# U.S. Army Corps of Engineers

New England District
Concord, Massachusetts

**FINAL**

# FIELD SAMPLING PLAN

30 July 2001
DCN: GE-053001-AAMA

**FSP Addendum**
12 August 2003
DCN: GE-081203-ABSP

## Environmental Remediation Contract
## General Electric (GE)/Housatonic River Project
## Pittsfield, Massachusetts

Contract No. DACW33-00-D-0006

Task Order No. 0002

03P-1251

WESTON®
MANAGERS DESIGNERS/CONSULTANTS

# FINAL

# FIELD SAMPLING PLAN

## ENVIRONMENTAL REMEDIATION CONTRACT GENERAL ELECTRIC (GE) HOUSATONIC RIVER PROJECT PITTSFIELD, MASSACHUSETTS

Contract No. DACW33-00-D-0006
Task Order No. 0002
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Prepared for:

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SS-2 Soil Sampling Using a Geoprobe®
SS-3 Pore Water Sampling
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# LIST OF ACRONYMS

| | |
|---|---|
| A/E | architect/engineer |
| ADCP | Acoustic Doppler Current Profiler |
| ANOVA | analysis of variance |
| APHA | American Public Health Association |
| ARCS | Alternate Remedial Contracting Strategy |
| ASTM | American Society for Testing and Materials |
| bgs | below ground surface |
| BOD | biochemical oxygen demand |
| CAB | cellulose acetate butyrate |
| CBP | Cooper Bredehoeft Papadopulos |
| CENAE | U.S. Army Corps of Engineers (USACE), New England District |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| cfm | cubic feet per minute |
| CFR | Code of Federal Regulations |
| CGI | combustible gas indicator |
| COC | chain-of-custody |
| COD | chemical oxygen demand |
| CPT | cone penetrometer testing |
| DAW | drive-and-wash |
| dGPS | differential GPS |
| DI | deionized |
| DNAPL | dense nonaqueous phase liquid |
| DO | dissolved oxygen |
| DOC | dissolved organic carbon |
| DOM | dissolved organic matter |
| DOT | U.S. Department of Transportation |
| DQCR | Data and Quality Control Report |
| DQOs | data quality objectives |
| EPA | U.S. Environmental Protection Agency |
| FID | flame ionization detector |
| FSP | Field Sampling Plan |
| ft bgs | feet below ground surface |
| GC/ECD | gas chromatography/electron-capture detector |
| GE | General Electric Company |
| GEOLIS | Geologic Logging and Interpretation System |

# LIST OF ACRONYMS
# (Continued)

| | |
|---|---|
| GPS | Global Positioning System |
| GZA | GZA GeoEnvironmental, Inc. |
| $H_2S$ | hydrogen sulfide |
| HASP | Health and Safety Plan |
| HBI | Hilsenhoff Biotic Index |
| HCN | hydrogen cyanide |
| HSA | hollow-stem auger |
| ID | inside diameter |
| IDW | Investigation Derived Wastes |
| IOTA | International Air Transport Association |
| L | liter |
| LEL | lower explosive limit |
| LNAPL | light nonaqueous phase liquid |
| MADEP | Massachusetts Department of Environmental Protection |
| Mag | Magnehelic gauge reading |
| MATCs | Maximum Allowable Tissue Concentrations |
| MDFW | Massachusetts Department of Fisheries and Wildlife |
| MS/MSD | matrix spike/matrix spike duplicate |
| µm | micrometer |
| µm | microns |
| NAPL | nonaqueous phase liquid |
| NJDEPE | New Jersey Department of Environmental Protection and Energy |
| NPL | National Priorities List |
| NSF | National Sanitation Foundation |
| NTU | nephelometric turbidity units |
| O&M | operation and maintenance |
| OC | organochlorine |
| OD | outer diameter |
| ORP | oxidation-reduction potential |
| OSC | On-Scene Coordinator |
| OU | Operable Unit |
| OVA | organic vapor analyzer |
| OVM | organic vapor meter |
| PAHs | polycyclic aromatic hydrocarbons |
| PCBs | polychlorinated biphenyls |
| PE | Performance Evaluation |
| PETG | polyethylene terephtalate glycol |

# LIST OF ACRONYMS
# (Continued)

| | |
|---|---|
| PID | photoionization detector |
| POC | particulate organic carbon |
| POST | Power On Self Testing |
| PPE | personal protective equipment |
| PSD | Prevention of Significant Deterioration |
| psi | per square inch |
| PTFE | polytetrafluoroethylene |
| PUF | polyurethane foam |
| PVC | polyvinyl chloride |
| QA | quality assurance |
| QA/QC | quality assurance/quality control |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |
| RAB | riverine aquatic bed |
| ROST | Rapid Optical Screening Tool |
| RPM | Remedial Project Manager |
| rpm | revolutions per minute |
| RQD | rock quality determination |
| SAF | Sample Attribute Form |
| SAP | Sampling and Analysis Plan |
| SBLT | Sequential Batch Leaching Procedure |
| SD | Standard Deviations |
| SI | Supplemental Investigation |
| SOPs | Standard Operating Procedures |
| SPCS | State Plane Coordinate System |
| SVOCs | semivolatile organic compounds |
| TIE | toxicity identification evaluation |
| TKN | total Kjeldahl nitrogen |
| TOC | total organic carbon |
| TOM | total organic matter |
| TSS | total suspended solids |
| UPGMA | unweighted pair-group |
| USACE | U.S. Army Corps of Engineers |
| USFWS | U.S. Fish and Wildlife Service |
| UTM | Universal Transverse Mercator |
| UV | ultraviolet |
| VOA | volatile organic analysis |

# LIST OF ACRONYMS
# (Continued)

| | |
|---|---|
| VOCs | volatile organic compounds |
| WES | Waterways Experiment Station |
| WESTON® | Roy F. Weston, Inc. |
| WMA | Wildlife Management Area |
| WWTP | Wastewater Treatment Plant |

# 1. INTRODUCTION

This Field Sampling Plan (FSP) provides detailed procedures related to the collection and analysis of soil, sediment, water (ground and surface), biota, and other field activities used by Roy F. Weston, Inc. (WESTON®) as part of the Site-Specific Environmental Remediation Contract (ERC) for the General Electric (GE)/Housatonic River site in Pittsfield, Massachusetts. WESTON is performing this work for the U.S. Environmental Protection Agency (EPA) under contract to the U.S. Army Corps of Engineers (USACE), New England District (CENAE), contract number DACW33-00-D-0006. This document is prepared for WESTON, EPA, and CENAE staff as well as others who demonstrate a need for this information and the standard procedures for the project.

## 1.1 SITE BACKGROUND

The GE/Housatonic River site consists of 360 acres surrounding the GE manufacturing facility; the Housatonic River, riverbanks, and associated floodplains; former river oxbows that have been filled; neighboring commercial properties; Allendale School; Silver Lake; and other properties or areas that have become contaminated as a result of GE's facility operations.

Through previous investigations, several hazardous substances, including polychlorinated biphenyls (PCBs), dioxins, furans, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganic constituents, have been found on the affected properties.

The site has been used for industrial purposes since the turn of the century, when industries such as the Stanley Electric Company, the Berkshire Gas Company, and its predecessors occupied portions of the property in the Merrill Street area. Beginning in 1903, three manufacturing divisions at the GE facility (Transformer, Ordnance, and Plastics) conducted operations at the site.

Under previous contract vehicles (USACE contracts DACW33-94-D-0009 and DACA31-96-D-0006, and EPA Contract 68-W7-0026), architect/engineer (A/E) services were performed by WESTON at six operable units (OUs). Under the ERC, investigation and removal actions could be undertaken in several areas of the river and at the GE facility.

On 25 September 1997, EPA proposed the GE/Housatonic River Site for inclusion on the EPA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL). However, on 2 October 1998, an Agreement in Principle was reached among GE, EPA, and the Massachusetts Department of Environmental Protection (MADEP). The following year, on 7 October 1999, a Consent Decree among the parties listed above was lodged. The Consent Decree was officially entered in the U.S. District Court on 27 October 2000. EPA has agreed not to list the site on the CERCLA NPL as long as progress is being made under the Consent Decree.

## 1.2 PROJECT PURPOSE

The purpose of this project is to support EPA through a contract between CENAE and WESTON for a removal action at the GE /Housatonic River site in Pittsfield, MA. The proposed removal action involves the removal of bank soils and sediments in the 1 ½ mile reach of the Housatonic River from Lyman Street to the confluence of the East and West branches. EPA has selected a recommended removal action, which is described in Section 6 of the Engineering Evaluation/Cost Analysis (WESTON, 2000 [07-0030]). After review and comment by federal and state agencies, GE, and the public, this removal action will be documented in an EPA Action Memorandum.

In addition, this contract may also be used to provide oversight of GE remedial actions at the facility and in the first ½ mile reach of the river, floodplains in the upper 2-mile reach, along the Rest of River, and in off-site areas impacted by GE’s operations. Other services to be provided include, but are not limited to:

- Site definition studies.
- Removal investigations.
- Feasibility studies.
- Designs.
- Removal/remediation actions.
- Short-term operation and maintenance (O&M).
- Oversight of GE activities and any other actions necessary to complete remediation activities at the site.

## 1.3 PURPOSE/SCOPE OF DOCUMENT

The purpose of this Field Sampling Plan is to provide a compilation of the field sampling methods, sample handling procedures, and quality assurance/quality control (QA/QC) procedures for the successful execution of the ERC. As any new procedure is required, addendums to this document will be issued.

The FSP and the Quality Assurance Project Plan (QAPP) (WESTON, 1999 [00-0324] and 2001 [00-0507]) constitute a Sampling and Analysis Plan (SAP) that provides a process for obtaining data of sufficient quality and quantity to satisfy project needs.

The QAPP describes policy, organization, functional activities, and the data quality objectives (DQOs) and measures necessary to obtain adequate data for a given purpose.

In addition to the FSP, individual work plans may be generated, which:

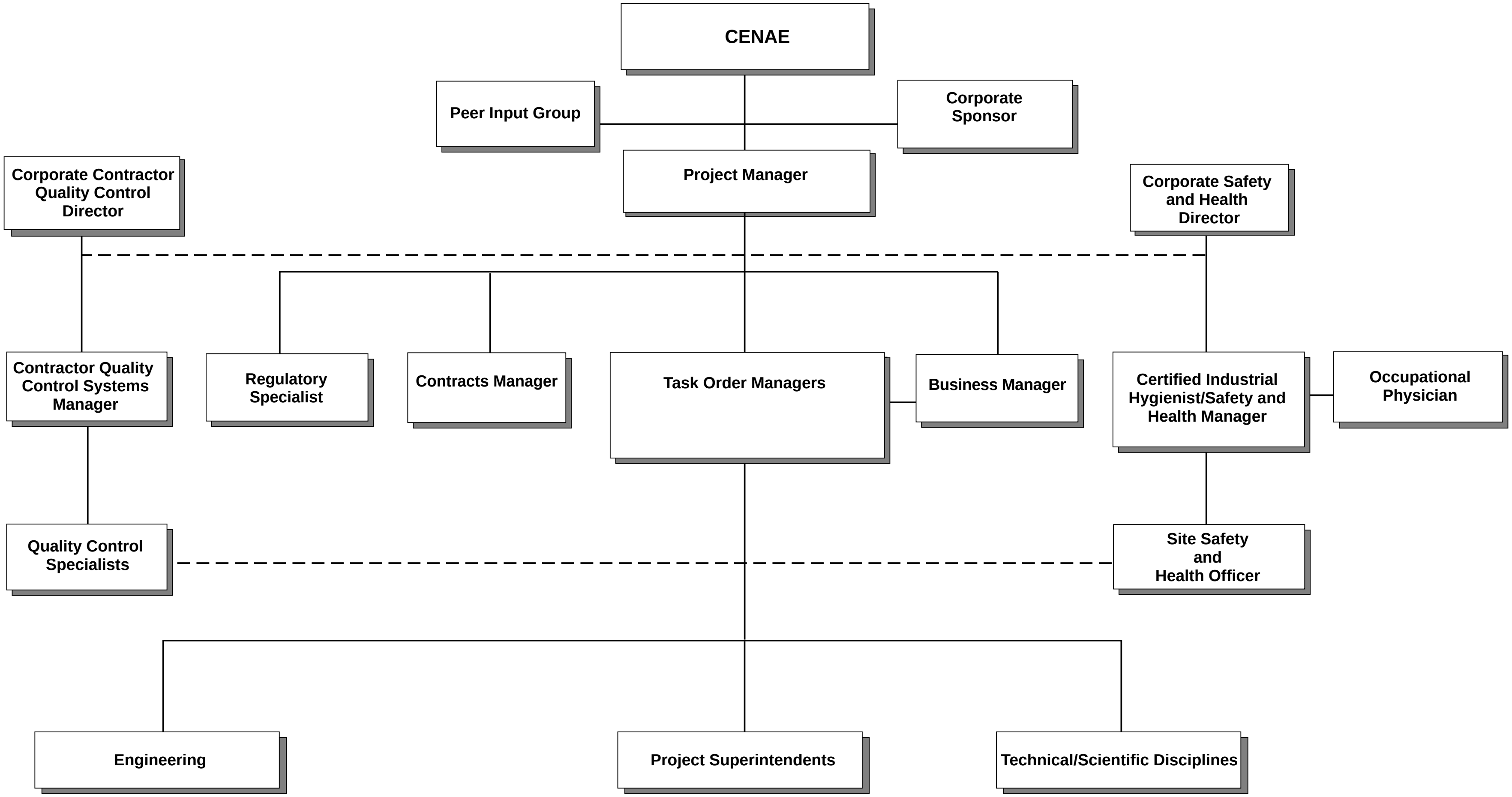
- Describe team members, specifically subcontractors.
- Describe field investigation tasks in detail.
- Address sampling locations and depths.
- Establish sample types and sampling methods.
- Provide DQOs.

