building, parking lots, and associated landscaped areas are located on the northern end of the parcel. The parcel also includes two constructed caps: Cap No. 1 on the southern end of the parcel, which is bordered by Allendale Pond, the Woonasquatucket River and associated land to the south, and the Woonasquatucket River to the west; and Cap No. 3 along the eastern extent of the parcel that includes a drainage channel and occupies the area of the former tailrace. The property is bordered to the north by the Brooks Village Apartments property. The location of the Centredale Manor property is shown in Drawing 1.

The Groundwater Action Area at the site has been identified by the USEPA as the area within the Brook Village parking lot that surrounds the former location of abandoned monitoring well MW-05S and is characterized by soil and groundwater that are contaminated with dioxin and volatile organic compounds (Drawing 1).

1.3 Objectives

This FSP has been prepared by LEA to supplement the USEPA-approved Work Plan. This FSP specifies the procedures to be followed in implementing groundwater sampling activities at monitoring locations MW-GWR-001 and MW-GWR-002. This plan is to be used along with the November 18, 2009 Quality Assurance Project Plan (QAPP) prepared for the TCRA and submitted to USEPA. The objective of this FSP is to provide a common, written understanding of all procedures to be followed in implementing groundwater sampling activities that are required by the Order. This FSP references the Standard Operating Procedures (SOPs) to be followed while conducting the field sampling activities. The QAPP includes the SOPs to be followed while conducting laboratory analysis of the samples that are collected. The QAPP provides a description of the procedures needed to establish and maintain effective quality controls during the analysis of the groundwater samples.

1.4 Scope of Work

The scope of work that is covered by this FSP includes groundwater monitoring point development and sampling activities. The samples that are collected will be submitted for laboratory analysis. The activities to be performed in accordance with this FSP are consistent with the 1990 National Oil and Hazardous Substances Pollution Contingency Plan (NCP) found in Title 40, Part 300 of the Code of Federal Regulations (40 CFR Part 300).

2. FIELD SAMPLING PLAN

2.1 Groundwater Monitoring Point Construction

Each monitoring point was constructed of two-inch diameter, Schedule 40 polyvinyl chloride (PVC) screen and riser. The screen consists of a 2.5-foot section of 0.012-slot, flush-thread Vee-Pack™, pre-packed (20/40 mesh sand) screen. The screen is thread-coupled to a plug at the bottom of the screen. The PVC riser of each groundwater monitoring point is thread-coupled to the screen and placed along the embankment above the high-density polyethylene (HDPE) liner and uniaxial geonet and below the geocell of the constructed, impermeable cap. Each point was completed with an expandable, locking cap within a 3-foot by 3-foot protective vault set flush with the ground surface. The pre-packed screen of each monitoring point was overpacked with ¾-inch stone. A bentonite seal was placed around the PVC riser above the crushed stone.

2.2 Field Sampling Tasks

The tasks to be implemented under this FSP include:

- developing the two monitoring points;
- installing groundwater sampling pumps; and
- obtaining groundwater samples;

Tasks associated with these field sampling activities include:

- analyzing the groundwater samples at a certified environmental laboratory;
- validating the laboratory analytical results;
- evaluating the validated laboratory analytical data; and
- reporting.

Each of these tasks are described in the following sections.

2.2.1 Monitoring Point Development

Using surge and over-pumping techniques, both newly installed monitoring points will be properly developed in accordance with LEA's *Standard Operating Procedure for Installing and Developing Monitoring Wells and Piezometers* provided in Appendix A. Developing the monitoring points will remove fine-grained sediments from the vicinity of the screen and will enable groundwater to flow freely from the formation into the screen. Also, developing the

monitoring points will reduce the turbidity of the groundwater samples obtained during the sampling event.

Each monitoring point will be developed using a submersible pump to draw down the level of the water in the point, followed by physical surging. After surging, the monitoring point will be vigorously pumped to remove accumulated sediment. The cycle will be repeated until the monitoring point produces clear water and the following hydrogeochemical parameters stabilize: temperature, pH, and specific conductance. The water pumped from the point will be assessed to be clear if it is visibly clear and field turbidity measurements of the pumped water are below 5 Nephalometric Turbidity Units (NTUs). The hydrogeochemical parameters will be assessed to be stabilized in accordance with Loureiro Engineering Associates, Inc.'s *Standard Operating Procedure for Installing and Developing Monitoring Wells and Piezometers* provided in Appendix A. Further development by over-pumping and surging will be performed as necessary until the monitoring point produces clear water and the field parameters stabilize. Development water will be properly containerized as described in Section 2.3.

2.2.2 Groundwater Sampling Pump Installation

Groundwater samples will be collected using peristaltic pumps and dedicated tubing. The tubing will be installed in the two monitoring points no sooner than two weeks following development. The tubing intake will be set at a depth corresponding to the mid-section of the monitoring point screen. Groundwater will be purged from each monitoring point and samples will be obtained no sooner than two weeks following placement of the pump tubing.

2.2.3 Groundwater Sample Collection

One groundwater sampling event will be performed no sooner than two weeks following the placement of the groundwater pumps and associated tubing. Also, the groundwater sampling event will be performed during average River flows. Using the general procedures described in Loureiro Engineering Associates, Inc.'s *Standard Operating Procedure for Low Flow (Low Stress) Liquid Sample Collection and Field Analysis*, provided in Appendix A, groundwater samples will be collected from each of the two monitoring points. Modifications to this SOP have been made for the TCRA groundwater monitoring activities. The modifications are provided as follows:

- Section 4.7.5 of the SOP specifies that the rate of evacuation shall be approximately 0.1 liters per minute (100 milliliters per minute (ml/min)), with the evacuation rate not to exceed 0.25 liters per minute (250 ml/min). For the groundwater sampling conducted in accordance with

this FSP, this specification is modified such that the rate of evacuation from the monitoring points shall not exceed 0.04 liters per minute (40 ml/min).

- Section 4.9.2 of the SOP specifies that if after 2.5 hours of purging, or the evacuation of three "well" volumes, the turbidity has not stabilized, then sample collection can be initiated. For the groundwater sampling conducted in accordance with this FSP, this specification is modified such that if the turbidity has not stabilized, sample collection will be initiated only if a turbidity level of less than 5 NTUs has been established and has stabilized. No samples will be collected if purged groundwater exhibits a turbidity of greater than 5 NTUs.

Both unfiltered and filtered groundwater samples will be collected and submitted for analysis. The filtered samples will be field-filtered using a 0.45-micron in-line filter. The purged groundwater will be contained as described in Section 2.3.

2.2.4 Groundwater Sample Analysis

The unfiltered groundwater samples will be analyzed for dioxins/furans using USEPA SW-846 Method 8290A. A decision to analyze the filtered groundwater samples for dioxins/furans may be made following receipt of the results for the unfiltered groundwater samples. During the groundwater sampling event, the quality assurance/quality control (QA/QC) measures that will be implemented will include the analysis of one field equipment rinsate blank sample, one field duplicate sample, one matrix spike/matrix spike duplicate (MS/MSD) sample, and one performance evaluation (PE) sample for dioxins/furans using USEPA SW-846 Method 8290A. The samples to be analyzed for dioxins/furans will be performed by TestAmerica of West Sacramento, California. For each sample to be analyzed, two one-liter amber glass bottles will be collected.

2.2.5 Data Evaluation

Once the laboratory analytical results are obtained, they will be validated by a third-party validator, Environmental Standards of Valley Forge, Pennsylvania (ES). Tier III level validation will be performed for the dioxin/furan data. The validated data will be evaluated relative to data previously obtained by USEPA for this area of the site.

2.2.6 Reporting

A summary report of the TCRA groundwater sampling activities conducted in accordance with this FSP will be prepared and submitted to USEPA. This report will provide a description of the

methods and procedures used to obtain and analyze the samples. The field and laboratory analytical data that are obtained will be summarized in tables appended to this report. In addition, a copy of the third-party data validation reports will be appended to the report. The report will include a discussion of the evaluation of the validated data. Also, the summary report will include the following certification signed by a person who supervised or directed the preparation of the report:

"Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of the report, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

The summary report will be submitted to USEPA within 45 days of receiving the validated laboratory analytical results. An electronic version of the report will be provided at the request of USEPA.

2.3 Management of Waste Water Generated During Sampling

During the course of the groundwater sampling event, groundwater requiring containerization will be brought to the surface. LEA field personnel will ensure that the material is properly containerized and initially labeled as monitoring point purge water, with the date of containerization and the identification as to the location from which the material was derived. The containerized water will be sampled and analyzed to properly characterize the investigation-derived waste for disposal at an off-site permitted facility.

3. GROUNDWATER SAMPLING QUALITY CONTROL

3.1 Overview

In implementing this FSP, information and data will be obtained from the site. The information and data will include field observations and recorded measurements that are obtained using the QA/QC procedures provided in Loureiro Engineering Associates, Inc.'s *Standard operating Procedure for Quality Assurance/Quality Control Measures for Field Activities* (Appendix A). Also, the information and data will include laboratory analytical results of the USEPA Method 8290A analyses and the associated laboratory QA/QC documentation. The associated laboratory analyses will be conducted in accordance with the November 18, 2009 QAPP prepared and submitted to USEPA. Additional information obtained in implementing this FSP will include chain-of-custody documentation and other documentation associated with sample collection and analysis. The need to maintain accurate and complete documentation of the information and data that are acquired is critical to assessing whether any dioxins/furans are being transported and discharged into the River.

3.2 Quality Control Organization and Personnel

The quality control (QC) organization for the project will consist of personnel in the field and in the offices of LEA. On-site QC inspection will be provided by the LEA groundwater sampling team leader. The on-site personnel will be responsible for performing each phase of QC identified below. Office personnel will be responsible for the final review and approval of submittals, maintaining the proper QC documentation, and providing support in the event that any deficiencies or inconsistencies are identified that may require action.

Prior to implementing groundwater sampling activities, the personnel who will be collecting the groundwater samples will review this FSP and the site-specific QAPP. Procedures that differ from SOPs will be duly noted. Also, the personnel conducting the groundwater sampling will review the groundwater sampling task Job Hazard Analysis (JHA) that is incorporated into the site-specific Health and Safety Plan (HASP).

The LEA groundwater sampling team leader will conduct an inspection of all groundwater sampling equipment and the monitoring points to be sampled to ensure that the task will be performed in accordance with this FSP and the QAPP. Any conditions that necessitate deviations from this FSP or the QAPP will be documented on Daily Field Report Forms. The LEA groundwater sampling team leader will discuss any deviations with the LEA Project

Manager and a plan will be developed, as needed, to ensure that appropriate and representative data are collected.

3.3 Deficiencies and Corrective Actions

In the event that a deficiency is identified or work is not performed in accordance with this FSP or with the QAPP, the LEA Project Manager will be notified immediately. The LEA Project Manager will discuss the deficiencies with the team performing the work, and will immediately identify corrective actions that will be taken to correct the deficient work. The LEA groundwater sampling team leader will confirm that the work has been corrected prior to allowing additional tasks that are affected by the non-conforming work to be performed.

3.4 Documentation

The LEA groundwater sampling team leader shall document and record all QC measures that are implemented in the field. The QC measures will be documented on Daily Field Report Forms. Also, any deviations from the QC measures outlined in this FSP will be recorded on these forms. The Daily Field Report Forms will be maintained in the central file for the project.

4. SCHEDULE

The groundwater monitoring point development and sampling activities will be implemented following the completion of construction activities associated with the TCRA. It is anticipated that the planned groundwater sampling activities will be conducted in November and December 2009. It is anticipated that the groundwater sample analytical results will be received within three weeks from the date that the samples are submitted to TestAmerica. Validated laboratory analytical results are expected to be received from ES three weeks, thereafter. The summary report of the groundwater sampling activities is expected to be submitted to USEPA within three weeks of receiving the validated laboratory analytical data from ES.

REFERENCES

United States. 1990 National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 40 CFR Part 300.

DRAWINGS

LEGEND

- LIGHT POLE
- UP680 — UTILITY POLE
- STORM SEWER
- ELEC HH — ELECTICAL BOX
- TREE
- 103 — GROUND SURFACE ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL
- GROUNDWATER ACTION AREA
- MONITORING WELL
- MONITORING WELL (ABANDONED)
- PIEZOMETER
- PIEZOMETER (ABANDONED)
- STAFF GAUGE

MAP REFERENCE:
USGS 7.5 MINUTE SERIES QUADRANGLE FOR PROVIDENCE, R.I., DATED 1996

1200 0 1200 2400 3600
SCALE IN FEET

CENTREDALE BYP
WATERMAN AVE
DONOVAN COURT
SMITH STREET
MILL ST
STEERE AVENUE
GROVER STREET
REDFERN STREET
LIMIT OF ALLENDALE
CAP NO.3
CAP NO.2
CAP NO.1
"BROOK VILLAGE"
"CENTREDALE MANOR"
N. PROVIDENCE
JOHNSTON
RIPRAP
3/4" STONE DITCH
3/4" STONE
STAFF
TMW3
MW10D
MW10B
MW03S
MW01S
MW02S
MW13S
MW02M
MW02D
MW04M
MW04D
MW04S
MW15D
MW14M
MW06S
MW07S
MW08S
MW09S
P-LEA-01
P-LEA-02
P-LEA-03
MW-GWR-001
MW-GWR-002
SP-01
SP-02
SP-03
SP-04
SP-05
SP-06
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P19
P20
P21
GEC1
GEC2
GEC3
GEC4
GEC5
GEC6
GEC7

25 0 25 50 75
SCALE IN FEET

SITE PLAN

REV.	DESCRIPTION OF REVISION	DATE	APPR.