The combination of the FSP, QAPP, and work plans comprise the documents describing field activities, laboratory activities, and contract deliverables related to the acquisition and reporting of environmental data.

All staff participating in field efforts are required to read this manual and become familiar with the field procedures and the implementation of these procedures to ensure that sampling goals are met consistently. In addition, key personnel are responsible to mentor assigned staff in aspects of this FSP that would have a potential impact on the work assigned to them. This FSP should be generally made available to personnel working on the ERC. The guidelines set forth in this FSP are intended to enhance consistency on the project.

# 2. PROJECT ORGANIZATION AND RESPONSIBILITIES

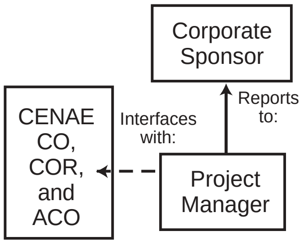
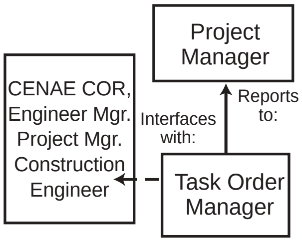
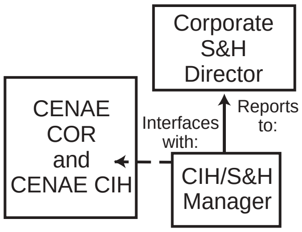
To effectively execute the field program for the GE/Housatonic River Project site, the following management structure, with clearly defined positions, has been developed (Figure 2-1). General summaries of the responsibilities by position are presented in Figure 2-2.



**Field Sampling Plan**
**GE/Housatonic River Project**
**Pittsfield, Massachusetts**

## FIGURE 2-1
## WESTON TEAM
## PROJECT ORGANIZATION CHART

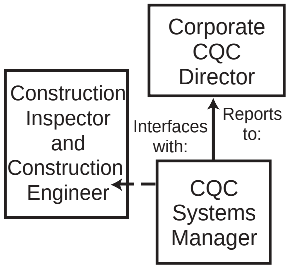
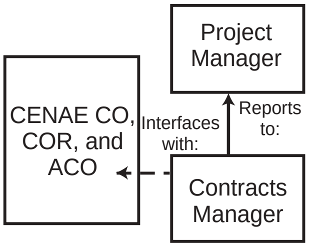
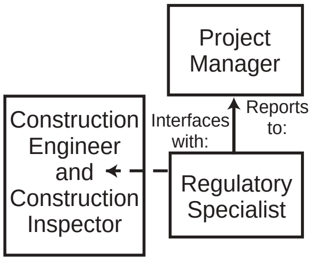
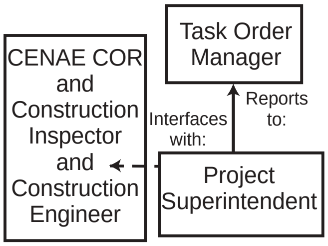
00P-1831-3

| Position | Responsibility | Authority |
|---|---|---|
| **Project Manager**<br> | • Single point of contact.<br>• Ensures contract cost, schedule, and technical quality.<br>• Ensures task order execution in accordance with SOW, approved plans, and regulations.<br>• Coordinates and communicates with CENAE for project progress and cost/schedule reporting.<br>• Oversees subcontractor performance.<br>• Oversees safety and health, technical quality, and compliance with applicable regulations.<br>• Ensures all schedules and budgets are met.<br>• Ensures all contractual requirements are satisfied.<br>• Monitors progress against SB/SDB/WOSB goals.<br>• Develops and implements recordkeeping system for administrative, QC, and project closeout.<br>• Manages and directs team staff and team integration. | • Accepts and negotiates task orders.<br>• Executes task orders and contract modifications.<br>• Power of Attorney.<br>• Signature authority up to the value of the contract.<br>• Approves project plans, policies, and procedures.<br>• Approves allocation and fund expenditures.<br>• Commits resources, including team personnel, and evaluates performance.<br>• Evaluates task orders for SB/SDB/WOSBs.<br>• Selects task order managers.<br>• Takes corrective action for unacceptable performance.<br>• Approves subcontract agreements.<br>• Approves all invoices.<br>• Stops work for safety, health, or quality issues. |
| **Task Order Managers**<br> | • Serve as primary point of contact for a task order.<br>• Ensure task order quality and site safety.<br>• Ensure task order execution within cost and schedule.<br>• Monitor cost and schedule in accordance with approved budgets.<br>• Manage and execute task order in compliance with the SOW, work plan, and other project documents.<br>• Lead or assist subcontractor negotiation.<br>• Recommend SB/SDB/WOSB opportunities.<br>• Generate cost/schedule progress reports.<br>• Direct task order team resources. | • Direct home office and field work for task orders.<br>• Assist with negotiation of task orders, including cost proposals.<br>• Negotiate subcontract agreements.<br>• Approve work plans.<br>• Issue daily, weekly, and monthly cost and schedule reports.<br>• Interface with CENAE.<br>• Select/assign project staff and reassign as needed.<br>• Certify invoices.<br>• Stop work for safety, health, and quality issues. |
| **Project CIH/S&H Manager**<br> | • Develops, oversees, and enforces all safety and health-related aspects of the contract.<br>• Develops and implements project-related safety and health procedures.<br>• Reviews all site safety and health plans to ensure worker safety and health; monitors SSHO performance.<br>• Performs site audits at active sites.<br>• Conducts site-specific training.<br>• Directs air-monitoring activities. | • Approves and implements all SSHPs.<br>• Assigns and oversees SSHO.<br>• Enforces compliance with SSHPs.<br>• Approves changes to SSHP requirements<br>• Issues safety and health compliance orders.<br>• Issues stop work order when safety is compromised.<br>• Reviews and approves monitoring results.<br>• Reviews and approves accident reports. |

**Field Sampling Plan**
**GE/Housatonic River Project**
**Pittsfield, Massachusetts**

**FIGURE 2-2**
**RESPONSIBILITIES AND AUTHORITIES OF THE WESTON MANAGEMENT TEAM**

00P-1831-1

| Position | Responsibility | Authority |
|---|---|---|
| **CQC Systems Manager**<br> | • Single point of contact for all site QC activities.<br>• Ensures implementation of QC system.<br>• Plans and executes administrative, field, construction, and chemical data acquisition QC.<br>• Performs work inspections and QC audits.<br>• Maintains current records in accordance with approved CQC plans for factual evidence that QC activities and/or tests have been performed.<br>• Develops daily and weekly QC reports.<br>• Maintains QC records management system.<br>• Monitors Chem. QC Specialist performance. | • Approves and implements CQC plans.<br>• Enforces compliance with CQC plans.<br>• Conducts QC inspections during all phases of the work to ensure compliance with contract requirements.<br>• Acts in all QC matters in coordination with superintendent.<br>• Rejects noncompliant work, equipment, and test results.<br>• Stops work for quality and safety issues.<br>• Certifies that all submittals are in compliance with contract.<br>• Evaluates subcontractor performance, and issues and enforces QC corrective actions. |
| **Contracts Manager**<br> | • Ensures compliance with FAR, DFAR, and contract requirements.<br>• Oversees purchasing, receiving, invoicing procedures, and system compliance.<br>• Serves as small business advocate.<br>• Administratively manages subcontractor performance.<br>• Conducts recordkeeping of all subcontracts.<br>• Manages document control system. | • Administers and enforces the provisions of the contract and FAR on prime and all subcontracts, in coordination with Project Manager.<br>• Approves purchasing and subcontract procedures.<br>• Approves contract aspects of task order/change order.<br>• Negotiates/signs purchase orders and subcontract agreements, in coordination with Project and Task Order Managers. |
| **Regulatory Specialist**<br> | • Single point of contact for all regulatory matters.<br>• Completes all manifest requirements in accordance with work plans, SSHP, SAP, Waste Management Plan (WMP), and regulatory requirements.<br>• Completes waste profiles, hazardous waste tracking, exception and discrepancy reports, transportation and disposal reports.<br>• Conducts hazardous material management.<br>• Assists in technical selection of disposal method.<br>• Acquires all necessary permits. | • Reviews and approves all T&D procedures.<br>• Establishes and implements policies and procedures for waste management.<br>• Signs manifests.<br>• Audits and prequalifies disposal facilities.<br>• Develops and issues all transportation and disposal reports, discrepancy reports.<br>• Enforces provisions of all permits received. |
| **Project Superintendent**<br> | • Oversees management and execution of all task order on-site activities.<br>• Oversees and monitors subcontractor field performance.<br>• Assigns personnel to daily tasks.<br>• Conducts daily, weekly meetings.<br>• Monitors contractor's SSHP in conjunction with program CIH and SSHO. | • Issues and oversees implementation of corrective actions in the field.<br>• Ensures regulatory and SSHP compliance.<br>• Stops work for safety, health, and quality issues.<br>• Directs all field personnel during task order implementation.<br>• Manages all site resources including staff assignments. |

**Field Sampling Plan**
**GE/Housatonic River Project**
**Pittsfield, Massachusetts**

**FIGURE 2-2**
**RESPONSIBILITIES AND AUTHORITIES OF THE WESTON MANAGEMENT TEAM (Continued)**

00P-1831-2

# 3. FIELD ACTIVITIES

As part of the various field investigations, several standard field procedures may be performed as required in the respective work plan documents. This section of the FSP describes the procedures and references the appropriate detailed procedures. All sampling and field procedures will be conducted in accordance with the requirements described in the Health and Safety Plan (WESTON, 2001 [00-0506]) and site-specific health and safety plans.

The majority of the practices and standard operating procedures (SOPs) presented in this section have been compiled and/or modified from the following sources:

- EM-200-1-3 – Requirements for SAPs
- EM 1110-1-4000—Monitor Well Design
- WESTON SOPs
- EPA Protocols
- American Society for Testing and Materials (ASTM) Standards

These procedures should be viewed as standard procedures, which can be modified only through the issuance of a revised procedure.

All field work must be undertaken in compliance with the Health and Safety Plan (HASP), and no procedures outlined in this section have precedence over procedures outlined in the HASP. The senior WESTON person at a work location will identify all visitors to that location; determine whether they have permission to be at the work location; and record their name, work affiliation, and reason for being at the work location.

Standard Operating Procedures for the following tasks are included in Appendix C:

| SOP NO. | TASK |
|---|---|
| **GENERAL SOPS** | |
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| G-3 | Field Documentation |
| G-4 | Field Filtration |
| G-5 | Field Measurements |
| G-6 | Field Sample Numbering |
| G-7 | Management of Investigation Derived Wastes (IDW) |
| G-8 | Oversight of General Electric Field Activities |
| G-9 | Quality Assurance/Quality Control Sampling |
| G-10 | Sample Documentation |
| G-11 | Sample Packing and Shipping |
| G-12 | Surveying |
| G-13 | Trimble Pathfinder Pro Xl GPS Unit |
| **MEDIA-SPECIFIC SOPS**<br>**SOIL AND SEDIMENT** | |
| SS-1 | Determination of Presence of Free Product |
| SS-2 | Soil Sampling Using a Geoprobe® |
| SS-3 | Pore Water Sampling |
| SS-4 | Sediment Sampling |
| SS-5 | Soil Sampling |
| SS-6 | Test Pit Excavation |
| **Surface Water** | |
| SW-1 | Acoustic Doppler Current Profiler (ADCP) |
| SW-2 | PCB Congener Sampling in Surface Water |
| SW-3 | Stormflow Sampling |
| SW-4 | Surface Water Sampling |
| SW-5 | Remediation Monitoring Sample Collection and Sample Processing |
| **Groundwater** | |
| GW-1 | Borehole/Well Abandonment |
| GW-2 | Low Stress (Low Flow) Groundwater Purging and Sampling |
| GW-3 | Groundwater Monitoring Well Installation |
| GW-4 | NAPL Sampling |

| SOP NO. | TASK |
|---|---|
| GW-5 | Potable Water Sampling |
| GW-6 | Pumping Test Aquifer Testing |
| GW-7 | Slug Test Aquifer Testing |
| GW-8 | Water Level and Well Depth Measurements |
| GW-9 | Well Development |
| **Air** | |
| A-1 | Ambient Air Monitoring |

# APPENDIX A

# REFERENCES

# APPENDIX A

# REFERENCES

00-0324 WESTON (Roy F. Weston, Inc.). 1999. *Final Quality Assurance Project Plan, GE Housatonic River Project, Volume III*.