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SCALE	COMM. NO.	DATE	DATE
AS SHOWN	07MD0509	11/20/09	11/20/09
DRAWN BY		APPROVED BY	
A.C.L.		D.N.S.	

CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SHALLOW GROUNDWATER REMEDY - GROUNDWATER ACTION AREA SITE PLAN

An Employee Owned Company

DRAWING 1

SHEET NO. 1 NO. OF SHEETS 1

APPENDIX A

Loureiro Engineering Associates, Inc.
Standard Operating Procedures

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Installing and Developing Monitoring Wells and Piezometers

SOP ID: 10007
Date Initiated: 02/20/90
Revision No. 006: 08/12/02

Approved By: _____ 8/12/02
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Director of Quality

REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	02/20/90	
001-004	-	No record.
005	12/31/01	Formatting and minor revisions throughout.
006	08/12/02	Added section on utility clearance.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Installing and Developing
Monitoring Wells and Piezometers

1. Purpose and Scope

This standard operating procedure (SOP) is designed to describe the methods and procedures used to install and develop monitoring wells and piezometers in a water-table aquifer. Monitoring well and piezometer installation and development shall generally follow the guidelines presented in the "*Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*" (United States Environmental Protection Agency (EPA), 1989), the "*RCRA Ground Water Monitoring Technical Enforcement Guidance Document*" (EPA, 1986), and any state or local guidance, or regulatory documents which are available.

This SOP describes general procedures and guidelines to be followed or consulted for the proper methods to be used when installing monitoring wells or piezometers in unconsolidated deposits and bedrock. Because each site is unique and the purpose of the monitoring wells may vary from installation to installation, no definitive rules can be established. Throughout this SOP reference to monitoring wells is also intended to mean piezometers unless specifically indicated otherwise. This SOP also applies to monitoring wells and piezometers installed by Geoprobe® direct push technologies.

2. Definitions

Geoprobe® Direct Push Machine: A vehicle-mounted, hydraulically-powered machine that uses static force and percussion to advance small-diameter sampling tools into the subsurface for collecting soil, vapor , or groundwater samples. Geoprobe® machines ad tools are manufactured by Geoprobe Systems®, Salina, Kansas.

Prepacked Well Screen (0.5 in and 1.5 in): An assembly consisting of a clotted polyvinyl chloride (PVC) pipe surrounded by environmental grade sand contained within a stainless steel wire mesh cylinder. The inner component of the prepacked screen is a flush-threaded, 0.5 inch Schedule 80 PVC pipe with 0.01 in slots. (Alternatively, a 1.5 inch Schedule 80 PVC pipe can be used). Stainless steel wire mesh with a pore size of 0.011 in makes up the outer component of the prepack. The space between the inner slotted pipe and outer wire mesh is filled with 20/40 mesh silica sand. Geoprobe®

prepacked screens are available in sections of various lengts (3 ft or 5 ft)and a nominal inside diameter of 0.5 in or 1.5 in.

3. Equipment and Decontamination

3.1. Equipment Supplied by the Drilling Contractor:

- Drilling rig.
- Monitoring well casing.
- Monitoring well screen.
- Bottom caps, plugs or points.
- Centering guides (if they are to be used).
- Filter pack sand.
- Bentonite.
- Cement-bentonite grout.
- Mud-scale to measure densities.
- Protective casing or road box.
- Steam-cleaning apparatus and supplies.
- Suitable containers (e.g., Department of Transportation (DOT)-approved 55-gallon drums with liners) for soil cuttings, well development water, and water generated from steam cleaning.
- Metal stamps for permanently marking wells.
- All necessary permits and licenses.
- If the Geoprobe® is used for well installation, Geoprobe®-specific equipment for well installation.

3.2. Equipment Supplied by Loureiro Engineering Associates, Inc. (LEA)

- Field forms.
- Indelible markers.
- Lock(s) and keys.
- Well development equipment (pumps, surge block, bailers, etc.).
- Analytical instrumentation (Analytical instrumentation includes, but is not necessarily limited to turbidity meters, pH meters, specific conductivity meters, and thermometers.).
- Calibration supplies for all analytical instrumentation, as appropriate.
- Alconox®, or other non-phosphate laboratory grade detergent.
- 5-gallon buckets.
- Decontamination brushes.
- Distilled, de-ionized water.
- Decontamination fluids (<10% methanol in water, 100% n-hexane, and

10% nitric acid).

3.3. Equipment Selection and Specifications

The following specifications will be followed:

Cement-Bentonite Grout: If cement-bentonite is utilized, the cement-bentonite grout will be a mixture of 95 pounds of Type II Portland cement, 4 to 6 pounds of powdered sodium bentonite, and 5 gallons of potable water. The bentonite must be thoroughly mixed with the water before the cement is added. The cement bentonite grout shall have a density of 14 pounds/gallon.

Filter Pack Sand: All filter pack sand will be clean, well-rounded silica sand, in factory-sealed bags. The sand will conform to the most recent version of the American Water Works Association (AWWA) Standard AWWA/ANSI A100 for water wells. In brief, the standard states that filter pack sand will have an average specific gravity of 2.5 with not more than 1% of the material having a specific gravity less than 2.25. Thin, flat or elongated particles shall not exceed 2% of the material, no more than 5% of the material shall be soluble in hydrochloric acid, and the material shall be washed and free of shale, mica, clay, dirt, loam, and organic impurities.

Bentonite: All bentonite will be pure, additive-free bentonite whether it is pellets, chips, or powder.

3.4. Equipment Decontamination

3.4.1. Equipment Decontamination for Monitoring Well Installation

All well materials and drilling equipment which are used to construct a monitoring well or piezometer must be clean and free of any potential contaminants. All well construction materials not certified by LEA personnel as decontaminated when delivered will be decontaminated by steam cleaning before being installed. Drilling equipment must also be decontaminated, prior to beginning work, by steam cleaning. Geoprobe® equipment shall be cleaned using a detergent such as Liquinox®.

All decontamination activities shall be completed at a specially constructed decontamination pad (or a portable decontamination unit). The decontamination pad shall be constructed before any drilling

activity begins. The pad shall be constructed of high-density polyethylene (HDPE) liner material, of sufficient size and strength to allow the drill rig access to the pad, and bermed to contain the generated wastewaters.

3.4.2. Equipment Decontamination for Sampling Equipment and Well Development.

All materials and equipment used to sample soil or which enter a well must be clean and free of any potential contaminants. In general, the choice of decontamination procedures shall be based upon the site-specific contaminants and outlined in the site-specific work plan.

For sites at which the contaminants are unknown, but contamination is suspected, the decontamination procedures outlined below shall be followed.

3.4.2.1. Prior to commencing any field activities, the following solutions (as appropriate for the anticipated contaminants) shall be prepared and placed into 500-ml laboratory squirt bottles: <10% methanol in water; 10% nitric acid in water; 100% n-hexane; distilled, de-ionized water. Other chemicals may be used for decontamination of site-specific contaminants if needed for decontamination of those contaminants.

3.4.2.2. In the field, prepare approximately 2.5 gallons of a solution of Alconox® (or other suitable non-phosphate laboratory grade detergent) in tap water in a 5-gallon bucket.

3.4.2.3. Prepare a piece of 5-mil polyethylene sheeting to underlie the decontamination area. The sheeting shall be of sufficient size to contain any accidental discharge of decontamination solutions. The plastic shall be bermed to contain spills. The decontamination for Geoprobe® equipment shall be performed in buckets or in tubs.

3.4.2.4. The order for decontaminating equipment is as follows:

1) Detergent scrub.
2) De-ionized (DI) water rinse.
3) Hexane rinse (to be used only if separate-phase petroleum product, other than gasoline, is present).
4) DI water rinse.

5) 10% nitric acid rinse (to be used only when metals are suspected as potential contaminants).
6) DI water rinse.
7) Methanol rinse (<10% solution).
8) Air dry.

The order of decontamination may change if different chemicals are used.

3.4.2.5. Disposable materials such as cord shall not be decontaminated and shall be disposed of after use.

3.4.3. At the end of the project day, all spent decontamination fluids and materials, such as the polyethylene sheeting and personal protective equipment, shall be managed and/or disposed of in accordance with all applicable municipal, state, and federal regulations.

4. Procedures

4.1. Utilities

4.1.1. Notify the appropriate "one call" utility notification service (e.g. Call Before You Dig at 1-800-922-4455, Contractor ID: 10502) at least three working days prior to commencing operations on a site. The locations of all proposed borings must be clearly marked in the field prior to notification. The Project Engineer/Manager **must** call and confirm that each utility has been to the site and has marked their respective lines.

4.1.2. On private sites, consult with the Owner or other person knowledgeable about the site as to the locations of potential private or abandoned utilities and locate these prior to beginning work. Upon the discretion of the Project Engineer/Manager, a pipe locator can also be used to assist in locating utilities.

4.1.3. Note that OSHA may have additional requirements for location of utilities.

4.1.4. All efforts to locate underground utilities (including names of owner or designee and time) should be properly documented in the field logbook prior to onset of the work scheduled.

4.2. OSHA

4.2.1. The Senior LEA representative shall be the Competent Person required by OSHA for all work. However, this does not relieve other LEA representatives from bringing to his or her attention conditions, which may be unsafe or present a hazard to the drilling crew, the general public, or other workers on the site.

4.3. Monitoring Well and Piezometer Installation

The specific monitoring well installation methodologies are dependent upon the specific drilling method used. In general, monitoring wells will be constructed through the inside of the drill stem, once the borehole has been advanced to the desired depth. For Geoprobe® monitoring wells, the wells will be constructed through the inside of stainless steel casing.

4.3.1. Borehole Advancement

If the borehole has been drilled to a depth greater than that at which the well is to be set, the borehole must be backfilled with bentonite pellets, bentonite chips, or a bentonite-cement slurry to a depth of approximately one foot below the intended well depth. Approximately one foot of clean sand must be placed on top of the backfill to return the borehole to the proper depth for the well installation.

For bedrock monitoring wells, the borehole shall be advanced to approximately one foot into competent bedrock and the isolation casing grouted into place. The grout is to be allowed to cure for at least 24 hours before drilling continues. After the grout has cured, the borehole is to be advanced using the appropriate technique (e.g., coring, air rotary, mud rotary) to the desired depth. If the borehole is advanced to a depth greater than that at which the well is to be set, the borehole shall be backfilled as described above.

For Geoprobe® installed wells and piezometers, the steel casing will be drilled to the specified depth of the bottom of the well using the Geoprobe® and in certain cases manually.

4.3.2. Installation of Well Screen and Casing

The appropriate lengths of well screen (with bottom cap, or plug, or well point) and casing must be joined watertight and carefully lowered inside the drill stem to the bottom of the borehole. If centering guides are used, they must be placed at intervals around the well casing, beginning no lower than 5 feet above the top of the screen.

4.3.3. Design and Installation of the Filter Pack

After the well screen and casing are installed in the borehole, the filter pack shall be installed. For monitoring wells in unconsolidated materials, the selection of the appropriate filter pack material shall be based upon a grain-size analysis of a sample collected from the intended screen interval. The selection of the appropriate filter pack material shall be based upon the methodologies presented in the "*Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*" (EPA, 1989), the "*RCRA Ground Water Monitoring Technical Enforcement Guidance Document*" (EPA, 1986), or any state or local guidance, or regulatory documents which are available. In the absence of grain size analyses, the filter pack material shall be selected based upon an experienced geologist's best judgment as to the appropriate material.

For bedrock monitoring wells, the well screen and filter pack are emplaced primarily to stabilize the borehole and are therefore not sized in the same manner as for a monitoring well in unconsolidated sediments. For typical bedrock monitoring wells, 10-slot well screen is appropriate. The selection of the appropriate filter pack material shall be based upon the slot size selected for the well screen.

A filter pack of clean silica sand will be placed around the well screen. Place the filter pack into the borehole at a uniform rate in a manner that will allow even placement of the sand. The drill stem shall be raised slowly while the sand is being placed to avoid caving of the borehole walls; the drill stem shall never be raised above the top of the filter pack during installation. Using a stainless steel weight on the end of a fiberglass tape, continuously sound the top of the filter pack as it is being installed. The filter pack shall extend from a depth of approximately one foot below the screened interval to a minimum height of one to two feet above the top of the well screen. However, this length may be adjusted if it would create the potential for cross-contamination or in the case of shallow water tables.

A finer-grained sand cap shall be installed for a minimum of one foot above the filter pack. This height may also be adjusted in the case of shallow water tables.

4.3.4. Installation of Impermeable Seal

An impermeable seal at least two feet thick must be placed on top of the fine sand cap. The seal may be composed of either bentonite pellets or a bentonite slurry. The pellets must be placed into the borehole in a slow and continuous manner that prevents bridging. This is especially important in deeper monitoring wells where

the pellets may have to be emplaced through a considerable depth of standing water in the borehole.

The bentonite slurry shall be prepared by mixing approximately 15 pounds of bentonite powder with 7 gallons of water for each one cubic foot of slurry needed. The slurry shall be emplaced in the borehole via a tremie pipe. The tremie pipe must be plugged on the bottom and have openings along the sides of the bottom one foot of pipe. This will allow the slurry to be emplaced into the borehole without disturbing the fine sand cap. This procedure is especially important for the relatively deeper wells.