00-0506 WESTON (Roy F. Weston, Inc.). May 2001. *Final Health and Safety Plans.* Environmental Remediation Contract, GE/Housatonic River Project. DCN GE-052901-AALT.

00-0507 WESTON (Roy F. Weston, Inc.). March 2001. *Quality Assurance Project Plan.* Environmental Remediation Contract, GE/Housatonic River Project. Volumes I, II, IIA, and IV. DCN GE-021601-AAHM.

07-0030 WESTON (Roy F. Weston, Inc.). 2000. *Engineering Evaluation/Cost Analysis for the Upper Reach of the Housatonic River*. DCN GEP4-012400-AACJ.

Note: This reference list includes references for Sections 1 through 3 of the FSP. References for the Standard Operating Procedures (SOPs) presented in Appendix C are included following each SOP.

# APPENDIX B

# STANDARD FORMS

Figure B-1

# GEOLIS® Location Identification Form

CLIENT: ____________________
PROJECT: ____________________
PROPERTY: ____________________
SITE / AREA: __________ __________
LOCATION ID: ____________________
BEGIN DATE: ____________________
END DATE: ____________________
LOGGER: ____________________

QUALITY LEVEL: 1 - 2 - 3
UNIT SYSTEM: ENGLISH - METRIC

LOCATION TYPE: BOR - PIZ - WEL - PIT - __________
TEST PIT: LENGTH: ________ FT/M WIDTH: ________ FT/M
BOREHOLE COMPLETED IN: OVERBURDEN - BEDROCK
BEDROCK CONFIRMED: NOT - DRL - SPS - AUG - COR - CUT
TOTAL DEPTH: ____________________ FT/M BGS
DEPTH TO BEDROCK: ____________________ FT/M BGS

BOREHOLE DIAMETER No.1: __________ IN/CM
INTERVAL: __________ TO __________ FT/M BGS

| | | | | |
|---|---|---|---|---|
| METHOD: | HSA | SSA | BKA | JET |
| | DRT | RRT | COR | DAW |
| | CBT | DCD | DHH | SON |

OTHER : ____________________
FLUID: AIR - WATER - MUD - FOAM - NONE

BOREHOLE DIAMETER No.2: __________ IN/CM
INTERVAL: __________ TO __________ FT/M BGS

| | | | | |
|---|---|---|---|---|
| METHOD: | HSA | SSA | BKA | JET |
| | DRT | RRT | COR | DAW |
| | CBT | DCD | DHH | SON |

OTHER : ____________________
FLUID: AIR - WATER - MUD - FOAM - NONE

BOREHOLE DIAMETER No.3: __________ IN/CM
INTERVAL: __________ TO __________ FT/M BGS

| | | | | |
|---|---|---|---|---|
| METHOD: | HSA | SSA | BKA | JET |
| | DRT | RRT | COR | DAW |
| | CBT | DCD | DHH | SON |

OTHER : ____________________
FLUID: AIR - WATER - MUD - FOAM - NONE

DRILLING/EXCAVATING CO.: ____________________
DRILLER/OPERATOR: ____________________
EQUIPMENT/RIG: ____________________

N

SITE SKETCH

| | ESTIMATED | SURVEYED |
|---|---|---|
| SURFACE ELEVATION: | __________ | __________ |
| N. COORDINATE: | __________ | __________ |
| E. COORDINATE: | __________ | __________ |
| MEASURING POINT ELEVATION: | __________ | __________ |

WELL PERMIT No.: ____________________
ALIAS ID/WELL RECORDATION No.: ____________________

HOLE ABANDONED ? YES - NO (IF YES DESCRIBE IN COMMENTS)
WELL INSTALLED ? YES - NO
WELL CLUSTER ? YES - NO No. OF WELLS: ________
WELL NEST ? YES - NO No. OF WELLS: ________

PUMPS INSTALLED ? YES - NO

| | TYPE | DEPTH |
|---|---|---|
| PURGE: | __________ | __________ |
| SAMPLE: | __________ | __________ |

BOREHOLE TESTING

BOREHOLE GEOPHYSICS ? YES - NO
SLUG TESTS ? YES - NO
PACKER TESTS ? YES - NO
PUMPING TESTS ? YES - NO

COMMENTS: ____________________

DATA ENTRY BY: __________
DATE ENTERED: __________
QC REPORTS PRINTED ? YES - NO

QC REVIEW BY: __________
REVIEW DATE: __________
APPROVED WITH - WITHOUT REVISIONS

QA REVIEW BY: __________
REVIEW DATE: __________
APPROVED WITH - WITHOUT REVISIONS

GEOLIS Version 1.4 JAN 1995 G020195

Figure B-2

# GEOLIS® Borehole Logging Form

COMPANY: ____________________ LOCATION ID: ____________________
CLIENT: ____________________ DATE: ____________________
PROJECT: ____________________ LOGGER: ____________________
SITE / AREA: ____________________ SIGNATURE: ____________________

SAMPLING METHOD: SPS - CSS - STB - CTS - CUT - COR - NS
OTHER: ____________________
SAMPLING INTERVAL: __________ TO __________ FT/M BGS
RECOVERY: __________ / __________ FT/M NA
BLOW COUNT: ☐ ☐ ☐ ☐ / ☐ IN/CM NA
RQD: __________ % NA

FLUID ENTRY/ LOSS ZONES: __________ FT/M BGS __________ GPM
__________ FT/M BGS __________ GPM

ANALYTICAL SAMPLE ID INTERVAL (FT/M BGS)
__________ __________ - __________
TYPE / LAB : UND - DIS - CMP / MOB - GEO - CHM - __________ /
__________ __________ - __________
TYPE / LAB : UND - DIS - CMP / MOB - GEO - CHM - __________

SAMPLING INTERVAL No.: __________
LITHOLOGIC INTERVAL No.: __________
LITHOLOGIC INTERVAL: __________ TO __________ FT/M BGS

LITHOLOGY ARCHIVED? YES - NO
NO RECOVERY

MATERIAL: NATURAL - FILL - UNCERTAIN
OBSERVED: STN - SHN - ODR - PRD - NA - OTHER: __________
INSTRUMENT 1 TYPE: __________ READING: __________
INSTRUMENT 2 TYPE: __________ READING: __________

## OVERBURDEN

SECONDARY

SECONDARY TYPE: NA - BED - CLS - MIX
COLOR: MUN - GSA __________
COLORATION: UNI - STN - MOT - VAR
BOULDERS: ______ % MAX DIAM: ______ IN
COBBLES: ______ % MAX DIAM: ______ IN
TEXTURE: C - M - F
GRAVEL: __ __ __ ______ % ______ %
SAND: __ __ __ ______ % ______ %
SILT: ______ % ______ %
CLAY: ______ % ______ %
ORGANIC: ______ % ______ %
ROUNDNESS:
GRAVEL: FAC - STR - ANG - SUB - RND - NA
SAND: ANG - SUB - RND - NA
SORTING: WEL - MOD - POR - NA
PLASTICITY: NON - LOW - MOD - HGH - NA
MOISTURE: DRY - MST - WET - SAT - NA
CEMENTATION: NON - SLT - MOD - WEL - NA
GRAIN TYPE: QTZ - FRG - FOS - BIO - NA ______
MATRIX: MSM - CSM - CAL - OXD - ARG - SIL - NA
STRENGTH:
COHESIVE: VSF - SFT - FRM - STF - VST - HRD
NONCOHESIVE: VDN - DEN - FIR - LSE - NA
UPPER CONTACT: SHP - GRD - DIF - SME - NA
BEDDING THICK: ______ IN/CM No.: ______
TYPE: XBD - RPL - HOR - INC - NA
MAS - LNS - LAM - GRU - GRD

GRAPHIC LOG

## BEDROCK

SECONDARY

SECONDARY TYPE: NA - BED - VEN - MIX
COLOR: MUN - GSA __________
ROCK TYPE: OTHER: __________
SED: SHL - SLT - SST - CGL - LST - DOL - COL
MET: SLA - PHY - SHS - GNS - HRN - QZT - MBL
IGN: GRN - RHY - BSL - GBR - TUF - BRC
TEXTURE: C - M - F NA
GRAVEL: __ __ __ ______ % ______ %
SAND: __ __ __ ______ % ______ %
SILT: ______ % ______ %
CLAY/LIME MUD: ______ % ______ %
GRAIN TYPE: QTZ - FRG - FOS - BIO - NA
MATRIX: CAL - MIC - OXD - ARG - SIL - ORG - NA
STRENGTH: EWK - VWK - WEK - MOD
STR - VST - EST
UPPER CONTACT: SHP - GRD - DIF - SAM - NA
SECONDARY POROSITY: VUG - FRC - BED - NA - OTHER
HGH - MOD - LOW
WEATHERING: FRS - SLT - MOD - HGH - CPL - NA

NATURAL FRACTURE SETS

| INTERVAL (FT/M BGS) | #/FT-M | DIP | DIR | FILL/SHAPE/ROUGH/SURFACE |
|---|---|---|---|---|
| -- | | | | FILL: OPN - PRT - FUL<br>SHAPE: PLN - CUR - UND - STP - IRR<br>ROUGH: SMH - MOD - RGH<br>SURFACE: CLN - MIN - OXD - STN - WTH |
| -- | | | | FILL: OPN - PRT - FUL<br>SHAPE: PLN - CUR - UND - STP - IRR<br>ROUGH: SMH - MOD - RGH<br>SURFACE: CLN - MIN - OXD - STN - WTH |
| -- | | | | FILL: OPN - PRT - FUL<br>SHAPE: PLN - CUR - UND - STP - IRR<br>ROUGH: SMH - MOD - RGH<br>SURFACE: CLN - MIN - OXD - STN - WTH |
| -- | | | | FILL: OPN - PRT - FUL<br>SHAPE: PLN - CUR - UND - STP - IRR<br>ROUGH: SMH - MOD - RGH<br>SURFACE: CLN - MIN - OXD - STN - WTH |

STRAT UNIT:
NOTE LINE :

| | | | |
|---|---|---|---|
| NEXT INTERVAL | SAMP/LITH No.<br>______ / ______ | DEPTH INTERVAL<br>______ TO ______ | NOT SAMPLED<br>NO RECOVERY |

COMMENTS: (1) ______________________________
______________________________
(2) ______________________________

GEOLIS Version 1.4 JAN 1995 G030195

**Figure B-3**

# GEOLIS® Well Construction Form

Sheet ____ of ____

COMPANY: ____________________
PROJECT: ____________________
PROPERTY: ____________________
SITE/AREA: __________ / __________

LOCATION ID: ____________________
DATE: ____________________
LOGGER: ____________________
SIGNATURE: ____________________

START DATE: ____________________
COMPLETION DATE: ____________________
WELL STATUS: PMP - ABN - COL - NOR
STATUS DATE: ____________________

| SURVEYED ELEVATIONS (MSL) | | DEPTH TO WATER | DATE / TIME |
|---|---|---|---|
| GROUND LEVEL: | ________ FT/M | ________ FT/M(TOC) | ________ |
| MEASURING POINT: (TOP OF CASING) | ________ FT/M | ________ FT/M(TOC) | ________ |
| | | ________ FT/M(TOC) | ________ |

| WELL DIAGRAM - NOT TO SCALE | DEPTH (FT. BGS) | WELL CODE |
|---|---|---|
| | | |
| | 0 | GRS |

WELL TYPE: SCREEN - MULTIPLE SCREEN - OPEN HOLE - NESTED - PROBE
CASING: SINGLE - DOUBLE - TRIPLE COMPLETION: FLUSH - PROT - VAULT - CAP - NA
TOTAL NO. OF SCREENS/WELLS: ______ SCREEN/WELL NO.: ______
WELL USE: DOM - PUB - IRR - FIR - MON - HYD - EXT - DEW - RCH - VEW - INJ - OTH: ______

## WELL DESIGN CONSTRUCTION

CASING #1: *(INNERMOST)* DIAMETER: ______ IN/CM INTERVAL: ______ TO ______ FT/M BGS
TYPE: PVC - STN - LCS - GAL - ____ SCHEDULE: 5 - 10 - 20 - 40 - 80 - ____
CASING JOINTS: FLT - BUT - EUT - SOL - WLD - SCW - CAM - OTH: ______

CASING #2: DIAMETER: ______ IN/CM INTERVAL: ______ TO ______ FT/M BGS
TYPE: PVC - STN - LCS - GAL - ____ SCHEDULE: 5 - 10 - 20 - 40 - 80 - ____

CASING #3: *(OUTERMOST)* DIAMETER: ______ IN/CM INTERVAL: ______ TO ______ FT/M BGS
TYPE: PVC - STN - LCS - GAL - ____ SCHEDULE: 5 - 10 - 20 - 40 - 80 - ____

STICK UP: INNER CASING: ______ FT/M OUTER CASING: ______ FT/M

GROUT: TYPE: CMT - C/B - BEN - HSB - OTH: ______
INTERVAL: ______ TO ______ FT/M BGS
PLACEMENT: TRM - PRS - GRV CENTRALIZERS: NON - 1 - 2 - 3 - OTH: ______

SEAL: TYPE 1: ______ INTERVAL: ______ TO ______ FT/M BGS
TYPE 2: ______ INTERVAL: ______ TO ______ FT/M BGS

SAND PACK: TYPE: ______ INTERVAL: ______ TO ______ FT/M BGS

SCREEN OR DEVICE: DIAMETER: ______ IN/MM INTERVAL: ______ TO ______ FT/M BGS
TYPE: PVC - STN - LCS - TEF - CER - HDP - OTH: ______
SLOTS: CON - SLH - SLV - BRG - CUT - OTH: ______
SLOT SIZE: 6 - 10 - 20 - 30 - 40 - ______ SLOT

STRAT UNIT MONITORED: ______ ☐☐☐
ESTIMATED WELL YIELD: ______ GPM/LPM DRAWDOWN: ______ FT/M BMP
WATER SAMPLING SYSTEM: NON - PMP - PKR - MLS TYPE: ______
SEAL INTERVAL: ______ TO ______ FT/M BGS INTAKE DEPTH: ______ FT/M BGS
NOTES: ______

OPEN HOLE: DIAMETER 1: ______ IN/CM INTERVAL: ______ TO ______ FT/M BGS
DIAMETER 2: ______ IN/CM INTERVAL: ______ TO ______ FT/M BGS

SILT TRAP/SUMP: YES - NO INTERVAL: ______ TO ______ FT/M BGS
INSIDE WELL T.D.: ______ FT/M BGS COLLAPSE/BACKFILL: COL - BFL - BTH - NON
COLLAPSE INTERVAL: ______ TO ______ FT/M BGS
BACKFILL INTERVAL: ______ TO ______ FT/M BGS TYPE: ______

*WELL CONSTRUCTION CODES*

| | |
|---|---|
| GRS = GROUND SURFACE | TSC = TOP OF SCREEN |
| BPC = BOTTOM OF PROTECTIVE CASING | TST = TOP OF SILT TRAP |
| TBS = TOP OF BENTONITE SEAL | WTD = TOTAL DEPTH INSIDE WELL |
| TBR = TOP OF BEDROCK | BTD = BOREHOLE TOTAL DEPTH |
| BOC = BOTTOM OF OUTER CASING | TOC = TOP OF CASING (INNER) |
| TSP = TOP OF SAND PACK | BGS = BELOW GROUND SURFACE |

COMMENTS: ______

GEOLIS Version 1.4 JAN 1995 G051294

Figure B-4

# GEOLIS® Multi-Screen Well Form

Sheet ____ of ____

COMPANY: ____________________
PROJECT: ____________________
PROPERTY: ____________________
SITE/AREA: __________ / __________

LOCATION ID: ____________________
DATE: ____________________
LOGGER: ____________________
SIGNATURE: ____________________

| WELL DIAGRAM - NOT TO SCALE | DEPTH (FT. BGS) | WELL CODE |
|---|---|---|
| | | |

MULTIPLE SCREEN CONSTRUCTION — *SCREEN No.:*

CASING #1: (INNERMOST) DIAMETER: ______ IN/CM INTERVAL: ______ TO ______ FT/M BGS
TYPE: PVC - STN - LCS - GAL - ____ SCHEDULE: 5 - 10 - 20 - 40 - 80 - ____
CASING JOINTS: FLT - BUT - EUT - SOL - WLD - SCW - CAM - OTH: ______
GROUT: TYPE: NON - CMT - C/B - BEN - HSB - OTH: ______
INTERVAL: ______ TO ______ FT/M BGS
PLACEMENT: TRM - PRS - GRV CENTRALIZERS: NON - 1 - 2 - 3 - OTH: ____
SEAL: TYPE 1: ______ INTERVAL: ______ TO ______ FT/M BGS
TYPE 2: ______ INTERVAL: ______ TO ______ FT/M BGS
SAND PACK: TYPE: ______ INTERVAL: ______ TO ______ FT/M BGS
SCREEN OR DEVICE: DIAMETER: ______ IN/MM INTERVAL: ______ TO ______ FT/M BGS
TYPE: PVC - STN - LCS - TEF - CER - HDP - OTH: ______
SLOTS: CON - SLH - SLV - BRG - CUT - OTH: ______
SLOT SIZE: 6 - 10 - 20 - 30 - 40 - ______ SLOT

STRAT UNIT MONITORED: ______ ☐☐☐
ESTIMATED WELL YIELD: ______ GPM/LPM DRAWDOWN: ______ FT/M BMP
WATER SAMPLING SYSTEM: NON - PMP - PKR - MLS TYPE: ______
SEAL INTERVAL: ______ TO ______ FT/M BGS INTAKE DEPTH: ______ FT/M BGS
NOTES: ______

COMMENTS: ______

MULTIPLE SCREEN CONSTRUCTION — *SCREEN No.:*

CASING #1: (INNERMOST) DIAMETER: ______ IN/CM INTERVAL: ______ TO ______ FT/M BGS
TYPE: PVC - STN - LCS - GAL - ____ SCHEDULE: 5 - 10 - 20 - 40 - 80 - ____
CASING JOINTS: FLT - BUT - EUT - SOL - WLD - SCW - CAM - OTH: ______
GROUT: TYPE: NON - CMT - C/B - BEN - HSB - OTH: ______
INTERVAL: ______ TO ______ FT/M BGS
PLACEMENT: TRM - PRS - GRV CENTRALIZERS: NON - 1 - 2 - 3 - OTH: ____
SEAL: TYPE 1: ______ INTERVAL: ______ TO ______ FT/M BGS
TYPE 2: ______ INTERVAL: ______ TO ______ FT/M BGS
SAND PACK: TYPE: ______ INTERVAL: ______ TO ______ FT/M BGS
SCREEN OR DEVICE: DIAMETER: ______ IN/MM INTERVAL: ______ TO ______ FT/M BGS
TYPE: PVC - STN - LCS - TEF - CER - HDP - OTH: ______
SLOTS: CON - SLH - SLV - BRG - CUT - OTH: ______
SLOT SIZE: 6 - 10 - 20 - 30 - 40 - ______ SLOT

STRAT UNIT MONITORED: ______ ☐☐☐
ESTIMATED WELL YIELD: ______ GPM/LPM DRAWDOWN: ______ FT/M BMP
WATER SAMPLING SYSTEM: NON - PMP - PKR - MLS TYPE: ______
SEAL INTERVAL: ______ TO ______ FT/M BGS INTAKE DEPTH: ______ FT/M BGS
NOTES: ______

COMMENTS: ______

GEOLIS Version 1.4 JAN 1995 G05A0195

**Figure B-5**

# GEOLIS® Field Activity Logging Form

COMPANY: ____________________

PROJECT: ____________________

PROPERTY: ____________________

SITE/AREA: ____________________

LOCATION ID: ____________________

PROJECT No.: ____________________

LOGGED BY: ____________________

EQUIPMENT/RIG TYPE: ____________________

SUBCONTRACTOR: ____________________

DRILLER/OPERATOR: ____________________

____________________
APPROVED BY

| DATE | TIME START - END | ACTIVITY CODE | TOOL DIAM. (IN.) | SAMPLING METHOD | FOOTAGE | | EXPLANATION |
|---|---|---|---|---|---|---|---|
| | | | | | INCR. | TOTAL | |
| | - | | | | | | |
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### ACTIVITIES - GENERAL

SBY = STANDBY
DNT = DOWNTIME
WLI = WELL INSTALLATION
DCN = DECONTAMINATION
WDV = WELL DEVELOPMENT
GRT = GROUTING
SPR = SITE SET UP/CLEAN UP
TST = TESTING
MOB = MOBILIZATION
WKB = WORK BREAK
WTR = FILL WATER TRUCK
SMP = SAMPLING
OTH: ____________________

EXC = EXCAVATING PITS
CLR = SITE ACCESS PREP.
HYD = HYDROPUNCH
GPB = GEOPROBE
SRV = SURVEYING
WRH - WELL REHABILITATION
ABN - WELL ABANDONMENT
DRM = MOVING DRUMS/TANKS

### ACTIVITIES - DRILLING

HSA = HOLLOW STEM AUGERING
MDR = MUD ROTARY
ARR = AIR ROTARY
RTF = ROTARY FLUSH
CBT = CABLE TOOL
REM = REAMING
DCD = DRILL THROUGH CASING DRIVER
DUR = DUAL ROTARY CASING DRIVER
COR = CORING
RVC = REVERSE CIRCULATION
DHH = DOWNHOLE HAMMER
DAW = DRIVE CASING & WASH
OTH: ____________________

### SAMPLING (TESTING) METHODS

SS/? = SPLIT SPOON SAMPLING
CS/? = CALIFORNIA SPLIT SPOON SAMPLING
(REPLACE ? WITH SAMPLING INTERVAL)
(C = CONTINUOUS, I = IRREGULAR)
CTS = CONTINUOUS TUBE SAMPLING
STS = SHELBY TUBE SAMPLING
COR = CORING
WTS = WATER SAMPLING
PKT = PACKER TESTING
BGP = BOREHOLE GEOPHYSICS
PMT = PUMPING TESTING
SGT = SLUG TESTING
OTH: ____________________

| SUPPORT SERVICES OR DRILLING/WELL SUPPLIES (TYPE & SIZE) | DATE | HOURS | QUANTITY | UNIT |
|---|---|---|---|---|
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GEOLIS Version 1.4 JAN 1995 G130195

Figure B-6

# GEOLIS Well Development Form

COMPANY: ____________________ LOCATION ID: ____________________
CLIENT: ____________________ DATE: ____________________
PROJECT: ____________________ MEASURED BY: ____________________
SITE/AREA: ____________________ SIGNATURE: ____________________

ONE WELL VOLUME: __________ gallons WELL TD: __________ ft TOC

| Well Volume (gallons/foot) | 2-inch = 0.16 | 6-inch = 1.47 |
|---|---|---|
| | 4-inch = 0.65 | 8-inch = 2.61 |

| TIME | ACTIVITY CODE | DEPTH TO WATER (ft) | PURGE RATE (gpm) | PURGE VOLUME (gal) | FIELD MEASUREMENTS | | | | TURBIDITY | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
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| | FINAL | | | | | | | | | |

FINAL WELL YIELD: __________ GPM PUMP RATE - ESTIMATED CORRESPONDING DRAWDOWN: ______ FT

**DEVELOPMENT ACTIVITY CODES**

| | |
|---|---|
| DBB - Begin Bailing | DBE - End Bailing |
| DOB - Begin Overpumping | DOE - End Overpumping |
| DRB - Begin Rawhiding | DRE - End Rawhiding |
| DCB - Begin Recirculation | DCE - End Recirculation |
| DHB - Begin Hydraulic Jetting | DHE - End Hydraulic Jetting |
| DAB - Begin Air Surging | DAE - End Air Surging |
| DSB - Begin Surge Blocking | DSE - End Surge Blocking |
| DXB - Begin Other | DXE - End Other |

Specify other method: ____________________
FMT - Field Measurements (select from codes at right)

**FIELD MEASUREMENT CODES**

MTP - Temperature
MSC - Specific Conductance
MPD - Photoionizer (e.g., HNu)
MFD - Flame Ionizer (e.g., OVA)
MDO - Dissolved Oxygen
MPH - pH
MEH - Eh
MMC - Imhoff Cone
MO1 - Other: __________
MO2 - Other: __________

**TURBIDITY**

Enter Turbidity Meter Reading (Final should be

OR

Enter Qualitative Observations

H - High: Opaque/Muddy/Silty
M - Medium: Translucent/Cloudy
L - Low: Transparent/Some Silt
N - None: Clear/No Visible Silt