Verify the position of the top of the bentonite seal using a weighted tape measure. If all or a portion of the bentonite seal must be emplaced above the water table, hydrate the bentonite with clean water. Allow 30 minutes after adding the water for the bentonite to hydrate.

The thickness of the bentonite seal may be adjusted for wells completed in aquifers with shallow water tables.

4.3.5. Installation of Grout Backfill

Place an annular seal of cement-bentonite grout above the bentonite seal. Install the cement-bentonite grout continuously from the bottom of the annular space to the ground surface through a tremie pipe. The tremie pipe must be plugged on the bottom and have openings along the sides of the bottom one-foot length of pipe. This will allow the grout to be emplaced into the borehole without disturbing the bentonite seal. Alternatively, a bentonite slurry can be used.

4.3.6. Surface Completion

All monitoring wells will be finished at the surface with a concrete pad (Figure 1). The concrete pad shall typically be two-feet square and at least four inches thick. The concrete shall fill the borehole to a depth below the frost line. The pad shall be constructed in one continuous pour of concrete. Note that some of the cement-bentonite grout used for the annular seal may have to be removed to install the concrete pad. A survey pin may be installed in the concrete pad before it dries, if necessary.

For monitoring wells that will be completed above-grade, a locking steel protective casing shall be installed in the concrete. The protective casing shall extend at least three feet into the ground and two feet above ground. For monitoring wells that will be completed flush, a steel roadbox, suitable for traffic loads, with a gasketed cover and drain shall be installed.

Each well will be properly labeled on the exterior of the locking cap or protective steel casing with a metal stamp indicating the permanent well identifier.

4.3.7. Well Protection Bollards

Guard posts may be installed in high-traffic areas for additional protection. One to four guard posts would be installed around the protective casing, within the edges of the concrete pad. If used, guard posts will consist of concrete-filled steel tubes, at least 3 inches in diameter, painted with multiple coats of epoxy-based paint to prevent rust. The guard posts would extend at least two feet below ground and approximately three feet above ground.

4.3.8. Geoprobe® Prepacked Screen Monitoring Well Installation

The installation of prepacked screen monitoring wells in general follows the following four steps (Figure 2):

4.3.8.1. Anchoring the Well Assembly at Depth

In the first step, an expendable anchor point is driven to the desired depth on the end of a 2.125 outside diameter probe rod string. A prepacked screen assembly is inserted into the inside diameter of the rod string with 5-ft sections of PVC riser. The screens and riser pipe are attached to the anchor point via a snap-lock connector. If the monitoring well is to have a flush-mount finish, it is suggested to prepare a large enough hole to accept a standard well protector before driving the probe rods.

4.3.8.2. Providing a Sand Pack and Grout Barrier

The natural formation will sometimes collapse around the well screens as the probe rod string is withdrawn. This is frequently encountered in sandy formations below the water table. This provides an effective barrier between the screens and grout material used to seal the well annulus. If the formation does not collapse, a sand barrier must be placed from the surface while retracting the well casing. This procedure needs to be followed carefully to prevent the grout from reaching the well screens, potentially giving rise to non-representative samples.

Using a flat tape measure or water level sounder, determine the depth from the top of the PVC riser to the bottom of the annulus between the riser and probe rods. If unstable conditions have resulted in formation collapse (measured depth of 2 to 3 ft), then proceed to 4.3.8.3. if the borehole has not collapsed, then retract the casing to 1 ft above the screen while adding

sand. Take measurements with a weighted tape. Continue until 2 ft of sandpack have been established above the well screen.

4.3.8.3. Installing a Bentonite Seal above the Screen

Proceed as in section 4.3.4. above. Bring the bentonite seal to within 2 ft from ground surface to allow well completion

4.3.8.4. Installing Well Protection.

Proceed as in Section 4.3.6. above.

5. Well Development

Monitoring well development may be accomplished by surging and bailing (or pumping), or over pumping. Other methods, such as air jetting, backwashing, or air-lift pumping, shall be avoided because these methods introduce fluids into the formation and may have unexpected influences on groundwater quality, if only for a short period of time.

Immediately upon opening the well, the air in the wellhead will be sampled for VOCs using a portable VOC analyzer, such as a Photovac MicroTIP®. The well cap shall be opened slightly and the sampling port of the VOC analyzer shall be inserted into the well. The maximum reading shall be recorded on the appropriate field paperwork. The instrument shall be zeroed with ambient air prior to the measurement, and the initial and final readings shall be recorded for each well.

Measures shall be taken during well sampling to prevent surface soils from coming in contact with the purging equipment and lines. Typically, a polyethylene sheet is placed on the ground providing adequate coverage for the equipment being used.

In addition, the procedures described in LEA SOP ID 10004 in the sections for Field Analysis, Well Evacuation, and Sample Withdrawal shall be followed.

5.1. Surging and Bailing

In surging and bailing, a well is developed by alternately surging a short section of the screen with a tight-fitting surge block. Begin by lowering the surge block to the top of the screened interval and swab the well with a pumping action with a typical stroke of 2 to 3 feet. (Begin surging at the top of the well intake to avoid having loosened material from "sand-locking" the surge block.) Do not surge the well too violently to avoid damaging the well screen or the filter pack. Remove the surge block at regular intervals and bail (or pump) the fine material from the well. Proceed with surging throughout the length of the well screen, being careful

to avoid hitting the bottom of the well. Check the quality of the bailed water at regular intervals, as described in Section 5.3.

In cases where a considerable volume of sediment may initially be drawn into the well, begin surging the well gently in the casing above the well screen. Proceed with surging and bailing to the bottom of the screened interval.

5.2. Overpumping

In overpumping, a well is developed by operating a pump in the well at a capacity which greatly exceeds the formation's ability to supply water. The flow velocity into the well during overpumping usually greatly exceeds the flow velocity induced during normal sampling. This increased velocity causes movement of particles from the formation into the well.

Begin developing the well by installing a suitable pump at the bottom of the well. Alternatively, a surface-mounted pump with a suction hose may be used if the drawdown inside the well will not exceed the pump's available lift. The discharge from the pump shall be directed to approved containers. The pump (or intake hose) must be equipped with a backflow-prevention valve to prevent introducing aerated water into the aquifer.

Start the pump and discharge water at the highest practical rate. If the well runs dry, stop the pump and allow the well to recharge. Check the quality of the discharged water at regular intervals as described in Section 4.3.

5.3. Completing Well Development

During bailing or pumping, measure and record water quality parameters to gauge the degree and effectiveness of development. Typically, pH, temperature, specific conductivity, and turbidity shall be checked at periodic intervals (but at least every three well-volumes) until the purge water begins to appear clear. Then measurements shall be made after each well volume until the parameters stabilize. The water quality parameters may be considered stable when:

- pH, temperature, and specific conductivity of consecutive measurements have relative percent differences (RPD), as defined below, of less than 10%; and,
- The turbidity is 5 NTU or less (applicable only in aquifers with low percentages of fines. This may not be achievable in all situations, but the turbidity shall be less than 50 NTU and shall stabilize with an RPD of less than 10%).

However, in no case shall the development stop before the above criteria are met, and:

- At least 3 well volumes have been removed; or,
- The well has been surged and pumped for at least 30 minutes.

The RPD between two measurements (e.g., M1 and M2) is calculated as follows:

$$RPD = \frac{|M1 - M2|}{(M1 + M2)/2} \times 100\%$$

All well development equipment and supplies shall be thoroughly decontaminated prior to and between each monitoring well. Place all development water into properly labeled, suitable containers; leave all filled containers in an appropriate location.

6. Documentation

6.1. Well Development

Well development activities will be documented on the appropriate field forms, and specifically on the "Field Data Record Groundwater" and "Well Development Report" forms. Information provided on those forms includes: purge method, amount of water per well volume, instrument readings after purging of each well volume.

6.2. Monitoring Well Completion Log Forms

During the installation of a monitoring well, complete records must be kept of quantities and types of all well construction materials used.

A complete geologic log shall be kept during advancement of the borehole for the well. The procedures for completing geologic logs are presented in *Standard Operating Procedure for Geologic Logging of Unconsolidated Sedimentary Materials* (SOP ID 10015). However, the additional information pertinent to monitoring well installations shall be recorded on a separate form. A monitoring well completion form is provided in Attachment 1. In addition typical wellhead details – one for flush-mount well completions and one for above-grade completions - are provided as Figure 1. Whenever a monitoring well is installed, record all appropriate information concerning the quantity of materials used, the

type and manufacturer of the materials, the mixtures of grouts or slurries, and any pertinent notes regarding the installation of each well.

After the project is completed, submit a copy of the attached Geologic Soil Boring/Well Completion Log Request Form along with copies of all Monitoring Well Completion forms for final typing and entry into the LEA database. The request form provides information on the types of final logs to be produced, the scale at which to plot the final forms, and notes common to all reports.

7. Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) procedures will be followed in compliance with the site-specific work plan.

8. References

8.1. EPA, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER 9950.1, September 1986.

8.2 EPA, *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA/600/4-89/034, 1989.

8.3 Geoprobe, *Geoprobe® 0.5-in x 1.4 in OD and 0.75 in x 1.4 in OD Prepacked Screen Monitoring Wells, Standard Operating Procedure*, Technical Bulletin No. 962000, September 1996, revised; June 2002.

END OF DOCUMENT

ATTACHMENT 1

Monitoring Well Completion Report and Well Development Forms

WELL COMPLETION REPORT

Project: | **Start Date** | **Well ID**
LEA Comm. No.
Client | **End Date**
Location
Drilling Contractor | **Logged by**
Drilling Method | **Drilling Foreman**
Sampling Method | **Drill Rig**
Groundwater Observation | **GPS Latitude**
Depth ____ **at** ____ **Hours** | **GPS Longitude**

Protector
- Material
- Diameter
- Length ____ Ground
- Stickup
- Key #
- Cover Type

Top Seal
- Top
- Bottom
- Material

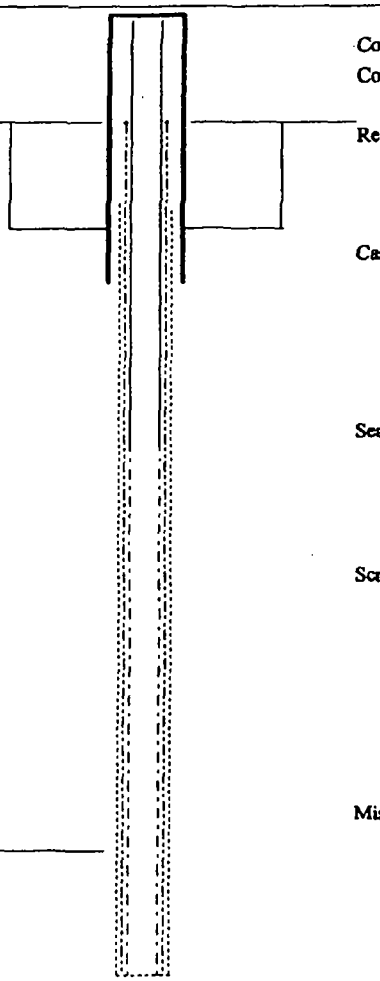
Backfill
- Top
- Bottom
- Material

Secondary Sand
- Top
- Bottom
- Size

Filter Pack
- Top
- Bottom
- Material

Reported depth to bottom of boring

Comments



Concrete Diameter
Concrete Thickness

Reference
- Stickup
- Description

Casing
- Diameter
- Material
- Length
- Stickup

Seal
- Top
- Bottom
- Material

Screen
- Top
- Bottom
- Material
- Diameter
- Length
- Slot Size

Miscellaneous Materials (Quantity Used/Item)
- Cement
- Bentonite Chips
- Bentonite Pellets
- Bentonite Powder
- Grout Weight
- Filter Pack Sand
- Capping Sand
- Well Point
- Well Plug

Signature _____

Loureiro Engineering Associates, Inc.

Loureiro Engineering Associates, Inc.