GEOLIS Version 1.4 JAN 1995 G060195

Figure B-7

# GEOLIS® Notes Form

COMPANY: ______________________ LOCATION NO.: ______________________
PROJECT: ______________________ DATE: ______________________
PROPERTY: ______________________ LOGGER: ______________________
SITE/AREA: ______________________ SIGNATURE: ______________________

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GEOLIS Version 1.4 JAN 1995 G14A0994

Figure B-8

# GEOLIS® Sketches Form

COMPANY: __________
PROJECT: __________
PROPERTY: __________
SITE/AREA: __________

LOCATION NO.: __________
DATE: __________
LOGGER: __________
SIGNATURE: __________

GEOLIS Version 1.4 JAN 1995 G1480994

# GEOLIS® Notes and Sketches Form

COMPANY:

PROJECT:

PROPERTY:

SITE/AREA:

LOCATION NO.:

DATE:

LOGGER:

SIGNATURE:

GEOLIS Version 1.4 JAN 1995 G14A0994

**Figure B-10**

# GEOLIS® Soil/Sediment Sampling Form

COMPANY:
PROJECT:
PROPERTY:
SITE/AREA: /
LOCATION ID:
DATE:
SAMPLER:
SIGNATURE:

| | ESTIMATED / GPS | SURVEYED |
|---|---|---|
| SURFACE ELEVATION: | | |
| N. COORDINATE: | | |
| E. COORDINATE: | | |

LOCATION TYPE: SSS - SED - BOR - PIT - OTH:
GRID COORD.: / GRID ID: NA
GROUND SLOPE: FLT - SLI - MOD - STP - NA
WATER BODY/SOIL SERIES NAME:

WATER TYPE: LAK - PND - EST - RVR - STP - STI - LAG - PIP - CHN - WET
NA - OTH: FLOW: FLD - FUL - LOW - POO - DRY - NA
WATER DEPTH: FT-M BMP VELOCITY: NON - LOW - MOD - HGH

## SITE SKETCH

N

## SAMPLING INFORMATION

SAMPLE ID:
COLLECTION TIME (24:00): :
SAMPLE DEPTH INTERVAL: TO FT-M BGS
SAMPLE TYPE: DISCRETE - COMPOSITE - OTH:
PURPOSE: BKG - RSK - GEO - EXP - CHR - REM - OTH:
ASSOCIATED WATER SAMPLE ID:
SAMPLING METHOD: TRL - SPT - BLP - DRG - BUC - SPS - CSS - STS
CUT - CTS - COR - OTH:
SAMPLER DECONTAMINATION: DED - LAB - FLD - NON
(1)DET - (2)STM - (3)ACE - (4)HEX - (5)MET - (6)DIW - (7)POT - (8)NO3
(9)OTH: SEQUENCE:
SAMPLING PROCEDURES USED: NON - SAP/QAPP - SOP - OTH
REFERENCE:
CHAIN-OF-CUSTODY No.:
QA SAMPLES: MS/MSD SAMPLE COLLECTED: YES - NO
DUPLICATE ID:
TRIP BLANK ID:
AMBIENT/RINSE BLANK ID:

## SAMPLE DESCRIPTION

MATERIAL: NAT - FIL - PRD - SDG - UNC - OTH:
ODOR: NOR - SEW - PET - CHM - ANB - NON - OTH:
SHEEN/STAIN (2): NON - SLI - MOD - HVY PET - IRN - BAC - OTH
INST. 1 TYPE: READING: UNITS:
INST. 2 TYPE: READING: UNITS:
SURFACE LAYER: SOL - GRS - LVS - VEG - GVL - ASP - CMT - FIL
OTHER:
THICKNESS (IN/CM): REMOVED - SAMPLED

SECONDARY TYPE: NA - BED - CLS - MIX
OVERALL COLOR: MUN - GSA - NON WET - DRY
CODE:
COLORATION: UNI - STN - MOT - VAR

| TEXTURE: | % C - M - F - VF | | SECONDARY |
|---|---|---|---|
| GRAVEL: | | % | % |
| SAND: | | % | % |
| SILT: | | % | % |
| CLAY: | | % | % |
| ORGANIC: | | % | % |

ROUNDNESS:
GRAVEL: FAC - ANG - SBA - SBR - RND - NA
SAND: ANG - SBA - SBR - RND - NA
SORTING: BIM - WEL - MOD - POR - NA
PLASTICITY: NON - LOW - MOD - HGH - NA
MOISTURE: DRY - MST - WET - SAT
STRENGTH: NONCOHESIVE: LSE - FIR - DEN - VDN
COHESIVE: VSF - SFT - FRM - STF - VST - HRD

## ANALYTICAL PARAMETERS

| | | LAB NAME |
|---|---|---|
| CHM: VOC - BNA - PES - PCB - HRB - PHE - TOC - TPH - MET - OTH: | | |
| CHM: VOC - BNA - PES - PCB - HRB - PHE - TOC - TPH - MET - OTH: | | |
| TCLP: VOC - BNA - PES - HRB - MET - OTH: | | |
| RAD/OTH: GAL - GBT - GGM - SAL - TRT - ASB - OTH: | | |
| GEOTECH: GRA - SPG - ATL - POR - PRM - CON - CMP - SHR - OTH: | | |

SPLIT SAMPLES: NON - CLI - OWN - OVR - OTH:
SPLIT SAMPLE ID NO.:
ORGANIZATION NAME:
PARAMETERS: SAME - OTHER:
REPRESENTATIVES NAME:
QA/QC SAMPLES: NON - DUP - RNS - TRP - MSD

COMMENTS:

GEOLIS Version 1.4 JAN 1995 G100994T

Figure B-11

# GEOLIS ® Soil Boring Sampling Form

COMPANY:
PROJECT:
PROPERTY:
SITE/AREA: /

LOCATION ID:
DATE:
SAMPLER:
SIGNATURE:

## SAMPLING INFORMATION

SAMPLER DECONTAMINATION: DED - LAB - FLD - NON
(1)DET - (2)STM - (3)ACE - (4)HEX - (5)MET - (6)DIW - (7)POT - (8)NO3
(9)OTH: - (10)OTH:
SEQUENCE: ☐☐☐☐☐☐☐☐☐☐
SAMPLING PROCEDURES USED: NON - SAP/QAPP - SOP - OTH
REFERENCE:
CHAIN-OF-CUSTODY No.:

QA SAMPLES: MS/MSD SAMPLE COLLECTED: YES - NO
DUPLICATE ID: ☐
TRIP BLANK ID: ☐
RINSE BLANK ID: ☐
☐

| SAMPLE ID | COLLECTION TIME (24:00) | DEPTH INTERVAL FT/M BGS | | SAMPLE TYPE | SAMPLE PURPOSE | SAMPLING METHOD | ANALYTICAL PARAMETER CODES OR SET No. |
|---|---|---|---|---|---|---|---|
| | : | | | DIS - CMP | | | |
| | : | | | DIS - CMP | | | |
| | : | | | DIS - CMP | | | |
| | : | | | DIS - CMP | | | |
| | : | | | DIS - CMP | | | |
| | : | | | DIS - CMP | | | |
| | : | | | DIS - CMP | | | |
| | : | | | DIS - CMP | | | |
| | : | | | DIS - CMP | | | |
| | : | | | DIS - CMP | | | |

SAMPLING METHOD:
SPS - CSS - STS - CUT - CTS - COR - OTH:

SAMPLE PURPOSE:
BKG - RSK - GEO - EXP - CHR - REM - OTH:

## ANALYTICAL PARAMETERS

| SET | | LAB NAME |
|---|---|---|
| #1 | VOC - BNA - PES - PCB - HRB - PHE - TOC - TPH - MET - OTH: | |
| #2 | VOC - BNA - PES - PCB - HRB - PHE - TOC - TPH - MET - OTH: | |
| #3 | VOC - BNA - PES - PCB - HRB - PHE - TOC - TPH - MET - OTH: | |
| #4 | TCLP: VOC - BNA - PES - HRB - MET - OTH: | |
| #5 | RAD: GAL - GBT - GGM - SAL - TRT - OTH: | |
| #6 | GEOTECH: GRA - SPG - ATL - POR - PRM - CON - CMP - SHR - OTH: | |

SPLIT SAMPLES: NON - CLI - OWN - OVR - OTH:
ORGANIZATION NAME:
REPRESENTATIVES NAME:

SPLIT SAMPLE ID NO.: ☐
PARAMETERS: SAME - OTHER:
QA/QC SAMPLES: NON - DUP - RNS - TRP - MSD

COMMENTS:

GEOLIS Version 1.40 JAN 1995 G110195

Figure B-12

# GEOLIS® Test Pit Logging Form

COMPANY:
CLIENT:
PROJECT:
SITE/AREA:

LOCATION ID:
DATE:
LOGGER:
SIGNATURE:

SOIL SERIES:

PARENT MATERIAL: ALL - RES - COL - LOS - OTHER:

SOIL DRAINAGE CLASS: VPD - PRD - SPD - MWD - WLD - SED - EXD

PROPOSED USE:

LIMITING ZONE:
TYPE: BED - MOT - FRG - HCF - WAT - NON
DEPTH:

TOTAL DEPTH FT-M

DEPTH DETERMINED BY: PRU - WAT - CFR - MRB - OTH

DEPTH TO STANDING WATER: FT-M

WATER ENTRY ZONES

| DEPTH FT/M BGS | FLOW RATE GPM/LPM | WALL |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

SOIL HORIZON No.:

SOIL HORIZON INTERVAL: TO FT-M BGS

HORIZON DESIGNATION:

MATERIAL: NATURAL - FILL - UNCERTAIN

APPEARANCE: SHN - ODR - PRD - NA - OTHER:

INSTRUMENT 1 TYPE: READING:

INSTRUMENT 2 TYPE: READING:

| SAMPLE ID | INTERVAL (FT-M BGS) | TIME | | PARAMETERS |
|---|---|---|---|---|
| | - | | TYPE: SMP - COL - SPL - RNS - LCS - OTH<br>DESTINATION: CHM - RAD - GEO - ARC - OTH | |
| | - | | TYPE: SMP - COL - SPL - RNS - LCS - OTH<br>DESTINATION: CHM - RAD - GEO - ARC - OTH | |

SECONDARY TYPE: NA - BED - CLS - MIX

OVERALL COLOR:
MUN - GSA WET - DRY

COLORATION: UNI - STN - MOT - VAR

DRAINAGE MOTTLING: NONE
INTERVAL: TO FT/M BGS
ABUNDANCE: FEW - CMN - MNY
CONTRAST: FNT - DIS - PRM
COLOR: HIGH CHROMA:
LOW CHROMA:
50/50 MATRIX: YES - NO

PEDON STRUCTURE:
TYPE: PLT - PRS - COL - BLK - ABK
SBK - GRN - SGR - MAS
GRADE: SLI - WEK - MOD - STR
DRY CONSISTENCE: LSE - SFT - SLH
HRD - VHD - EHD
MOIST CONSISTENCE: LSE - VFB - FRB
FRM - VFM - EFM

TEXTURE:

| | | SECONDARY |
|---|---|---|
| COARSE MATERIAL: | % | % |
| SAND: C - M - F | % | % |
| SILT: | % | % |
| CLAY: | % | % |
| ORGANIC: | % | % |

GRAPHIC LOG

COARSE FRAGMENTS:
ROUNDED: GRA - COB - STN - BLD
FLAT: CHN - FLG - STN - BLD

ROUNDNESS:
GRAVEL: FAC - STR - ANG - SUB - RND - NA
SAND: ANG - SUB - RND - NA

SORTING: WEL - MOD - POR - NA
PLASTICITY: NON - LOW - MOD - HGH - NA
MOISTURE: DRY - MST - WET - SAT
CEMENTATION: NON - SLT - MOD - WEL
GRAIN TYPE: QTZ - FRG - FOS - NA
MATRIX: CAL - OXD - ARG - SIL - NA

STRENGTH:
NONCOHESIVE DNS - FRM - LSE
COHESIVE STF - FRM - SFT - HRD

LOWER CONTACT:
DISTINCTNESS: ABT - CLR - GRD - DIF
TOPOGRAPHY: SMT - WVY - IRR - DIS

BEDDING:
THICKNESS: IN/CM
NUMBER:
TYPE: XBD - RPL - HOR - INC - NA
MAS - LNS - LAM - GRU - GRD

SECONDARY

STRAT UNIT:

NOTE LINE :

COMMENTS:

GEOLIS Version 1.4 JAN 1995 G040195

# GEOLIS® Water Level Form

**Figure B-13**

COMPANY: ______________________
CLIENT: ______________________
PROJECT: ______________________
SITE/AREA: ______________________