FIELD SAMPLING RECORD
WELL DEVELOPMENT

LEA Comm. No. Page _____ of _____
Project Date ___/___/____
Location Time ___:___
Client

Monitoring Well Number _____ Sample Number(s) _____ _____

Initial Field Data and Measurements

Depth of Well _____ Reference Used _____
Depth to Water _____ PID/FID Reading _____
Height of Column _____ Interface Yes / No If yes, Depth _____ Lighter / Heavier

Well Casing Diameter _____ Material _____
Protector Road Box / Stickup
Ground to Reference _____
Comments _____

General Condition	OK	Bad
Casing Secure		
Collar Intact		
Cover Locked		
Other (describe)		

Development Information

Purge Volume Factors
0.5" - 0.01
1" - 0.041
1.5" - 0.091
2" - 0.16
4" - 0.65
6" - 1.5

Initial Sample Observations
Clear ☐
Colored ☐
Cloudy ☐
Turbid ☐
Odor ☐
Sheen ☐

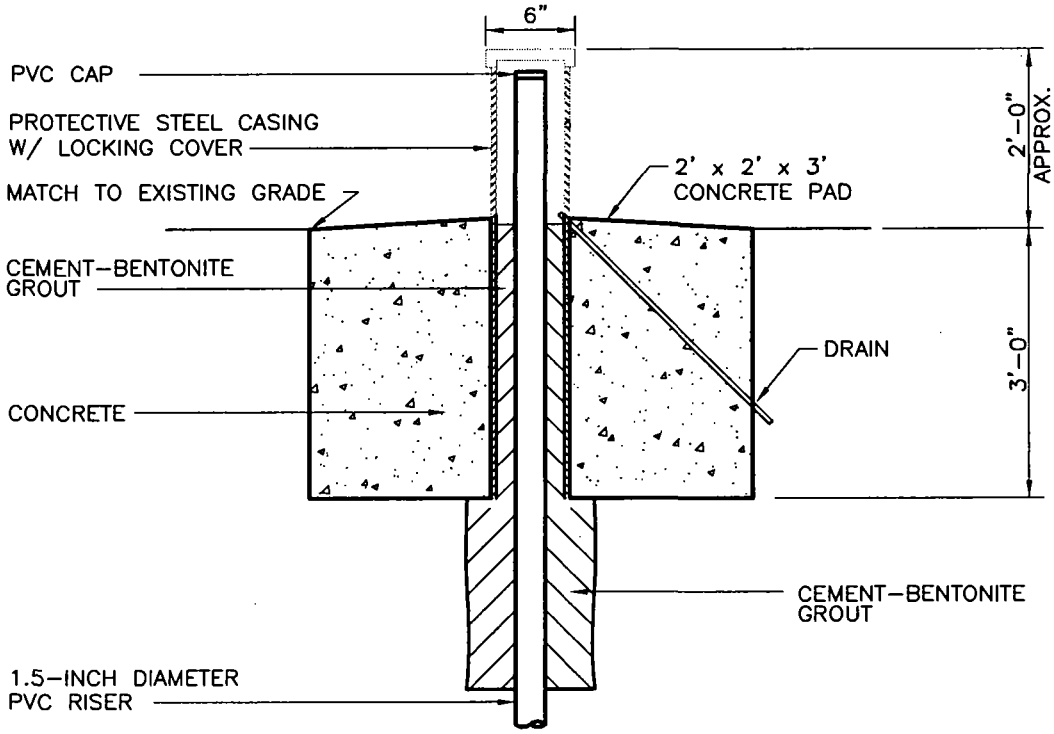
Volumes \ Parameter	Gallons	Temp (C)	pH (SU)	Spec.Con.	Turbidity	Other
Initial						

Developement Method Peristaltic Pump / Bailer / Inertial Pump / Other _____
Field Decontamination? Yes / No If Yes, with what? _____
Waste Container ID _____

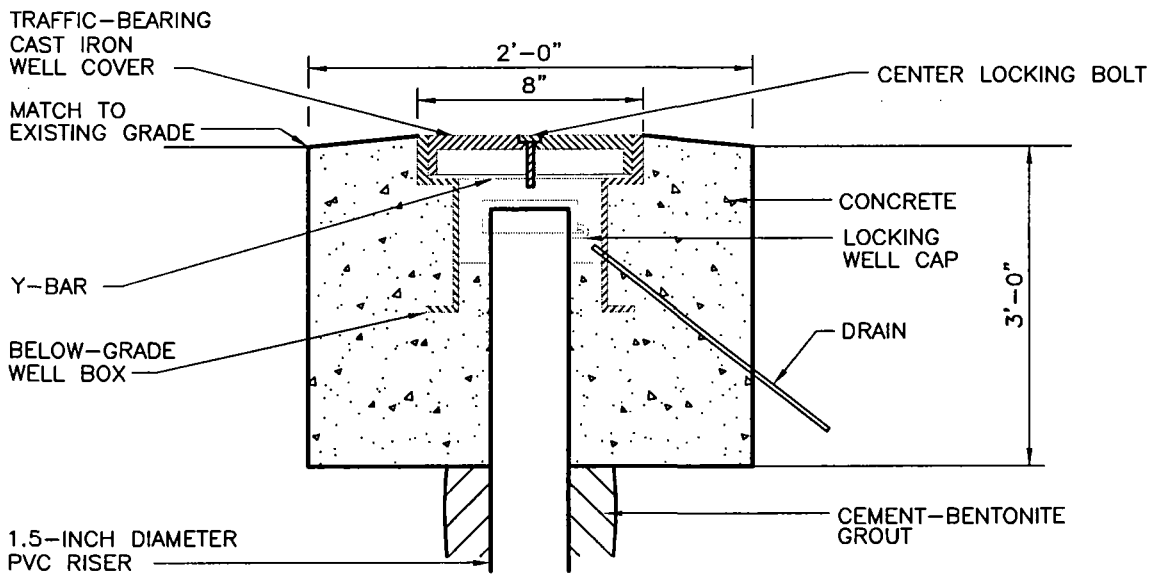
Additional Comments

Field Personnel _____ _____ ***Signature***
_____ _____ _____

FIGURES



ABOVE GRADE WELLHEAD
CONSTRUCTION DETAIL – NOT TO SCALE



FLUSH TO GRADE WELLHEAD
CONSTRUCTION DETAIL – NOT TO SCALE

REFERENCES:

EPA, "RCRA GROUNDWATER MONITORING TECHNICAL ENFORCEMENT GUIDANCE DOCUMENT", OSWER 9950.1, SEPTEMBER 1986.

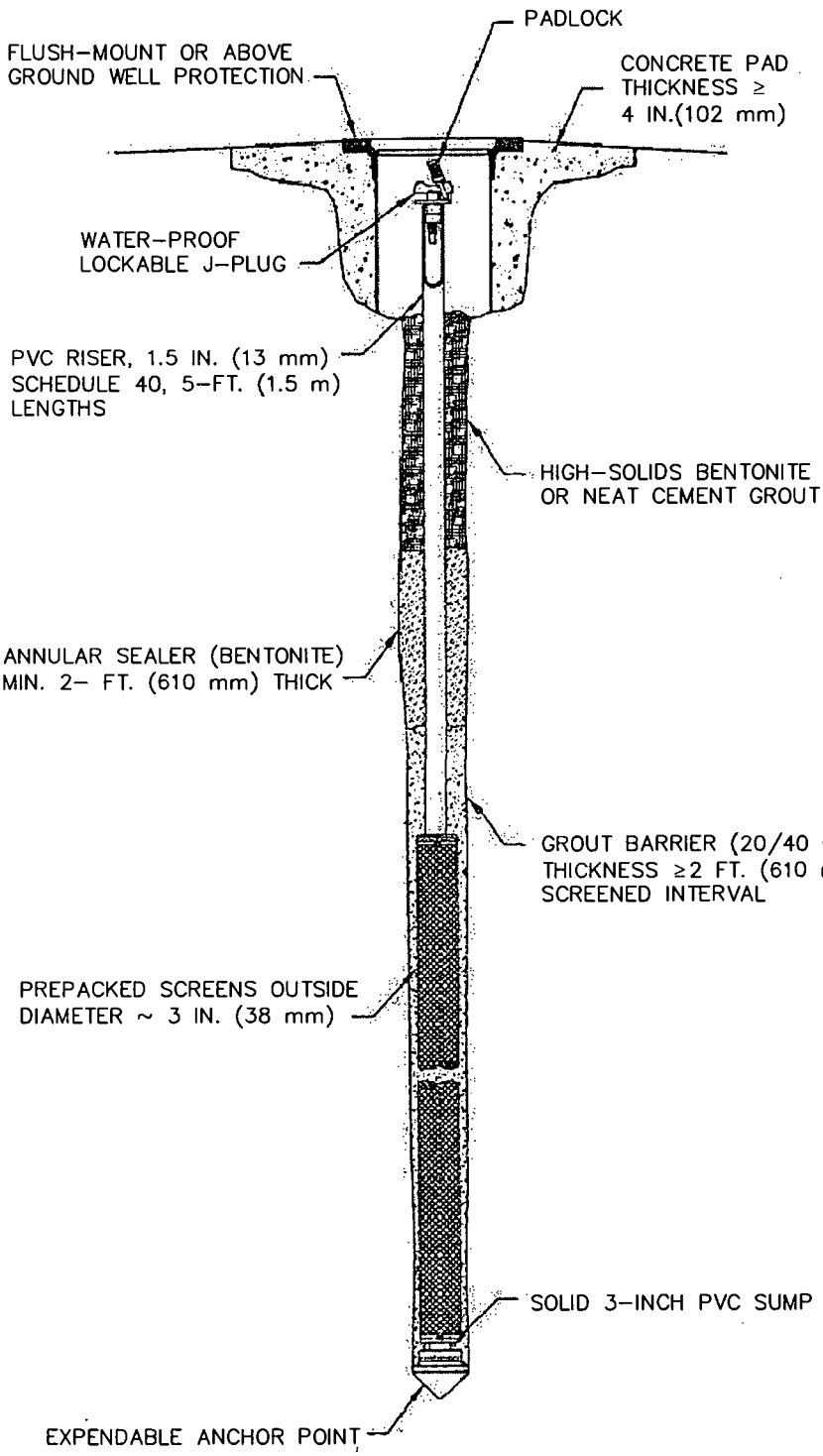
EPA, "HANDBOOK OF SUGGESTED PRACTICES FOR THE DESIGN AND INSTALLATION OF GROUNDWATER MONITORING WELLS", EPA/600/4–89/034, 1989.

LEA SOP for Installing & Developing Monitoring Wells & Piezometers

TYPICAL WELLHEAD DETAILS
Modified March 2008

Comm.No.	
100	**FIGURE 1**

G:\AUTOCAD\PROJECTS\000100\SOPS\WELLHEAD DETAILS.DWG Tab:REV MAR 2008 Saved: 3/5/2008 2:01 PM Plotted: 3/5/2008 2:23 PM



ADAPTED FROM "GEOPROBE ® SYSTEMS - THE COMPLETE PROBING SYSTEM", TECHNICAL BULLITEN 99250, AUG. 1999, REVISED DEC. 2002.

LEA SOP for Installing & Developing Monitoring Wells & Piezometers

COMPLETED PRE-PACKED SCREEN WELL

Modified March 2008

Comm.No. 100

FIGURE 2

G:\AUTOCAD\PROJECTS\000100\SOPS\PREPACK-SCREEN-WELL.DWG Tab:REV MARCH 2008 Saved: 3/5/2008 2:16 PM Plotted: 3/5/2008 2:20 PM

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Low Flow (Low Stress)
Liquid Sample Collection and Field Analysis

SOP ID: 10039
Date Initiated: 06/11/01
Revision No. 003: 04/01/05

Approved By: */s/ David C. Brisson* — *04/01/05*
David C. Brisson — **Date**
Project Geologist

/s/ Gail Batchelder — *04/01/05*
Gail L. Batchelder — **Date**
Technical Director, Hydrogeology

/s/ Nick D. Skoularikis — *04/01/05*
Nick D. Skoularikis — **Date**
Director of Quality

REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	06/11/01	
001	04/01/02	Updated to reflect new SOP format.
002	12/02/02	Updated to reflect stabilization procedures.
003	04/01/05	Incorporated modified low-flow sampling procedure to include the use of a peristaltic pump.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
For
Low Flow (Low Stress)
Liquid Sample Collection and Field Analysis

1. Purpose and Scope

This standard operating procedure (SOP) describes the procedures to be followed for measurement of static water level elevations, detection of immiscible layers, well evacuation, sample withdrawal, and field analyses utilizing low flow sampling techniques.

2. Definitions

2.1. Immiscible layers: The term is used to denote free-phase liquids that may be present in the aquifer as a result of a release. These liquids may have a density lighter than water (light non-aqueous phase liquids (LNAPL) or floaters) or heavier than water (dense non-aqueous phase liquids (DNAPL) or sinkers).

3. Equipment

3.1. Equipment required for the collection and field analysis of liquid samples shall include:

- Water-level indicator (accurate to 0.01 foot).
- Distilled water.
- Hand towels.
- Portable volatile organic compound (VOC) analyzer (Photovac MicroTIP®, Foxboro OVA® or equivalent).
- Interface probe/clear view bailer (to check for light non-aqueous phase liquids only).
- Flow-through cell capable of monitoring pH, temperature, specific-conductance, oxidation reduction potential (Eh), dissolved oxygen (DO), and turbidity.
- Polyethylene plastic sheeting.

- Adjustable rate submersible pump (preferred), adjustable rate centrifugal pump, bladder pump (constructed of stainless steel or Teflon®), or adjustable rate peristaltic pump
- Appropriate tubing for the pump used, for instance polyethylene tubing (1/4 to 3/8 inch outer diameter (O.D.)) for the peristaltic pump
- Clean disposable gloves.
- Alconox®, or other non-phosphate laboratory grade detergent.
- Three 5-gallon buckets.
- Decontamination brushes.
- Distilled, de-ionized (DI) water.
- Decontamination fluids (less than 10 percent methanol in water, 100 percent n-hexane, and 10 percent nitric acid).

4. Procedure

4.1. Health & Safety Requirements

All health and safety requirements described in the site specific Health & Safety Plan and/or Job Hazard analysis shall be observed

4.2. Equipment Decontamination

All materials and equipment that enter a well must be clean and free of any potential contaminants. Do not use any contaminated equipment or materials which are not designed to be used for groundwater monitoring, even if this means that the sampling will not be performed as planned.

In general, the choice of decontamination procedures should be based upon knowledge of the site-specific contaminants and outlined in the site-specific work plan.