LOCATION ID: (SEE FIRST COLUMN ON THE LEFT)
DATE: ______________________
MEASURED BY: ______________________
SIGNATURE: ______________________

| LOCATION ID | TIME | DEPTH TO WATER (ft) | DEPTH TO PRODUCT (ft) | DEPTH TO BOTTOM (ft) | BOTTOM CONDITION CODE | LEVEL STATUS CODE | LOCATION TYPE CODE | MEASURING POINT CODE | FIELD MEASURE. CODE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
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COMMENTS: ______________________

**LOCATION TYPE CODE**

BUC - UNCASED BORING
WOH - OPEN HOLE WELL
WSC - SCREENED WELL OR PIEZOMETER
TPO - OPEN TEST PIT
STR - RIVER/STREAM
SPR - SPRING/SEEP
OTH - ______________

**LEVEL STATUS CODE**

STA - STATIC
WDV - DURING DEVELOPMENT
PPR - POST PURGE
TPP - PUMP TEST/PUMPED WELL
TPO - PUMP TEST/MONITOR WELL
TSR - SLUG TEST/RISING HEAD
TSF - SLUG TEST/FALLING HEAD
TAP - PACKER TEST/PUMPED ZONE
TAO - PACKER TEST/OBSERVED ZONE
OTH - ______________

**MEASUREMENT POINT CODE**

TIC - TOP OF INNER CASING
TOC - TOP OF OUTER CASING
ELM - ELEVATION MARKER
GRS - GROUND SURFACE
OMP - OTHER: ______________

**BOTTOM CONDITION CODE**

FRM - FIRM BOTTOM
SFT - SOFT BOTTOM
DRY - DRY BOTTOM, NO WATER

**FIELD MEASUREMENT CODE**

MTP - TEMPERATURE
MSC - SPECIFIC CONDUCTANCE
MPD - PHOTOIONIZER (e.g., HNu)
MFD - FLAME IONIZER(e.g., OVA)
MDO - DISSOLVED OXYGEN
MPH - pH
MEH - Eh
MO1 - Other: ______________
MO2 - Other: ______________

GEOLIS Version 1.4 JAN 1995 G080195

**Figure B-14**

# *GEOLIS® Well Purging Form*

COMPANY:
CLIENT:
PROJECT:
SITE / AREA:
LOCATION ID:
DATE:
SAMPLER:
SIGNATURE:

## WELL OBSERVATIONS

CASING & LID: OK - DAMAGED - HEAVED - NO LID LOCKED: YES - NO KEY NO: STICKUP: FT-M

WELL DIAMETER: 2" - 4" - 6" - 8" - OTH: BOREHOLE DIAMETER: IN-CM MEASURING POINT: TIC - TOC - GRS

VAPOR READINGS: PID - FID - OTHER: BACKGROUND: INSIDE WELL:

CHECKED FOR NAPL LAYER: YES - NO OBSERVED: NON - FLT - SNK THICKNESS: IN-CM SHEEN: YES - NO

## PURGING CALCULATIONS

(A) DEPTH TO WELL BOTTOM: FT-M BMP
(B) DEPTH TO WATER: FT-M BMP
(C) SAND PACK LENGTH FT-M
(D) WATER COLUMN HEIGHT (A - B): FT-M
(E) CASING VOLUME FACTOR: GPF-LPM
(F) SAND PACK VOLUME FACTOR: GPF-LPM
(G) CASING VOLUME (D x E): GAL-L
(H) SAND PACK VOLUME (C x F): GAL-L

Casing Factor (GPF for inches) = 0.041(Well Diameter)$^2$
2" = 0.16; 4" = 0.65; 6" = 1.47; 8" = 2.61 GPF

Sand Pack Factor (GPF for inches)
= [0.041(Hole Diameter)$^2$ - 0.041(Well Diameter)$^2$] 0.45

(I) TOTAL WELL VOLUME (G + H): GAL-L
(J) VOLUMES TO BE PURGED:
(K) TOTAL PURGE VOLUME (I x J): ☐ GAL-L

## PURGING INFORMATION

PURGE ENDPOINT: VOLUME - TIME - PARAMETER STABILIZATION - TURBIDITY CRITERIA:

PURGING METHOD: BAILER - SUB. PUMP - CENT. PUMP - PACKER & PUMP - OTHER:

DEVICE DESCRIPTION: DEVICE No.:

PUMP/BAILER INTAKE: SCREEN TOP - SCREEN/WELL BOTTOM - MID SCREEN/WELL - WATER LEVEL - MOVED UP/DOWN

PURGE WATER: DISCHARGED - TREATED - STORED ONSITE STORED IN: TANKS - DRUMS NO.:

FIELD MEASURMENTS IN: FLOW THRU CHAMBER - OPEN JAR CASCADING WATER: YES - NO DEPTH: FT-M BMP

WELL PURGING INTERVAL: TO FT-M BMP PURGE DEPTH TO WATER (MAX): FT-M BMP

| TIME | DEPTH TO WATER (FT-M BMP) | PURGE RATE or VOLUME (GPM-GAL) | TURBID -ITY (NTU) | FIELD MEASUREMENTS AND UNITS | | | | | | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MTP | | | | | | |
| | | | | °C. | | | | | | |
| | | | | | | | | | | Pre Purge Readings |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | Post Purge Readings |

TOTAL PURGE TIME: HRS TOTAL PURGE VOLUME: GAL - L RECOVERY: FAST - SLOW - V.SLOW

### FIELD MEASUREMENT CODES

MTP - Temperature (°C.)
MSC - Specific Conductance (mS/cm)
MPD - Photoionizer (e.g., HNu)
MFD - Flame Ionizer (e.g., OVA)
MCL - Color
MPH - pH
MEH - Eh
MAL - Alkalinity
MDO - Dissolved Oxygen (mg/L)
MO1 - Other:
MO2 - Other:
MO3 - Other:
MD1 - DTW in Well
MD2 - DTW in Well
MD3 - DTW in Well
MD4 - DTW in Well

GEOLIS VERSION 1.4 JAN 1995 G070794

**Figure B-15**

# GEOLIS® Water Sampling Form

COMPANY: ____
PROJECT: ____
PROPERTY: ____
SITE/AREA: ____ / ____
LOCATION ID: ____
DATE: ____
SAMPLER: ____
SIGNATURE: ____

## SITE SKETCH

|  | ESTIMATED/GPS | SURVEYED |
|---|---|---|
| SURFACE ELEVATION: | ____ | ____ |
| N. COORDINATE: | ____ | ____ |
| E. COORDINATE: | ____ | ____ |

WELL PERMIT No.: ____
MEASURING POINT: TOC - TSG - WAT - OTH: ____

## SAMPLING INFORMATION

SAMPLE ID: ☐

| | | | |
|---|---|---|---|
| COLLECTION TIME (24:00) | : | DURATION HRS:MIN | : |
| SAMPLE DEPTH FT-M BMP | | SAMPLING QTR/ROUND | |

SAMPLE PURPOSE: BKG - SCR - RSK - RND - SDW - CON - OTH: ____
SAMPLE TYPE: DISCRETE - COMPOSITE - OTHER: ____
SAMPLING METHOD:
GROUNDWATER: BLO - BLC - PSB - PPR - PCN - PBL - NLF - MLS
SURFACE WATER BOT - KEM - BCB - SCP - TGS
OTHER: ____
SAMPLER DECONTAMINATION: DED - LAB - FLD - NON
(1)DET - (2)STM - (3)ACE - (4)HEX - (5)MET - (6)DIW - (7)POT - (8)NO3
(9)OTH: ____ SEQUENCE: _ _ _ _ _ _ _ _ _
SAMPLING PROCEDURES USED: NON - SAP/QAPP - SOP - OTH
REFERENCE: ____
QA SAMPLES: MS/MSD SAMPLE COLLECTED: YES - NO
DUPLICATE ID: ☐
TRIP BLANK ID: ☐
AMBIENT - RINSE BLANK ID: ☐
CHAIN-OF-CUSTODY No.: ____
48 HOUR PRECIPITATION: NON - LTE - MOD - HVY
CUR - 8 - 16 - 24 - ____ HOURS PRIOR TO SAMPLING
WELL PURGE RECOVERY: ____ % OF INITIAL WATER LEVEL

## SAMPLE DESCRIPTION

GROUNDWATER WOS - WBS - WBO - SUP - RES - BOR - HYD - SPR
SEP - PIT - SMP - OTH: ____
SURFACE WATER: TAL - LAK - PND - RVM - RVB - RVS - STP - STI - WET
OUB - INB - LAG - PIP - SWR - CUL - CHN - DCH - OTH: ____
SAMPLED: WATER - NAPL/PRODUCT - OTH: ____
WATER BODY/FORMATION NAME: ____
FLOW: FLD - FUL - LOW - POO - DRY - NA WIDTH: ____ FT-M
DEPTH: ____ FT-M VELOCITY: ____ FT/S-M/S
VELOCITY METHOD: MMB - PYG - DYE - OBJ - EST
WATER COLOR: CLR - LBN - MBN - DBN - TUR - GRE - STN
NAPL LAYER PRESENT: NO - FLT - SNK
THICKNESS ____ IN-CM SHEEN: YES - NO
DESCRIPTION ____

| FIELD PARAMETERS: | UNITS | BEFORE | AFTER |
|---|---|---|---|
| TIME | 24:00 | | |
| WATER LEVEL (BMP) | FT-M | | |
| TEMPERATURE | | | |
| SP. CONDUCTANCE | | | |
| pH | | | |
| Eh | | | |
| DISS. OXYGEN | | | |
| PID / FID | | | |
| ALKALINITY | | | |
| TURBIDITY | | | |
| FERROUS IRON (Fe2+) | | | |
| CARBON DIOXIDE (CO2) | | | |

| ANALYTICAL PARAMETERS | | LAB NAME |
|---|---|---|
| CHM: VOC - BNA - PES - PCB - HRB - PHE - TOC - UMT - FMT - ION - SOL - INO - OTH: | ____ | ____ |
| CHM: VOC - BNA - PES - PCB - HRB - PHE - TOC - UMT - FMT - ION - SOL - INO - OTH: | ____ | ____ |
| RAD/OTH: GAL - GBT - GGM - SAL - TRT - ASB - OTH: | ____ | ____ |

SPLIT SAMPLES: NON - CLI - OWN - OVR - OTH: ____
ORGANIZATION NAME: ____
REPRESENTATIVES NAME: ____
SPLIT SAMPLE ID NO.: ☐
PARAMETERS: SAME - OTHER: ____
QA/QC SAMPLES: NON - COL - RNS - TRP - MSD

COMMENTS: ____

GEOLIS Version 1.4 JAN 1995 G090994T

**Figure B-16**

# SAMPLE ATTRIBUTE FORM

**LOCATION ID**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

| | |
|---|---|
| **GPS:** ☐ Yes<br>☐ No | GPS Comment: |

**Location Description Codes (circle one)**

| | | | |
|---|---|---|---|
| BB | Soil Boring – TD in Bedrock | MUA | Monitoring Well – Screens Upper Alluvium |
| BF | Soil Boring – TD in Fill | MW | Monitoring Well – Screens Water Table |
| BG | Soil Boring – TD in Glacial Till | MWT | Monitoring Well – Screens Water Table and Till |
| BL | Soil Boring – TD in Lower Alluvium | PW | Public/Residential Well |
| BM | Soil Boring – TD in Middle Alluvium | RW | Recovery Well |
| BT | Soil Boring – TD in Top of Till | SF | Surface/Shallow Soil – Floodplain |
| BU | Soil Boring – TD in Upper Alluvium | SP | Surface/Shallow Soil – Paved/Covered |
| BW | Soil Boring – TD at Water Table | SR | Surface/Shallow Soil – Riverbank |
| DL | Sediment – Lake or Pond | SU | Surface/Shallow Soil – Unpaved |
| DO | Sediment – at Sewer/Pipe Outfall | TB | Tissue Sample – Brain |
| DR | Sediment – River/Stream | TF | Tissue Sample – Fillet |
| MB | Monitoring Well – Screens Bedrock | TL | Tissue Sample – Liver |
| MFW | Monitoring Well – Screens Fill and Water Table | TO | Tissue Sample – Offal |
| MG | Monitoring Well – Screens Within Till | TR | Tissue Sample – Breast |
| MLU | Monitoring Well – Screens Lower Alluvium | TW | Tissue Sample – Whole Body |
| MMA | Monitoring Well – Screens Middle Alluvium | WS | Surface Water Sample |
| MT | Monitoring Well – Screens Top of Till | WSD | Surface Water Suspended Sediment Sample – Multiple Depths |