For sites at which the contaminants are unknown, but contamination is suspected, the decontamination procedures outlined below should be followed.

4.2.1. Prior to commencing any field activities, the following solutions (as appropriate for the appropriate contaminants) should be prepared and placed into 500-ml laboratory squirt bottles: less than 10 percent

methanol in water; 10 percent nitric acid in water; 100 percent n-hexane; distilled, de-ionized water.

4.2.2. In the field, prepare approximately 2.5 gallons of a solution of Alconox® (or other suitable non-phosphate laboratory grade detergent) in tap water in a 5-gallon bucket.

4.2.3. Prepare a piece of 5-mil polyethylene sheeting to underlie the decontamination area. The sheeting should be of sufficient size to contain any accidental discharge of decontamination solutions. The plastic should be bermed to contain spills.

4.2.4. The order for decontaminating equipment is as follows:

1) Detergent scrub.
2) DI water rinse.
3) Hexane rinse (to be used only if separate-phase petroleum product, other than gasoline, is present).
4) DI water rinse.
5) 10 percent nitric acid rinse (to be used only when metals are suspected as potential contaminants).
6) DI water rinse.
7) Methanol rinse (less than 10 percent solution).
8) Air dry.

4.2.5. Materials such as the bailer cord should not be decontaminated and should just be disposed of after each test. Note: Bailers should be used **only** to check for LNAPL before sample collection using low-flow/low stress procedures. A bailer may be used to check for DNAPL only **after** all sample collection equipment has been removed from the well.

4.2.6. Wrap each piece of decontaminated equipment in aluminum foil, as appropriate, to maintain cleanliness.

4.2.7. At the end of the project day, dispose of all spent decontamination fluids and materials such as the polyethylene sheeting and personal protective equipment in accordance with all applicable municipal, state, and federal regulations.

4.3. Sample Collection

4.3.1. Immediately upon opening the well, the air in the well head will be sampled for VOCs using a portable VOC analyzer, such as a Photovac

MicroTIP® or equivalent. The instrument shall be zeroed with ambient air prior to the measurement, and the highest reading observed shall be recorded for each well. Measurements should be taken until stabilization of the readings has occurred.

4.4. Detection of Immiscible Layers

4.4.1. Should evidence warrant, a sampling event shall include provisions for the detection of immiscible phases prior to well evacuation or sample collection. LNAPLs are relatively insoluble liquid organic compounds with densities less than that of water (1 g/ml), while DNAPLs are organic compounds with densities greater than that of water. Lighter and/or denser immiscible phases may be encountered in a groundwater monitoring well.

4.4.2. An interface probe will be used to determine the existence of any immiscible layers, light or dense. Alternatively, a clear fluorocarbon resin or PVC bailer may be used to determine the existence of the phases or oil sheen in the well when no accurate determination of the immiscible layer thickness is required. As noted above, efforts to detect LNAPL only can be performed prior to sample collection. Efforts to detect DNAPL can be performed only AFTER sample collection has occurred.

4.4.3. Should elevations of the immiscible layers be required, levels of the fluids shall be measured to an accuracy of 0.01 feet using an electronic interface probe capable of detecting the interfaces between air, product, and water. The interface levels shall be recorded in the field form. Adjustments of the observed head to the theoretical hydraulic head shall be calculated based on the density conversion factor associated with the particular non-aqueous phase liquid.

4.4.4. If LNAPL is detected in a well, collection of a groundwater sample from that well is not recommended unless otherwise specified in the site-specific work plan or work instruction. However, if a groundwater sample must be collected from that well, low-flow sampling is the recommended technique, although care must be taken to minimize mobilization of the LNAPL into the zone from which the sample will be collected.

4.5. Measurement of Static Water Level

4.5.1. The static water elevations in each well shall be measured prior to each sampling event. This is performed initially to characterize the site, and in subsequent sampling rounds to determine whether horizontal or vertical flow gradients have changed. A change in hydrologic conditions may necessitate modification of the groundwater monitoring program.

4.5.2. Remove the protective cover and locking cap from the well.

4.5.3. Each well shall have a surveyed reference point located at the top of the well casing with the locking cap removed. The reference point shall be easily recognizable, since the personnel conducting the sampling may differ from one sampling event to the next.

4.5.4. The following parameters shall be measured with an accuracy of 0.01 ft:

- Depth to standing water.
- Depth to bottom of well.

4.5.5. A water-level indicator with a fiberglass tape will be used for measurement. As a result of possible pressure differences between the well atmosphere and the ambient atmosphere, the water level will be allowed fifteen minutes to equilibrate upon removal of the well cap. If excess pressure is encountered the water level will be allowed greater than fifteen minutes to equilibrate upon removal of the well cap. The results shall be recorded on the appropriate field form(s).

4.5.6. Total depth measurements will be compared to original depths to determine the degree of siltation that may have occurred. This information shall be noted on the field forms. Should significant siltation occur in any well, the well shall be redeveloped by an approved method.

4.5.7. The portion of the tape immersed in the well shall be decontaminated during retrieval using a distilled water rinse followed by drying with a clean wipe, prior to use in another well. This decontamination procedure shall be amended, as needed, to accommodate the specific type of contamination anticipated.

4.5.8. The static water level should be monitored and recorded throughout the purging and sampling of each well.

4.6. Field Analysis

4.6.1. Parameters that are physically or chemically unstable shall be tested utilizing a flow-through cell. Such parameters as pH, temperature, specific conductance, DO, Eh, and turbidity will be measured in the field at the temperature of the well sample.

4.6.2. Parameters such as pH, temperature, specific conductance, DO, and Eh shall be measured using a flow-through-cell (YSI model 6820 or equivalent). The meter shall be calibrated prior to use and at the end of the day using supplied solutions in accordance with the instructions provided by the manufacturer. Calibration information will be recorded in the field before and after each calibration.

4.5.3 Turbidity can be measured with a separate turbidimeter, although some flow-through cells include a turbidimeter. It is useful to have a separate turbidimeter on hand to check the validity of the turbidity values obtained using the flow-through cell if there is difficulty reaching low turbidity values or if the turbidity readings recorded do not seem to be consistent with visual observation of the water samples. All samples, including turbidity samples and samples to be submitted for analysis, must be collected before the groundwater passes through the flow-through cell to prevent cross-contamination by potentially stagnant fluid within the flow-through cell. This can be accomplished by using a bypass assembly or disconnecting the tubing from the flow-cell inlet prior to sampling.

4.7. Well Evacuation

4.7.1. Calculate standing water in the well based on the following schedule and record on the appropriate field form:

Well Diameter (inches)	Conversion Factor (gal/feet)
2	0.163
4	0.654
6	1.47

4.7.2. Generally, a submersible, air-lift, bladder, or peristaltic pump equipped with appropriate tubing of inert materials (such as polyethylene), shall be used to evacuate the monitoring wells.

4.7.3. A new piece of polyethylene plastic shall be placed on the ground adjacent to the well. Sampling and purging equipment such as the pump, tubing, containers, etc., shall be placed on the polyethylene sheet, never on the ground.

4.7.4. The pumps and tubing shall be prepared for insertion into the well while wearing disposable gloves. Make sure that any tubing or pump apparatus is of sufficient length to reach the appropriate depth for pumping.

4.7.5. Lower the pump and/or tubing gently into the water column to the midpoint of the saturated portion of the screened interval, unless otherwise specified. A site-specific sampling plan should specify the sampling depth, or provide specific criteria for the selection of intake depth for each well. If possible keep the pump intake two feet above the bottom of the well. Start the pump at the lowest speed setting and slowly increase the speed until discharge occurs. The initial pumping rate shall be approximately 0.1 liters per minute, however, the pumping rate shall not exceed 0.25 liters per minute. Measure the water level to ensure that drawdown in excess of 0.3 feet does not occur in the well. Adjust the pumping rate as necessary until little or no drawdown occurs. If the drawdown exceeds 0.3 feet, reduce pumping rate if possible. If drawdown still does not stabilize at a depth above the pump intake, shut the pump down and allow the well to recharge. It should be noted that stable drawdowns of 0.3 feet are desirable but not mandatory. Stabilization of the drawdown to a depth greater than 0.3 feet is acceptable as long as the depth at which stabilization occurs is above the pump intake. However, it is important that the stabilization depth is clearly recorded and maintained.

4.7.6. Monitor and record the water level and pumping rate at a minimum of every five minutes during purging. Calculate the volume of the discharge tubing, bladder pump (if used), and the flow-through cell. Monitor and record indicator field parameters (turbidity, pH, Eh, DO, temperature and specific conductance) in the well from the first water extracted during the purging process and at least every five minutes thereafter. Stabilization is considered to be achieved when three consecutive readings are within the following limits and no increasing or decreasing trend in the data can be observed:

- Turbidity (10% for values less than 5 and greater than 1 NTU). It should be noted that achievements of turbidity levels less than 5 NTUs are not mandatory but efforts should be made to collect a groundwater samples with the lowest turbidity achievable.
- DO (10%, measured as milligrams per liter).
- Specific Conductance and Temperature (3%).
- pH (+/- 0.1 unit).
- ORP/Eh (+/- 10 millivolts).

4.7.7. If after 2.5 hours of purging or the purging of three well volumes, (whichever comes first) the field parameters have not stabilized, purging may be discontinued to allow sample collection. Similarly, if it is not possible to obtain stabilization as described above as a result of slow recovery of the well, the well shall be evacuated and allowed to recover, at which point the samples should be collected immediately. The appropriate sampling forms shall include a notation that sample collection occurred without stabilization. Samples obtained from slow-yielding wells shall be collected as soon as a sufficient volume is available for a sample for each parameter.

4.7.8. Do **not** re-use purging equipment. Pumps shall be decontaminated between monitoring wells, in accordance with procedures noted in Section 4.1.

4.7.9. Record sampler's name, sampling time, volume of water purged, parameters measured, weather conditions, sample number, analyses required and all other pertinent information in the field notebook and/or appropriate field forms, and complete the chain of custody form.

4.7.10. Any water purged from the monitoring wells shall be stored in appropriate containers until the laboratory analyses are available. Then it should be disposed of in accordance with all applicable local, state and federal requirements.

4.7.11. Storage shall be in containers approved for storage of hazardous materials, and in an appropriate designated location at the facility.

4.8. Sample Withdrawal

4.8.1. In order to ensure that the groundwater sample is representative of the formation, it is important to minimize physical alteration (i.e. agitation during purging and/or sample collection) or chemical contamination of the sample during the withdrawal process.

4.8.2. Use an appropriate pump to purge each well; the same pump used for purging shall be used for sample withdrawal.

4.8.3. The samples shall be collected at a location before entering the flow-through cell. To minimize the effects of water column agitation on sample quality, samples shall be collected from the pump tubing in the following order into pre-labeled sample containers:

- VOCs.
- Total petroleum hydrocarbons.
- Extractable organics (semivolatiles).
- PCBs.
- Metals.
- Phenols.
- Cyanide.
- Chloride and sulfate.
- Nitrate and ammonia.
- Turbidity.
- Radionuclides.
- Purgeable organic carbon (POCs).
- Purgeable organic halogens (POX).
- Total organic halogens (TOX).
- Total organic carbon (TOC).

4.8.4. Samples shall be obtained from the monitoring wells as soon as possible after purging. This may require waiting an extended period for low-yielding wells.

4.8.5. Samples collected for VOC analysis shall be free of any air bubbles and inverted upon filling. Bacterial samples shall be collected using dedicated gloves; taking care not to allow anything to touch the inside of the sampling container.

4.8.6. Samples collected for metals analysis, which are to be filtered in the field, shall be passed through an appropriately sized filter prior to placement in the sample bottle. Pre-rinse the filter with approximately 25 to 50 milliliters of groundwater prior to collecting the filtered metals sample. Filter sizes will generally be either 0.45 microns for dissolved metals and 10 microns for metals that could be present as colloids or adsorbed onto colloids that could be mobile in the aquifer. The appropriate filter size for the individual project must be provided in site-specific work instructions.

4.9. "What If" Scenarios

4.9.1. Certain field conditions may be encountered that influence the choice of equipment to be used or altogether limit the feasibility of low-flow sampling techniques. The following is a brief description of select scenarios to provide field personnel with a guideline if similar circumstances are encountered

4.9.2. Turbidity

4.9.2.1. If turbidity measurements do not stabilize as described above after 2.5 hours of purging or the evacuation of three well volumes, whichever comes first, sample collection can be initiated. Record observations of the color, clarity, and other observable characteristics of the groundwater (such as the presence or absence of particles) in the field paperwork

4.9.2.2. If samples are being collected for analysis for total (unfiltered) metals and the turbidity has not stabilized below 10 NTU, a sample for additional analysis for metals should also be collected after being filtered in the field through an in-line 10-micron filter, if specified in the work instructions.

4.9.3. Peristaltic Pump

4.9.3.1. Difficulty may be encountered while advancing the flexible polyethylene peristaltic pump tubing to the desired depth within a deep well or older well. Excessive friction may result from the tubing contacting the sidewall of the well casing or accumulations of material on the well casing (i.e. mineral and bacterial deposits). In these scenarios, the tubing may coil within the well during advancement and prevent the desired depth from being attained. Efforts to weight the tubing should be attempted before using alternate pumping techniques.