**Physical Location Description (e.g., Riverbank: Top of Slope)**

| Field Sample ID(s) | | | | Depth<br>(in Tenths of Feet) | | |
|---|---|---|---|---|---|---|
| *Site* | *Location ID* | *QC type* | *Start Depth or Date collected* | *Starting* | *Ending* | **If the Sample is Split:** |
| ___ ___ - | ___ ___ ___ ___ ___ ___ ___ ___ ___ | - ___ - | ___ ___ ___ ___ ___ | _____ | _____ | **Split To:** |
| **Comments: (e.g., refusal below this depth)** | | | | | | **Split Sample ID:** |
| ___ ___ - | ___ ___ ___ ___ ___ ___ ___ ___ ___ | - ___ - | ___ ___ ___ ___ ___ | _____ | _____ | **Split To:** |
| **Comments:** | | | | | | **Split Sample ID:** |
| ___ ___ - | ___ ___ ___ ___ ___ ___ ___ ___ ___ | - ___ - | ___ ___ ___ ___ ___ | _____ | _____ | **Split To:** |
| **Comments:** | | | | | | **Split Sample ID:** |
| ___ ___ - | ___ ___ ___ ___ ___ ___ ___ ___ ___ | - ___ - | ___ ___ ___ ___ ___ | _____ | _____ | **Split To:** |
| **Comments:** | | | | | | **Split Sample ID:** |
| ___ ___ - | ___ ___ ___ ___ ___ ___ ___ ___ ___ | - ___ - | ___ ___ ___ ___ ___ | _____ | _____ | **Split To:** |
| **Comments:** | | | | | | **Split Sample ID:** |
| ___ ___ - | ___ ___ ___ ___ ___ ___ ___ ___ ___ | - ___ - | ___ ___ ___ ___ ___ | _____ | _____ | **Split To:** |
| **Comments:** | | | | | | **Split Sample ID:** |

| Relinquished By | Received By | Date | Time |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

Figure B-17

**WESTON**®
MANAGERS DESIGNERS/CONSULTANTS

## FIELD ACTIVITY SUMMARY SHEET

*Client*:

*Project*:

*WO No.*:

*Prepared by*:

*Date*:

*Location*:

*Activity*:

*Weston Personnel*:

*Other Personnel*:

*Summary*:

*Deviations from Workplan/Concerns*:

*Sketch or ArcView Map*:

N
↑

*Samples Collected*:

*Photos*:

*GE/WESTON Split Sample IDs:*

LOCATION ID: ______________________
LOC TYPE: ______________________
LOC REASON: ______________________
SITE: ______________________

DRILLING COMPANY: ______________________
DRILLER'S NAME: ______________________
DRILLING METHOD & SIZE: ______________________
SAMPLING METHOD & DIAM: ______________________

START / END DATE: ______________________
LAB SAMPLE ID PREFIX: ______________________
BOREHOLE TOTAL DEPTH (ft): ______________________
DEPTH TO WATER (ft): ______________________

| DEPTH (ft) | SAMPLE & RECOVERY INTERVALS | RECOVERY (in / in) | BLOW COUNT | PID / FID (ppm) TYPE: ____ | NAPL SHOW OIL/SHEEN/ODOR | LAB SAMPLE ID SUFFIX & INTERVAL | LAB SAMPLE ANALYTE SUITE | GEOLOGIC COLUMN | LITHOLOGIC DESCRIPTION AND SAMPLING OBSERVATIONS | WELL / BORING CONSTRUCTION |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 0 | | | | | | | | | | |

WESTON
MANAGERS DESIGNERS/CONSULTANTS

CLIENT: ______________________
PROJECT:

COMPANY: ______________________
OVERSIGHT BY:

**OVERSIGHT BORING LOG**
Page ___ of ___

OversightBoringLog.ai - 9/5/00

Figure B-18

# Oversight
# Field Activity Checklist

**Date:** ____________________

**Name(s) of Oversight Personnel:** ____________________________________________________

**Name(s) & Company of GE Field Crew:** ______________________________________________

**Field Activities Observed:** ____________________________________________________________

**Location(s):** ________________________________________________________________________

Questions that are **bolded** are taken from the GE SAP. These should be answered in the affirmative. Non-bolded questions and comments appear as guidance for EPA field observers. When observing multiple events - even if only one of many instances was non-compliant, record the observation as non-compliant and discuss the details on the Comment lines.

## General Field Check List

1. Y☐N☐NA☐ Have sampling locations been changed by weather within the last 24 hours? (i.e., erosion/deposition)
2. Y☐N☐NA☐ **Were a copies of the GE SAP, WP and a site plan with proposed boring/well locations available on site?**
3. Y☐N☐NA☐ **Have each of the GE samplers signed off on the H&S and WP?**
4. Y☐N☐NA☐ **Was sampling equipment properly cleaned and calibrated?**
5. Y☐N☐NA☐ Were calibrations recorded?
6. Y☐N☐NA☐ Was each field measurement tool coded or numbered? Were the codes recorded with the sample in the field notebook?
7. Y☐N☐NA☐ Have Safety Zones and local decon areas been properly set-up?
8. Y☐N☐NA☐ Was field equipment (sampling tools, well casing, sample jars, decon water) stored in a clean, secured location overnight…away from exhaust fumes, decon fluids, and fuel (volatiles)?
9. Y☐N☐NA☐ Was decon/rinse water from an acceptable source and have appropriate samples been taken to assure its quality?
10. Y☐N☐NA☐ Were decon/rinse water sources recorded?
11. Y☐N☐NA☐ Periodically visit the central decon area to observe decon processes. Were proper decon procedures followed?
12. Y☐N☐NA☐ Were photos being taken of the sampling/drilling activities? Photos should electronically capture time and date and descriptions of each photo should be entered into the field notebooks.
13. Y☐N☐NA☐ Were field forms and field notebooks being checked and secured on a daily basis?

**Comments:** ________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

## Well Installation and Development     Not Applicable☐

1. Y☐N☐ **Was all well installation equipment and materials (including the rig) properly deconned?**
2. Y☐N☐ Were wells developed to their total, finished depth?
3. Y☐N☐ Was the sand pack and bentonite seal tremie fed (rather than gravity fed) into the hole?
4. Y☐N☐ Was development done immediately after installation or after 24 - 48 hours?

# Oversight
# Field Activity Checklist

5. Y☐N☐ Was the development pump located above the screened interval?
**6.** Y☐N☐ **Were quantities of sand, bentonite and cement used in well construction being recorded per hole?**
7. Y☐N☐ Were depth measurements being taken around the entire circumference of the borehole annulus when determining sand and/or bentonite levels?
8. Y☐N☐ Was a different sand pack size/mix used in wells based in different lithologic material types? (tills vs. outwash?)
**9.** Y☐N☐ **Were well construction figures or tables available for determining mid-screen pump placement?**
**10.** Y☐N☐ **Were wells installed in accordance with the GE SAP and Work Plan?**

**Comments:** ____________________________________________

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**Groundwater Purging and Monitor Well Sampling**
**Low Flow Pump Method** Not Applicable☐

1. Y☐N☐ Was the well secure prior to and after sampling (i.e. padlocked or in a locked/gated area)?
2. Y☐N☐ Was the well surface seal in good condition prior to sampling?
3. Y☐N☐ Was well properly developed prior to sampling?
**4.** Y☐N☐ **Were well construction/depth and historic water level tables available on site?**
5. Y☐N☐ Was a total depth taken of the well to determine if it had silted up since installation?
**6.** Y☐N☐ **Was a low flow pump used to purge the well at 200 – 500 milliliters/minutes?**
**7.** Y☐N☐ **Was an appropriate volume of groundwater removed?**
**8.** Y☐N☐ **Were water level measurements taken and recorded before and after pump installation and at 2 – 5 minute intervals thereafter?**
**9.** Y☐N☐ **Was any drawdown recorded?**
**10.** Y☐N☐ **Was sample collected after field indicator parameters remained within 10% for 3 consecutive readings?**
**11.** Y☐N☐ **Was sample turbidity <50 NTU?**
**12.** Y☐N☐ **Were samples collected in proper order (VOC-TOC-SVOC-metals and cyanide, other)?**
**13.** Y☐N☐ **Was the sample collected before the any flow-thru-cell?**
**14.** Y☐N☐ **Were water levels taken after purging and after sampling to determine well response?**
**15.** Y☐N☐ **Was an after-sampling groundwater volume collected and tested for field indicator parameters?**
16. Y☐N☐ Were there any signs of NAPL or odor connected with the purge water prior or after sampling?
**17.** Y☐N☐ **Were samples collected from wells in order of increasing contamination? (If known)**
**18.** Y☐N☐ **Did equipment blanks include blanks of the pump and tubing?**
**19.** Y☐N☐ **Were equipment blanks taken after sampling wells with the highest concentrations (if known)?**
20. Y☐N☐ Were the proper numbers and types of QC samples collected?

**Comments:** ____________________________________________

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# Oversight
# Field Activity Checklist

## Groundwater Purging and Monitor Well Sampling
## Bailer Method Not Applicable☐

1. Y☐N☐ Was the well secure prior to and after sampling (i.e. padlocked or in a locked/gated area)?
2. Y☐N☐ Was the well surface seal in good condition prior to sampling?
3. Y☐N☐ Was well properly developed prior to sampling?
**4.** Y☐N☐ **Were well construction/depth and historic water level tables available on site?**
5. Y☐N☐ Was a total depth taken of the well to determine if it had silted up since installation?
**6.** Y☐N☐ **Was the bailer and rope properly deconned (wrapped in aluminum, plastic)?**
**7.** Y☐N☐ **Was the well properly surged/purged?**
**8.** Y☐N☐ **Was an appropriate volume of groundwater removed?**
**9.** Y☐N☐ **Was sample collected after field indicator parameters remained within 10% for 3 consecutive readings?**
**10.** Y☐N☐ **Were samples collected in proper order (VOC-TOC-SVOC-metals and cyanide, other)?**
**11.** Y☐N☐ **Was an after-sampling groundwater volume collected and tested for field indicator parameters?**
12. Y☐N☐ Were water levels taken after purging and after sampling to determine well response?
13. Y☐N☐ Were the proper numbers and types of QC samples collected?
14. Y☐N☐ Were there any signs of NAPL or odor connected with the purge water prior or following sampling?

**Comments:** ________________________________________

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## Surface Water Sampling Not Applicable☐

1. Y☐N☐ Were sampling devices properly deconned and packaged (wrapped in aluminum, plastic) prior to sampling?
**2.** Y☐N☐ **Were sampling locations identified on appropriate sampling log or field notebook?**
**3.** Y☐N☐ **Did sampling take place during a precipitation event (it shouldn't)?**
**4.** Y☐N☐ **Were samples collected from locations in a downstream to upstream order?**
**5.** Y☐N☐ **Were volatile samples collected directly from the water sampler to 40 ml vials?**
6. Y☐N☐ **Were samples collected in the proper order (VOC-TOC-SVOC-metals and cyanide, other)?**
7. Y☐N☐ Was the sample collected upstream of personnel entry point? (to avoid suspended sediments kicked up by entry)
**8.** Y☐N☐ **Were samples requiring filtration, filtered using a peristaltic pump, new tubing and a 0.45 micron filter? (PCB samples are to be filtered in the lab not the field)**
**9.** Y☐N☐ **Was water temperature (~1 ft below water surface) and ambient air temperature measured and recorded following sampling?**
**10.** Y☐N☐ **Was a peristaltic pump and new tubing used to collect samples at depth from ponds, lakes or impoundments?**
11. Y☐N☐ Were water level reference levels taken at the beginning and end of each day?
**12.** Y☐N☐ **Was the depth of water at the sampling location recorded?**
**13.** Y☐N☐ Were the proper numbers and types of QC samples collected?

**Comments:** ________________________________________

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# Oversight
# Field Activity Checklist

## Surface Soil Sampling Not Applicable☐

**1.** Y☐N☐ **Were grass, sod, leaves and/or dense root matter removed prior to sample collection?**
**2.** Y☐N☐ **Was PID screening done on sample splits?**
3. Y☐N☐ Was a sufficient quantity of sample recovered?
4. Y☐N☐ Were the proper numbers and types of QC samples collected?