4.9.3.2. If such well conditions are expected, a bladder pump or similarly submersible pump should be used instead of a peristaltic pump. A bladder pump provides sufficient mass on the tubing to allow for advancement in deep or older wells.

4.9.3.3. A peristaltic pump cannot be used to sample wells in which the depth to water is greater than approximately 25 feet.

4.9.4. Sampling Depth

4.9.4.1. If conditions exist that prevent the appropriate pump or tubing from being advanced to the midpoint of the saturated portion of the screened interval, low-flow sampling techniques shall not be used. Instead, sampling shall be conducted using conventional purging and sampling techniques, as described in LEA SOP 10004 entitled *Liquid Sample Collection and Field Analysis*. Justification for not using low-flow sampling techniques must be provided in the field paperwork.

4.10. Field Documentation

4.10.1. Field documentation shall include at a minimum: a chain-of-custody form, Field Data Record Groundwater Form, Sample Collection Form, Daily Field Report. Sample labels and sample seals shall be used for proper sample identification.

4.10.1.1. The labels shall be sufficiently durable to withstand immersion for 48 hours without detaching and to withstand normal handling. The information provided shall be legible at all times.

4.10.1.2. The following information shall be provided on the sample label using an indelible pen:

- Sample identification number.
- Date and time of collection.
- Place of collection.
- Parameter(s) requested (if space permits).

4.10.1.3. Appropriate field forms will be used to log all pertinent information with an indelible pen. The following information shall be provided:

- Project and site identification.
- LEA commission number.
- Identification of well.
- Static water level measurement technique.
- Presence of immiscible layers and detection method.
- Time well purged.
- Collection method for immiscible layers and sample identification numbers.
- Well evacuation procedure/equipment.
- Sample withdrawal procedure/equipment.
- Date and time of collection.
- Types of sample containers used and sample identification numbers.
- Preservative(s) used.
- Parameters requested for analysis.
- Field analysis method(s).
- Whether or not field filtration was performed and the filter size, if appropriate.
- Field observations on day of sampling event.
- Record of site activities.
- Field personnel.

- Climatic conditions, including air temperature.
- Status of total production.
- Record of non-productive time.

4.10.1.4. The Field Sampling Record shall include at a minimum the following information:

- Identification of well.
- Date and time of collection.
- Name of collector.
- Sample number.

4.10.1.5. The chain-of-custody record shall include the following information:

- Company's name and location.
- Date and time of collection.
- Sample number.
- Container type, number, size.
- Preservative used.
- Signature of collector.
- Signatures of persons involved in the chain of possession.
- Analyses to be performed.
- Type and number of samples.

4.10.1.6. The Field Data Record Groundwater Form shall be updated during the sampling of each well and include the following information:

- Identification of well.
- Well depth, diameter, depth to water.
- Static water level depth and measurement technique.
- Purge volume and pumping rate.
- Time well is purged.

- Measurements of initial field parameters and all subsequent readings.
- Any specific circumstances, as described above, such as field filtering, lack of stabilization of parameters, water characteristics, etc.
- LEA commission number.
- Date.

4.10.1.7. The Daily Field Record shall include the following information:

- Client's name, location, LEA commission number, date.
- Instrument make, model, and type.
- Calibration readings.
- Calibration/filtration lot numbers.
- Field personnel and signature.

4.10.1.8. The Daily Field Record shall assure the completeness of the sampling round and include the following information:

- Reviewer's name, date, and LEA commission number.
- Review of all necessary site activities and field forms.
- Statement of corrective actions for deficiencies.

5. References

5.1. United States Environmental Protection Agency (EPA), Region I. *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells,* July 30, 1996, Revision 2.

5.2. EPA. *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers – Groundwater Forum Issue Paper,* Office of Solid Waste and Emergency Response, (EPA 542-S-02-001), May 2002.

5.3. Robert W. Puls and Michael Barcelona, EPA. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures,* in Groundwater Issue, (EPA/540/S-95/504), April 1996.

5.4. Connecticut Department of Environmental Protection, Bureau of Water Management, Permitting Enforcement and Remediation Division. *Site Characterization Guidance Document,* Draft, June 12, 2000.

END OF DOCUMENT

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Processing Performance Evaluation Samples

SOP ID: 10030
Date Initiated: 04/01/98
Revision No. 002: 05/02/05

Approved By: */s/ Christina M. Clemmey* *05/02/05*
Christina M. Clemmey **Date**
Analytical and Validation Services Manager

/s/ Nick D. Skoularikis *05/02/05*
Nick D. Skoularikis **Date**
Director of Quality

REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	04/01/98	
001	08/31/01	Revisions throughout. Updated to reflect new SOP format.
002	05/02/05	Changed SOP title from "Ordering" to "Processing".

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Processing Performance Evaluation Samples

1. Purpose and Scope

This document discusses procedures for obtaining and submitting performance evaluation (PE) samples to analytical laboratories that are used by Loureiro Engineering Associates, Inc. (LEA). The procedures outlined in this document are wholly for the purpose of establishing systematic procedures for obtaining, storing, handling, and submitting PE samples. This SOP is intended to serve as a reference for any LEA employee submitting PE samples to an analytical laboratory. Quality assurance/quality control (QA/QC) procedures have also been incorporated into this SOP.

The decision whether to use PE samples is project-specific, dictated by data quality objectives and agency requirements. Not all projects require the use of PE samples.

2. Definitions

2.1. PE samples: A sample that mimics actual samples in all possible aspects, except that its composition is known to the auditor and unknown to the analyst. (It is, however, recommended to use aqueous PE samples in cases where a soil matrix is being tested). PE samples are provided to test whether a measurement system can produce analytical results within specified performance goals.

2.2. Blind Sample: A sample submitted to the laboratory for analysis with a composition and identity known to the submitter but unknown to the analyst. A blind sample number should be used. No other designation on the sample label or chain-of-custody should exist that could be used by the laboratory to identify the sample as an evaluation sample. Blind samples are used to test the laboratory's proficiency in the execution of the measurement process. Samples may be either single blind (the analyst knows that the sample is a PE sample but does not know what analytes and at what concentrations it contains) or double-blind (the analyst does not know that the sample is a PE sample).

3. Equipment

- Laboratory glassware, identical to the ones provided by the laboratory.
- Cooler with identifiable cooler ID.
- Chain-of-custody.
- Thermometer.

4. Procedure

4.1. Define Evaluation Requirements

4.1.1. Define sampling objectives with Project Manager. Coordinate the receipt of PE samples with actual environmental media sampling. In most instances PE samples will be submitted concurrently with environmental media samples. In other cases the PE samples may be forwarded to selected laboratories individually in order to assess laboratory performance.

4.1.2. PE sample selection should be based on the objectives of the sampling requirements. Typically, PE samples are being submitted for the entire suite of analytes. It is recommended, however, to use separate sample numbers for the semivolatile organic compounds (SVOCs) and polychlorinated biphenyls (PCBs) to prevent a mix up by the laboratory.

4.2. Contact Accredited Laboratory (PE Vendor)

4.2.1. Place order for PE Samples selected with qualifying certified laboratory several days in advance. In most cases the vendor selected will be Environmental Resource Associates (ERA) of Arvada, CO.

4.2.2. Fax a copy of a purchase order, and an explanatory cover letter to the PE sample vendor. The cover letter should detail when the bottles will be sent to the PE vendor and when we expect to receive the PE samples in return. Examples of these documents are included in Attachment 1.

4.2.3. A list of recommended unknown constituents has been prepared to facilitate the selection of the PE parameters. The selection options are presented in the "Lab Performance Sample Matrix" which is also attached. The date that PE samples will arrive at LEA should be correlated with any sampling activities that are to be conducted.

4.2.4. Arrangements should be made so that the PE samples are received in our office at the same day as the day that the field activities are conducted. The laboratory should be notified that analyses should be performed on a tighter holding time. This is important since the PE samples are being prepared a day earlier and their holding time expiration is one day ahead of the field samples. It is also recommended to request that PE samples be prepared and shipped the same day.

4.2.5. Avoid requesting receipt of samples on Monday, as this will shorten the VOC holding time by 3 days.

4.3. Order Sample Jars from Analytical Laboratory to be Evaluated

4.3.1. Place a bottle order with the analytical laboratory, requesting the appropriate bottles for the environmental analyses selected, based on the environmental media and the intended analytes of the sampling program that is to be undertaken.

4.3.2. Process paperwork request with LEA Data Management for applicable field paperwork and sample labels for field sampling activities, or just for PE samples (if no concurrent sampling is to be conducted).

4.4. Sending Sample Jars to PE Vendor

4.4.1. Once the empty bottles are received from the analytical laboratory select the appropriate glassware for the PE sample constituents.

4.4.2. Pack empty bottles in bubble wrap, including a trip blank and a temperature blank. The trip blank and the temperature blank are of paramount concern if you are also sending sample jars for volatile organic compound (VOC) analysis (e.g. 40 ml VOA vials) to the PE manufacturer. Refer to SOP ID 10005, *Quality Assurance/Quality Control Measures for Field Activities*.

4.4.3. Fill out a chain of custody for the bottles you are sending to the PE vendor. Send the original chain of custody with the cooler and keep a copy of the chain of custody for your records.

4.5. Receiving PE Samples from the PE Vendor

4.5.1. Upon receipt of the cooler check custody seals.

4.5.2. If a VOC certified standard is included in the PE standards that are being checked in, the first thing that needs to be done when the cooler is received is to measure and record the temperature of the temperature blank included in the cooler. Record the temperature in the form provided by the vendor and sign the form. This needs to be done as soon as the cooler is received. As applicable, return the cooler to the PE sample vendor.

4.5.2.1. If the temperature blank exceeds 6°C, contact the project manager and the Analytical Laboratory and Data Validation Manager. The PE sample may not be valid particularly if a VOC performance sample is included. If this is the case contact the PE sample vendor to request a replacement. To prevent this from happening to the extent possible, the cooler should be opened and the temperature should be recorded as soon as possible after receipt by LEA.

4.5.3. Place the certified samples in a sample holding refrigerator. This refrigerator must have a set temperature of 4°C. Ensure that any VOC certified sample is accompanied by the original trip blank that was sent to the PE manufacturer.

4.5.4. Fill out the receiving chain of custody to the sample holding refrigerator, making sure to maintain a copy of the chain of custody with the samples while they are waiting to be shipped.

4.5.5. Do **not** remove the sample labels/tags yet that are attached by the PE manufacturer. These tags are the only indication of what constituents have been spiked into the bottles. This is particularly critical for SVOCs and PCBs since the bottles are generally identical and unpreserved.

4.6. Shipping PE Samples to the Analytical Laboratory

4.6.1. Remove the PE samples from the sample refrigerator with any accompanying QA/QC samples (trip blank), release the samples from the accompanying chain of custody, and file this paperwork appropriately.

4.6.2. If a PE sample is going to be submitted to the analytical laboratory with other collected environmental samples then be sure to add the PE sample to the original *Field Sampling Record*. When a PE sample is being added to an original *Field Sampling Record* make sure to include the appropriate class identifier. A water performance evaluation

sample (PEW) and a soil performance evaluation sample (PES) are the two classes identifiable in the LEA Database.

4.6.3. The procedure described in this section should be witnessed by two employees, who will each cosign the PE sample preparation form. Label the glassware including any accompanying QA/QC samples appropriately, with dedicated LEA sample labels in cases where the glassware being used is indistinguishable (similar container, same preservative). Only remove the PE manufacturer's labels after the LEA sample labels are affixed and checked. Dedicated means that all of the sample jars, for both soil and water, should have separate sample numbers for each type of analysis. This is particularly important for the SVOC and PCB analyses to ensure that there will be no sample selection errors by the analytical laboratory. (Note that water PCB samples are usually collected in the same jars as SVOC samples. Also, all soil samples are usually collected in similar jars.)

4.6.4. Write the LEA sample number on the vendor label and then remove the tag. Tape all original vendor tags onto the "Field Sampling Record – Performance Sample" to be filed in the project notebook. This will serve as a cross-reference for LEA sample number, constituent(s) and vendor lot number for future reference. A copy of the form is provided in Attachment 2.

4.6.5. Carefully transcribe the LEA sample number from the label that has been affixed to the jar onto the field paperwork as each vendor label is removed. Write the constituent (i.e. VOCs, SVOCs, etc) next to the sample number on the field paperwork. Also write the vendor's name and PE lot number on the field paperwork.

4.6.6. Include the PE samples on the chain of custody paperwork. This chain-of-custody form is different than the one used to ship and receive the glassware from the PE sample vendor.

4.6.7. Have another LEA employee check the cooler chain of custody for accuracy and have that person initial the chain of custody.

4.6.8. File copies of all applicable field sampling paperwork including the page with the original vendors tags taped to it.

4.7. Result Interpretation

4.7.1. Once the data reported by the laboratory are entered into the project-specific database it should be verified for accuracy against the hard

copies. Similarly, once the vendor-specified acceptance limits and "true" values are entered in the database they should be verified against the hard copies for accuracy.

4.7.2. Upon receipt of the results submit the "FAIL" or "FALSE NEGATIVE/POSITIVE" information to the analytical laboratory so they can check for possible errors and report any corrective actions taken. Please note that in some instances, the client may limit the amount of information reported to the laboratory to only the "FAIL" and FALSE NEGATIVE/POSITIVE" designation. The information reported back to the laboratory is project specific.

5. References

5.1. EPA, January 2000, *Guidance on Technical Audits and Related Assessments for Environmental Data Operations*, EPA QA/G-7, Final (EPA/600/R-99/080).

END OF DOCUMENT

ATTACHMENT 1

PE Sample Ordering Information

SOIL - BLIND PERFORMANCE SAMPLES					
	VOCs	SVOCs	METALs	TPH	PCBs
LOT #	1	2	3	4	5
A	Stock Lot - 1 of 11 available	Stock Lot - 1 avail = 4/year	Stock Lot - 1 of 2 available	Stock Lot - 1 of 3 available	Stock Lot - 1260 Low 1 avail = 4/year
B	Stock Lot - 2 of 11 available	Stock Lot - 1 avail = 4/year	Stock Lot - 2 of 2 available	Stock Lot - 2 of 3 available	Stock Lot - 1254 Low 1 of 3 available
C	Stock Lot - 3 of 11 available	Stock Lot - 1 avail = 4/year	Stock Lot - 1 of 2 available	Stock Lot - 3 of 3 available	Stock Lot - 1248 Low 1 of 2 available
D	Stock Lot - 4 of 11 available	Stock Lot - 1 avail = 4/year	Stock Lot - 2 of 2 available	Stock Lot - 2 of 3 available	Stock Lot - 1254 Low 2 of 3 available
PRICE	$295 each	$261 each	$215 each	$107 each	$215 each

WATER - DOUBLE BLIND SAMPLES					
	VOCs	SVOCs	METALs	TPH	PCBs
LOT #	1	2	3	4	5
A	TCE = 25 ug/l	Bis (2) = 50 ug/l	Cr = 0.4 mg/l	1 mg/l	1260 = 1.4 ug/l
	PCE = 50 ug/l	NAP = 75 ug/l	Zn = 0.5 mg/l		
	VC = 80 ug/l	PYR = 125 ug/l			
B	TCA = 25 ug/l	BAP = 10 ug/l	As = 0.2 mg/l	0.7 mg/l	1248 = 0.8 ug/l
	PCE = 100 ug/l	BBF = 10 ug/l	Pb = 0.5 mg/l		
	MC = 25 ug/l	PHN = 5 ug/l			
C	BZ= 5 ug/l	ANTH = 150 ug/l	Cd = 0.1 mg/l	2 mg/l	1260 = 1 ug/l
	EBZ = 75 ug/l	Bis (2) = 100 ug/l	Hg = 0.01 mg/l		
	TL = 100 ug/l	DBP = 5 ug/l			
D	MC= 50 ug/l	FA = 35 ug/l	Ba= 1 mg/l	5 mg/l	1254 = 0.7 ug/l
	ACT = 125 ug/l	FLE = 50 ug/l	Ni = 0.20 mg/l		
	PCE = 25 ug/l	BA = 5 ug/l			
PRICE	$216-B,C,D ($266-A)	$216 each	$155 each	$115 each	$126 each

LIST OF ABBREVIATIONS:

TCE = Trichloroethylene
PCE = Tetrachloroethylene
VC = Vinyl chloride
TCA = 1,1,1-Trichloroethane
MC = Methylene chloride
BZ = Benzene
EBZ = Ethylbenzene
TL = Toluene
ACT = Acetone
Bis (2) = Bis(2-ethylhexyl) phthalate
NAP = Napthalene
PYR = Pyrene
BAP = Benzo[a]pyrene
BBF = Benzo[b]fluoranthene
PHN = Phenanthrene
ANTH = Anthracene
DBP = Di-n-butyl phthalate
FA = Fluoranthene
FLE = Fluorene
BA = Benzo[a]anthracene

FACSIMILE TRANSMITTAL SHEET

Loureiro Engineering Associates, Inc.

TO:	**Dale Shallenberger**	FAX NUMBER:	**303-421-0159** **303.421.3062 (lab)**
COMPANY:	**ERA**	DATE:	**12/04/2001**
FROM:	**Nick Skoularikis**	NO. OF PAGES (including cover):	**3**
RE:	**PE sample preparation**	LEA REFERENCE NUMBER:	

☐ URGENT ☐ FOR REVIEW ☐ FOR YOUR USE ☐ PLEASE COMMENT ☐ PLEASE REPLY

NOTES/COMMENTS:

Dale

I am shipping the cooler with the glassware today. Please call tomorrow if there are any questions.
I am attaching the PO # 6312 and the solution types to be used.
Please reference the PO# in the invoice. Also add the Commission Number: 68VD134.001
Please use Lots A and B.
The lab needs the following jars per sample:

- 3 VOA vials
- Two 1-Liter for TPH
- Two 1-Liter for SVOCs
- Two 1-Liter for PCBs
- One 1-Liter for Cyanide
- Two for metals (one for filtered and one unfiltered)

Please ship overnight on Monday 8/6/01 and on Tuesday 8/7/01 (one each) for receipt the following day.

Thanks
Nick

Loureiro Engineering Associates, Inc.

PURCHASE ORDER

Loureiro Engineering Associates, Inc. 100 Northwest Drive Plainville, CT 06062 Phone: (860) 747-6181 Fax: (860) 747-8822	**Purchase Order Number: 6312**

Date: 12/04/01	**Ordered By: Nick Skoularikis**
	Approved By: Nick Skoularikis

Commission Number 68VD135	**Task Number** 001

Company **Env Resource Associates** Street Address/P.O. Box 5540 Marshall street City/State/Zip Code Arvada, CO 80002 Phone 800.446.8736 Fax	LEA, Plainville CT, Nick Skoularikis Company Attention Loureiro Engineering Assoc., Inc. Street Address/P.O. Box 100 Northwest Drive City/State/Zip Code Plainville, CT 06062 Phone 860/ 747-6181 Fax 860/747-8822 Shipping/Delivery Instructions: Overnight ,

CODE	QTY	PART NO.	DESCRIPTION	PRICE (EA)	AMOUNT
	2	Lots B,C	VOCs, aqueous PE sample	232	464
	2	Lots A, B	SVOCs, aqueous PE sample	232	464
	2	Lots A, B	Metals aqueous PE sample	170	340
	2	Lots A, B	TPH aqueous PE sample	125	230
	2	Lots A, B	PCBs aqueous PE sample	126	252
	2	Lots A,B	CN aqueous PE sample	89	178
			Plus shipping charges (FedEx Overnight)		
				SUBTOTAL	1928
				FREIGHT	
				TAX RATE	6.000%
				TAX	
				TOTAL DUE	

ATTACHMENT 2

Field Sampling Record
Performance Sample

Loureiro Engineering Associates, Inc.

FIELD SAMPLING RECORD

PERFORMANCE SAMPLE

LEA Comm. No.	**67PV102.001**	Page ____ of ____
Project		Date __/__/__
Location	Plainville Landfill, Plainville, CT	
Client	Town of Plainville	

LEA Sample ID _____

LEA Sample ID _____

LEA Sample ID _____

LEA Sample ID _____

LEA Sample ID _____

LEA Sample ID _____

Field Personnel	_____	_____	***Signature***
	_____	_____	_____

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Management of
Investigation-Derived Waste

SOP ID: 10059
Date Initiated: 03/04/09
Revision No. 000: 00/00/00

Approved By: *__/s/ Margaret Averill__* *__03/04/09__*
Margaret Averill, LEP **Date**
Vice President

__/s/ Nick D. Skoularikis__ __03/04/09__
Nick D. Skoularikis **Date**
Senior Project Manager

REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	03/04/09	

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Management of
Investigation-Derived Waste

1. Purpose and Scope

During field investigation activities, there are various investigation derived wastes (IDW) generated by day-to-day operations that may pose a risk to human health and the environment. Types of IDW include:

- Soil cuttings;
- Drilling muds;
- Purged groundwater;
- Decontamination fluids (water and other fluids);
- Disposable sampling equipment; and
- Contaminated disposable personal protective equipment (PPE).

These materials are typically stored in containers (i.e. portable devices including 55-gallon drums, cubic yard boxes, roll-off containers, etc.) temporarily and managed by the client/property owner prior to off-site disposal.

The management of IDW at Loureiro Engineering Associates, Inc. (LEA) client sites must be performed in such a way as to ensure protection of human health and the environment and must comply with applicable regulatory requirements.

2. Definitions

2.1. IDW are wastes generated during the normal course of environmental site investigations and include materials such as soil cuttings, purge waters, drilling muds, PPE, and decontamination fluids.

2.2. Temporary storage: Temporary storage is defined as the holding of waste materials for a temporary period, at the end of which the waste material is treated, disposed of, or stored elsewhere.

2.3. Container: A container is a portable device in which a material is stored, transported, treated, disposed of, or otherwise handled.

3. Equipment

3.1. Containers (Open-top & closed-top drums, cubic yard boxes, totes, roll-offs, etc.).

3.2. Containment pallets.

3.3. Wood pallets.

3.4. Adhesive labels.

3.5. Clear tape.

3.6. Indelible markers.

3.7. Paint stick.

4. Procedure

4.1. Pre-job communications

4.1.1. The project manager or designee shall communicate with the assigned field personnel the management methods for IDW generated at the site. Based on the planned scope of work, ensure the appropriate number and types of containers are available for the volume and types of IDW generated.

4.1.2. Clearly identify how the naming convention for IDW containers at the site will be done to facilitate identification at time of disposal. Note: some clients/sites issue containers with existing container identifications (IDs) and labels, however, this is not typical. Typically, we provide containers and assign a unique container designation that consists of the following information, each separated by a dash:

4.1.2.1. A two-letter site identifier (e.g., XY-):

4.1.2.2. A two digit container type identifier (e.g., OT-)

4.1.2.3. A three-digit container identifier (e.g., 001)

Using the above information, the resulting container designation is XY-OT-001. Container type identifiers are as follows:

OT – Open Top Drum
CT – Closed Top Drum
CY – Cubic Yard Box
5G – 5 Gallon Pail
PT – Portable Tank/Tote
RO – Roll-Off

4.1.3. Based on Resource Conservation and Recovery Act (RCRA) regulations, a site may be limited in the number of hazardous waste containers on a site at any given time (i.e., small quantity generators and conditionally exempt quantity generators). If it is known or presumed that the IDW generated meets the definition of a hazardous waste, the project manager or designee shall communicate with the assigned field personnel the maximum amount of waste that may be generated at the site prior to IDW characterization.

4.2. Temporary storage area location:

4.2.1. The location chosen for the temporary storage of IDW must be determined in advance and approved by the project manager or client. At locations where the client may not be the property owner, a location must be approved by the operating facility manager to ensure that they have knowledge of the material in case of an emergency condition (fire, flood, storm, etc.) and that the storage/location of the containers does not interfere with daily operations.

4.2.2. The location of the temporary storage area should be level and stable in order to prevent containers from shifting/tipping.

4.2.3. The location chosen should be readily accessible for waste vendors and transportation vehicles at the time of off-site disposal. Containers should not be located in areas which are not accessible for their removal.

4.3. Container Identification

4.3.1. Clearly identify each container with a unique container identification number and record information on daily field sheet. Write generator site name/address and a description of the waste along with the accumulation date on adhesive label and attach to the side of the container. The container markings should also include the words "investigation derived waste pending determination" and the container designation. The markings and labels should be covered with clear tape to prevent wash off and fading. A sample label is provided below. **Note:** once a container is full the word "full" should be marked on the container so that no additional material is added.

XYZ Corporation
10 Main Street
Somewhere, CT 00000

Investigation-Derived Waste Pending Determination
(Soil Cuttings, Disposable sampling equipment)

XY-OT-001

Accumulation Start Date: 03/05/2009

4.3.2. If a label is not available, use a paint marker and paint the following information on the side of the container: "Investigation derived waste pending determination", Container ID, description of the waste and accumulation date.

4.3.3. If it is known or presumed that the IDW generated meets the definition of a hazardous waste, the IDW drum shall be labeled as specified by the project manager and/or the site-specific work plan, but at a minimum should be marked with the words "hazardous waste" along with the other labeling information listed above.

4.4. Container Management

4.4.1. Only use containers that are compatible with the IDW generated.

4.4.2. Containers must be closed securely except when actively adding or removing waste.

4.4.3. Do not handle containers in a manner that could cause them to leak.

4.4.4. If a container holding IDW is not in good condition, or it begins to leak, transfer the IDW to another container in good condition.

4.4.5. Open-top drums are for the management of solid-phase IDW only (i.e., soil, PPE, disposable sampling equipment, debris). Liquid-phase IDW must not be managed in open-top drums.

4.4.6. Do not completely fill liquid containers. Leave at least two to four inches of headspace in all liquid containers to allow for expansion (in the event of heat generation or freezing conditions). To minimize the potential for container failure, work with the client to arrange for disposal of the IDW as soon as possible following generation.

4.4.7. Any IDW that is known to be characteristically hazardous for ignitability (D001) or reactivity (D003) must be stored at least 50 feet from the facility property line.

4.5. Temporary storage area management

4.5.1. Containers of IDW known to be hazardous should be physically segregated from non-hazardous IDW to minimize the volume of hazardous IDW that must be disposed of.

4.5.2. Place containers on surface that will allow monitoring for leakage. Liquid containers must be stored off the ground surface (e.g., be placed on a shipping pallet). If the IDW is known or presumed that the IDW generated meets the definition of a hazardous waste, the IDW must be placed on an impervious surface, such as a coated concrete floor or a containment pallet. Asphalt or uncoated concrete do not constitute an impervious surface.

4.5.3. Provide adequate access to each container for the purposes of inspection and emergency response. Containers must be arranged so that each container may be accessed.

4.5.4. If the IDW is incompatible with other wastes generated or materials stored in the area, (e.g., acids and bases), segregate the containers by waste type. Do not store incompatible wastes/materials together.

4.5.5. Arrange containers on pallet in a manner in which that identification information is visible (facing outward).

4.5.6. If temporary storage area is located outside, cover containers with plastic sheeting and secure sheeting to prevent rips, tears, and loss.

4.5.7. If there are a large number of containers, segregate by waste type (e.g., soil/groundwater/decon fluid, hazardous/non-hazardous/PCBs). It is likely that different handling will be required for the contents.

4.5.8. When demobilizing from the site, confirm waste container storage area free of waste materials and/or debris upon departure. Photograph the storage area to document the condition, if possible.

4.6. Post-Job Client Communications

4.6.1. Upon completion of sampling activities, provide the client with a copy of the IDW inventory on-site.

4.6.2. Upon receipt of the analytical data, provide the client with a copy of the data to assist with characterization and disposal of the IDW containers on-site.

4.6.3. Additional assistance with characterization and/or management of IDW may be provided for certain clients as specified by the project manager and/or the site-specific work plan.

5. Safety

5.1 Proper safety precautions must be followed during the management and handling of IDW. Site specific health & safety plans should be consulted for guidelines on safety precautions, including movement of containers and chemical safety.

6. Records and Markings

6.1. Due to the time limitations and restrictions posed by RCRA regulations on storage of hazardous waste, accumulation dates should be identified on all containers of IDW so that they can be managed in a timely manner.

6.2 Summarize waste container inventory on "Waste Container Inventory Sheet" included as Attachment 1, and include with daily field record sheets when no additional waste will be generated.

6.3. Provide facility representative with waste container inventory to allow them to make arrangements for disposal.

7. References

7.1. *Management of Investigation Derived Waste,* United States Environmental Protection Agency, Science and Ecosystem Support Division, Operating Procedure SESDPROC-202-R1, November 1, 2007.

7.2. *Management of Remediation Waste Under RCRA,* United States Environmental Protection Agency, Publication EPA/530-F-98-026, October 1998.

7.3. *Superfund Program Representative Sampling Guidance, Volume 4: Waste,* United States Environmental Protection Agency, OSWER Directive 9360.4-14, Publication EPA/540/R-95/141, December 1995.

7.4. *Guide to Management of Investigation-Derived Wastes,* United States Environmental Protection Agency, OSWER Directive 9345.3-03FS, April 1992.

ATTACHMENT 1

Waste Container Inventory Sheet

WASTE CONTAINER INVENTORY SHEET

Loureiro Engineering Associates, Inc.

PROJECT:						COMM NO.:		
CLIENT:						DATE:		
LOCATION:						PREPARED BY:		
#	Waste Container ID	Description of Contents	Accumulation State Date	Container Full		Container Labeled	Container in Good Condition	Sample Locations (Borings, wells, etc.) associated with container
				Yes	No			

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An Employee Owned Company

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Quality Assurance/Quality Control Measures
for
Field Activities

SOP ID: 10005
Date Initiated: 02/20/90
Revision No. 005: 11/05/09

Approved By: _____ *11/05/09*
Brian A. Cutler **Date**
Senior Vice President

_____ *11/05/09*
Nick D. Skoularikis **Date**
Director of Quality

REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	02/20/90	
001-003	-	No record.
004	12/31/01	Updated to reflect new SOP format. Added Section 4.3, Results Evaluation. Minor revisions throughout.
005	11/05/09	Added Section 4.4 on sample management procedures. Revised signature page.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Quality Assurance/Quality Control Measures
for
Field Activities

1. Statement of Purpose

This document describes procedures to be followed for proper Quality Assurance Quality Control (QA/QC) practices which shall incorporate all activities associated with sampling tool and instrument preparation, field measurements and sampling, proper documentation of field and post-field activities, QC sample preparation, chain-of-custody protocol and laboratory analytical procedures. The use of specific QA/QC measures is project-specific as defined in the project work plan. This standard operating procedure (SOP) was adopted in accordance with the United Stats Environmental Protection Agency (EPA) document *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846).

2. Definitions

2.1. Trip Blank: An aliquot of organic-free water or equivalent neutral reference material carried into the field but not exposed.

2.2. Equipment Blank: An aliquot of analyte-free deionized water processed through all sample collection equipment.

2.3. Replicate Samples: Samples that have been divided into two or more portions in the field.

2.4. Collocated Samples: Independent samples collected under identical circumstances in a way that they are equally representative of the parameter of interest.

2.5. Performance Evaluation (PE) Sample: A sample that mimics actual samples in all possible aspects, except that its composition is known to the auditor and unknown to the analyst.

3. Equipment

None

4. Procedure

4.1. General

4.1.1. All QA/QC sample preparation procedures shall be properly documented including:

- Name of person(s) or laboratory involved in sample preparation.
- Reagents used.
- Sample number.
- Analyses required.
- Concentration calculations.
- Accuracy of measurements.
- Number, type, size of containers used.
- Preservation method.
- Date and time of sample preparation.

4.1.2. All information shall be included in the field logbook and/or appropriate field forms, but not necessarily in the chain-of-custody record except as needed for proper sample identification and analysis. Blind sample numbers are being used in order not to disclose the nature of the sample to the laboratory. No information that would identify the sample as a QA/QC sample shall be included in the chain-of-custody record.

4.1.3. At the conclusion of each sampling day, a quality control review shall be conducted using the Field Quality Review Checklist and the Daily Field Report.

4.2. QC Sample Preparation

4.2.1. Trip Blank

4.2.1.1. Contaminated trip blanks may indicate contamination of the samples during the field trip or shipment to the lab, cross-contamination between the samples, contaminated sample vials, or improper handling.

4.2.1.2. Trip blanks shall be used only with samples that are to be analyzed for volatile organic compounds.

4.2.1.3. One trip blank shall be included per shipping container (cooler) carrying sample soil and/or groundwater samples that are to be analyzed for volatile organic compounds

4.2.1.4. Trip blanks are prepared using analyte-free deionized organic-free water prior to field activities associated with the sampling event, usually by the laboratory providing the sampling containers. Each trip blank is placed in a 40-ml glass VOA vial and is carried in the same shipping container as the sample(s). Trip blanks should not be opened at any time during transport.

4.2.2. Equipment Blank

4.2.2.1. The purpose of an equipment/rinsate blank is to determine if decontamination procedures were adequate or if any of the equipment might contribute contaminants to the sample.

4.2.2.2. An equipment blank is prepared by running analyte-free deionized water through all sample collection equipment (bailers, pumps, filters, split-spoon) and placing it in the appropriate sample containers for analysis. If equipment has been decontaminated in the field, the equipment blank shall be collected after decontamination procedures have been performed.

4.2.2.3. Equipment blanks shall be used when sampling surface water, groundwater, soil, and sediment.

4.2.2.4. One equipment blank shall be collected for each sample bottle/preservation technique/analysis procedure per matrix per sampling event, or as otherwise specified in project-specific documents.

4.2.3. Replicate Samples

4.2.3.1. Replicate samples provide precision information on handling, shipping, storage, preparation and laboratory analysis.

4.2.3.2. Replicate samples are samples that have been divided into two or more portions in the field. An example of a replicate sample is two identical sample bottles filled with water from the same bailer retrieval. To ensure homogeneity, the bailer should be emptied into a clean, decontaminated beaker used exclusively

for the purpose and containing sufficient volume for both sample containers, and from that into the sample containers.

4.2.3.3. Replicate samples cannot be used when sampling for volatile organic compounds.

4.2.3.4. One replicate sample shall be obtained for each sample bottle/preservation technique/analysis procedure per sampling event or one out of every 20 samples, unless collocated samples are used (see below), or as otherwise specified in project-specific documents.

4.2.4. Collocated Samples

4.2.4.1. Collocated samples provide precision information on sample acquisition, homogeneity, handling, shipping, storage, preparation and laboratory analysis.

4.2.4.2. Collocated samples are independent samples collected in such a way so that presumably they are equally representative of the parameter of interest. Examples of collocated samples are groundwater samples collected sequentially, soil core samples collected side-by-side, or air samples collected essentially at the same time from the same manifold.

4.2.4.3. Collocated samples are especially useful when sampling for volatile organic compounds, for which replicate samples cannot be used.

4.2.4.4. Collocated samples shall be obtained for each sample bottle/preservation technique/analysis procedure per sampling event or one out of every 20 samples, unless replicate samples are used (see above), or as otherwise specified in project-specific documents.

4.2.5. Split Samples

4.2.5.1. The purpose of split samples is to provide an assessment of the laboratory analytical procedure.

4.2.5.2. Split samples are collocated or replicate samples sent to two (or more) different laboratories.

4.2.5.3. Split samples can be used with any sample media. Split samples can be used in conjunction with spiked samples (see

below). In case contradictory results are obtained from the samples split between different laboratories, the spiked samples can be used to verify the analytical data (provided that the spiked samples were properly prepared and the appropriate documentation is available).

4.2.5.4. When used, one split/spiked sample per sample bottle/preservation technique/analysis procedure per sampling event or every 20 samples shall be included, or as specified in project-specific documents.

4.2.6. Spiked Samples

4.2.6.1. The purpose of spiked samples is to provide information on the precision of the laboratory analytical procedure. However, besides a wrong preparation, several other sources of error exist such as analyte stability, holding time and interactions with the sample matrix.

4.2.6.2. Spiked samples are samples spiked with the contaminants of interest. The compounds used for spiking should be of the same chemical group as the contaminants being investigated, but they do not have to be the exact chemical compounds. Spiking should be carefully designed and performed prior to the field investigations. Field matrix spikes are not generally recommended because of the high level of technical expertise required for proper preparation and documentation.

4.2.6.3. Can be used with any sample media, however, liquid matrices are preferred due to uniformity of mixing.

4.2.6.4. When used, one split/spiked sample per sample bottle/preservation technique/analysis procedure per sampling event or every 20 samples shall be included, or as otherwise specified in project-specific documents. In order to ensure defensible data, performance evaluation (PE) samples, prepared by an independent vendor, are typically being used. The ordering and handling procedures and record keeping requirements are discussed in Loureiro Engineering Associates, Inc. (LEA's) *SOP for Preparation of PE Samples* (SOP 10030).

4.3. Result Evaluation

4.3.1. The analytical results on QA/QC samples should be evaluated along with the remaining analytical data as follows:

4.3.1.1. No constituents should be detected in the trip blank or equipment blank.

4.3.1.2. The relative percent differences (RPDs) shall be computed for all constituents detected in both duplicate samples used.

The RPD between two measurements (e.g., M1 and M2) is calculated as follows:

$$RPD = \frac{|M1 - M2|}{(M1 + M2)/2} \times 100\%$$

4.3.1.3. Any deviations in the performance evaluation samples shall be brought to the attention of the laboratory. An investigation shall then be performed by the laboratory of the method used, laboratory QA/QC procedures followed, and computations performed. The laboratory shall report the results of their investigation and any corrective actions taken.

4.4. Sample Management

4.4.1. It is recommended that all samples be delivered or shipped to the analytical laboratory with a chain of custody form the day of collection. If this is not possible, and as a last resort only, samples may be stored in the LEA refrigerator or in the LEA freezer.

4.4.2. The intent of the freezer is to facilitate the temporary storage of soil samples collected for volatile organic compound (VOC) analysis in accordance with EPA Method 5035 when all other options have been exhausted. Options to be considered first include arranging sample pickup by laboratory courier (at LEA or at the Site) or shipping the samples to the selected laboratory at the end of each sampling day.

4.4.3. The freezer is generally intended to be used to freeze soil samples preserved with de-ionized water (DI), which represents the low VOC-level sample. It should be noted that other preservation methods exist. Please refer to LEA SOP 10057 entitled, *Collecting and Preserving*

Soil and Sediment Samples for Laboratory Determination of Volatile Organic Compounds.

4.4.4. The freezer must remain locked at all times except for brief periods during storage and retrieval of samples. The key can be requested from the Office Manager who will maintain a record of freezer usage.

4.4.5. Similarly, the intent of the refrigerator is to provide temporary storage of samples when other arrangements cannot be made. Storage in the refrigerator or freezer shall not under any circumstances exceed one calendar week.

4.4.6. A temperature log is posted on the outside door of the refrigerator. The refrigerator temperature shall be recorded, at a minimum, on a weekly basis by the LEA Lab Manager. It should be noted that the refrigerator should not be used by storing samples to its full capacity because temperature problems may be encountered.

4.4.7. An authorized LEA representative shall be present during pickup of the samples by a laboratory courier. Under no circumstances should the laboratory courier be allowed to pickup samples by themselves.

4.4.8. During pickup of the samples, the LEA representative shall verify the accuracy of the chain of custody form and the temperature recorded if any; sign the form to relinquish the samples; and ensure that the courier acknowledges receipt of the samples by his signature.

4.4.9. Any discrepancies noted on the chain of custody form shall be addressed during sample pickup and be brought to the attention of the Project Manager.

4.4.10. The refrigerator, freezer, and surrounding working space shall be kept clean and left in the same condition as found, or better.

5. References

5.1. EPA, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846).

END OF DOCUMENT