**Comments:** ________________________________________

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## Sediment Sampling Not Applicable☐

1. Y☐N☐ Were water level reference levels taken at the beginning and end of each day?
**2.** Y☐N☐ **Was the depth of water above the sampling location recorded?**
3. Y☐N☐ Was a description of the river bottom (i.e., soft, gravelly, hard, mushy) collected?
4. Y☐N☐ Was the sample taken on a bar or terrace or in the thalwag of the channel?
5. Y☐N☐ Were any obstructions in the river (fallen trees, beaver dams) noted relative to the sampling point?
6. Y☐N☐ Did observations include changes in color (not just lithology), noticeable odors or visible product, staining and aggregate/colloidal materials present?
7. Y☐N☐ Are samples for all intervals or sampled intervals being archived for later reference?
8. Y☐N☐ Were photos being taken of cores for later reference?
**9.** Y☐N☐ **Were reconnaissance and/or sediment probing conducted prior to sediment sampling?**
**10.** Y☐N☐ **Were locations identified on air photos or maps prior to sampling?**
**11.** Y☐N☐ **Were sampling locations identified on appropriate sampling log or field notebook?**
12. Y☐N☐ Were all probing results recorded or just those associated with soft, penetrable deposits?
13. Y☐N☐ Were blank Lexon cores properly deconned and package prior to sampling?
**14.** Y☐N☐ **Was the top of the recovered core sample marked "top"?**
**15.** Y☐N☐ **Was the sample tube and cap properly labeled immediately after it was capped and sealed?**
**16.** Y☐N☐ **Was a sample label affixed to the tube immediately after collecting the sample?**
17. Y☐N☐ Was lithologic and bedding information on each core recorded on forms or in the field notebook? (samples are taken based on depth, not lithology type or bedding)
**18.** Y☐N☐ **Were saws, knives, scrapers and other implements involved with the extrusion and sample partitioning process properly deconned?**
**19.** Y☐N☐ **Were VOC samples placed immediately into the sample jars?**
20. Y☐N☐ Were the proper numbers and types of QC samples collected?

**Comments:** ________________________________________

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## Soil Boring Installation and Sampling Not Applicable☐

**1.** Y☐N☐ **Were soil samples collected at the intervals and depths prescribed in the GE WP?**
**2.** Y☐N☐ **Was ASTM sampling method D-1588 (split spoon sampling) followed (when appropriate)?**
3. Y☐N☐ Were split-spoon drop distances being maintained? (for standard 2-inch by 2 foot split spoon and 140 lb. Hammer).
4. Y☐N☐ Were representative samples collected at all locations?

# Oversight
# Field Activity Checklist

5. Y☐N☐ Was a sufficient quantity of sample recovered at each sampling interval for representative analytical samples? The GE analytical samples need to represent the entire sampling interval (i.e. 0-1, 1-3, 1-6, 6-10, 6-15, etc.). If GE sample recovery is too low (<50%) then the analytical samples may be biased.
6. Y☐N☐ **Were subsurface soil samples thoroughly and properly described?** Observations should include <u>changes</u> in color (not just lithology), noticeable odors or visible product, staining and whether aggregate materials are present.
**7.** Y☐N☐ **Was PID field screening done?**
**8.** Y☐N☐ **Were VOA samples selected based on the results of PID field screening tests?**
**9.** Y☐N☐ **Were Appendix IX +3 samples selected based on the results of PID and/or visual inspection (or proximity to the water table surface?**
10. Y☐N☐ Were the proper numbers and types of QC samples collected?
11. Y☐N☐ Were samples for all intervals or sampled intervals being archived for later reference?

**Comments:** ________________________________________________________

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## Soil Sample Compositing Not Applicable☐

1. Y☐N☐ Was compositing of soils done in accordance with the GE SAP?
**2.** Y☐N☐ **Were representative soil samples from individual depth increments collected and screened with a PID?**
**3.** Y☐N☐ **Was the discrete soil sample depth interval with the highest PID reading sent for Appendix IX +3 VOC analysis?**
4. Y☐N☐ Were any samples archived for later examination or physical testing?
5. Y☐N☐ Were the proper numbers and types of QC samples collected?

**Comments:** ________________________________________________________

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## NAPL Soil Sampling Not Applicable☐

1. Y☐N☐ If product (NAPL) is suspected in an interval being sampled, were samples collected? By what procedure? Was a shake test or another field procedure used to discern whether the product was an LNAPL or DNAPL?
2. Y☐N☐ Are field instruments checked and calibrated on a regular basis (at least twice a day)?
3. Y☐N☐ Is GE doing any kind of NAPL test whenever the top of the water table or a confining unit is encountered?
4. Y☐N☐ In soil samples where NAPL was suspected was the sample headspace screened and a shake test performed in addition to a visual examination?
5. Y☐N☐ Were the proper numbers and types of QC samples collected?
6. Y☐N☐ When NAPL was detected, were soil/NAPL analytical samples collected for analysis?

# Oversight
# Field Activity Checklist

**Sample Documentation, Handling, Packaging and Shipping** Not Applicable☐

1. Y☐N☐ Were appropriate containers used for samples?
**2.** Y☐N☐ **Were samples kept at 4 degrees centigrade after being collected?**
3. Y☐N☐ Were sample containers stored, labeled and properly handled/packed and shipped?
**4.** Y☐N☐ **Was a Chain or Custody form made out for the samples?**
5. Y☐N☐ **Were appropriate and pertinent field details and descriptions recorded on field forms and in field notebooks?**
6. Y☐N☐ Were proper custody procedures followed? The samples were never left unsecured during the day.

**Comments:** ______________________________

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**Problems, Issues & Non-compliance:** ______________________________

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# APPENDIX C

# STANDARD OPERATING PROCEDURES

# TABLE OF CONTENTS – APPENDIX C

# TABLE OF CONTENTS – APPENDIX C
# (Continued)

# STANDARD OPERATING PROCEDURE G-1

# CALIBRATION OF FIELD SCREENING INSTRUMENTS

# STANDARD OPERATING PROCEDURE G-1

# CALIBRATION OF FIELD SCREENING INSTRUMENTS

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) presents the procedures for the calibration of various field instruments used for screening purposes. The field equipment must be properly calibrated, charged, and in good general working condition prior to the start of each workday.

All field instruments will be appropriately protected against inclement weather during the field investigation. Each instrument is especially designed to maintain its operating integrity during variable temperature ranges representative of those that will be encountered at the site. At the end of each workday, all field equipment will be stored in a cool, dry room. Prior to the start of work each day, the Equipment Manager will inspect all equipment for fluid leaks. If a leak is detected, the equipment will be removed from service for repair or replacement, and the action will be documented in a field logbook.

This procedure outlines the technical requirements and operational use of the field instruments that will be used for air, soil, and water monitoring during field screening and characterization activities. This section addresses standard operating procedures associated with the following air monitoring instruments:

- HNu PI101/MicroTip photoionization detectors.
- Organic vapor analyzer (OVA).
- Combustible gas indicator (CGI)/oxygen detector.
- Colorimetric detector tubes/Draeger bellows pump.
- Miniram aerosol monitor.
- Monitor detectors.

Instrument checklists for each air monitoring instrument are included at the end of this appendix.

## 2. EQUIPMENT

See methods discussed in Sections 4 and 5.

## 3. RELATED PROCEDURES

G-2 Decontamination

## 4. AIR MONITORING EQUIPMENT

### 4.1 HNU PHOTOIONIZATION ANALYZER AND MICROTIP

The HNu photoionization analyzer and MicroTip are designed to measure the concentrations of trace gases in air. These analyzers employ the principle of photo-ionization for detection. A sensor, consisting of a sealed ultraviolet light source, emits photons that are energetic enough to ionize many chemical agents, particularly organics. In general, the HNu will be calibrated as follows:

- Identify the type of lamp being used to determine the relative value of the calibration gas.
- Turn instrument switch to the standby position and check the electronic zero.
- Adjust the zero point with the Zero control.
- Set the function switch in the 0- to 200-ppm range.
- Connect the probe to one end of the calibration humidifier and the calibration gas to the other end.
- Open the valve on the pressured calibration container until a slight flow is indicated. The instrument will draw in the volume required for detection.
- Adjust the span potentiometer so that the instrument is reading the relative value of the calibration gas as determined by the type of probe. This will be done only if the instrument fails to read the calibration gas value labeled on the side of the Cal Gas Cylinder.
- Record on the provided form all original and readjusted settings as specified by the form.
- Calibration on the 0- to 200-ppm range allows for a linear response in the 0- to 20-ppm range; thus, a separate calibration is not required.
- If the span setting resulting from calibration is 0.0 or if calibration cannot be achieved, then the lamp must be cleaned.

- When the observed readings are within the required tolerances, the instrument is fully calibrated.

The HNu instrument will be calibrated daily.

The MicroTip must be calibrated for it to display concentration in units equivalent to parts per million. First, a supply of zero gas, which contains no ionizable gases or vapors, is used to set MicroTip's point. Then, span gas containing a known concentration of an ionizable gas or vapor is used to set the response factor.

Usually clean, outdoor air is a suitable zero gas. If there is any doubt, use a commercial source of zero-grade gas and a second sampling bag. A supply of span gas of the desired compound and concentration must be obtained for calibration. Observe proper handling techniques for all gases.

Isobutylene at 100 ppm in air is recommended for use as span gas. To calibrate the instrument, use the calibration kit as follows:

- Connect the supplied regulator to the span gas cylinder. Hand-tighten the fittings.
- Open the valve on the gas bag by turning the valve stem fully counterclockwise.
- Attach the gas bag adapter nut to the regulator. Hand-tighten the fittings.
- Turn the regulator knob counterclockwise about half a turn to start the flow of gas.
- Fill the gas bag about half full and then close the regulator fully clockwise to turn off the flow of gas.
- Disconnect the bag from the adapter and empty it. Flush the bag a few times with the span gas and then fill it.
- Close the gas bag by turning the valve clockwise.
- Press Setup and select the desired Cal Memory with the arrow keys and press Enter. Press Exit to leave Setup.
- Press Cal and expose the MicroTip to zero gas. Press Enter and MicroTip sets its zero point.
- MicroTip then asks for the span gas concentration. Enter the known span gas concentration and then connect the span gas bag adapter to the inlet.
- Press Enter and the MicroTip sets its response factor.

- When MicroTip's display reverts to normal, MicroTip is calibrated and ready for use.
- Remove the span gas bag from the inlet.

MicroTip has five calibration memories (Cal Memories) and can be calibrated with five different span gases if desired. Only one Cal Memory may be used at a time. Each memory stores a different zero point and response factor. Use the following procedure to program the Cal Memories:

- Press Setup and select the desired Cal Memory (1 to 5) with the arrow keys.
- Exit from Setup and press the Cal key.
- Follow the displayed calibration instructions. When the calibration is completed, it is automatically stored in the selected Cal Memory.

Whenever the instrument is calibrated, MicroTip updates the selected Cal Memory. The instrument should be calibrated once per day.

MicroTip can also be used as a high-sensitivity leak detector. When High Sensitivity is selected in Setup, only zero gas is required for calibration. MicroTip does not read directly in parts per million, but shows a reading proportional to the concentration of ionizable gases and vapors in the sample. During calibration in High Sensitivity, MicroTip does not ask for span gas, but automatically sets itself to the maximum response factor.

The HNU or MicroTip should be recalibrated after long periods of non-use (i.e., sampling downtime, after lunch breaks, etc.) Also, if the outdoor temperature reaches extreme temperatures (<32 $^{o}$F or >85 $^{o}$F), recalibration should be performed more frequently (at least in the morning and afternoon).

## 4.2 ORGANIC VAPOR ANALYZER

The Century portable organic vapor analyzer (OVA) is designed to detect and measure gases and organic vapors in the atmosphere. The instrument uses the principle of hydrogen flame ionization for detection. The OVA measures gases and vapors by producing a response to an unknown sample that can be related to a gas of known composition to which the instrument has been previously calibrated. The instrument is normally calibrated to methane gas. To calibrate the instrument, the following steps are followed in order:

1. Place the instrument in normal operation with the Calibrate switch set to X10 and the Gas Select control set to 300. Allow the instrument to warm up for at least 5 minutes before attempting calibration.
2. Introduce zero air and use the Calibrate Adjust (zero) knob to adjust the meter reading to zero.
3. Attach the end of a T assembly to the calibration gas cylinder and the other to the probe.
4. Open the calibration gas cylinder until a slight flow is detected exiting the open end of the T assembly. (Caution: If the calibration gas is toxic or highly flammable, calibration should occur inside a hood.)
5. Adjust trimpot R-32 on the internal circuit board so that the meter reads equivalent to the known sample (methane). This sets the instrument gain for methane with the panel-mounted gain adjustment (Gas Select) set at a reference number of 300.
6. Turn off the hydrogen Supply Valve to put out the flame.
7. With the Calibrate switch on X10, use the Calibrate Adjust (zero) knob to adjust the meter reading to 4 ppm.
8. Place the Calibrate switch in the X1 position, and, using trimpot R-31 on the internal circuit board, adjust the meter reading to 4 ppm.
9. Move the Calibrate switch to the X10 position again. Use the Calibrate Adjust (zero) knob to adjust the meter to a reading of 40 ppm.
10. Move the Calibrate switch to the X100 position and use trimpot R-33 on the internal circuit board to adjust the meter reading to 40 ppm.
11. Move the Calibrate switch to the X10 position and use the Calibrate Adjust (zero) knob to adjust the meter reading to zero.
12. The unit is now balanced range to range, calibrated to methane, and ready to be placed into normal service.

Calibration will be performed in a well-ventilated area prior to daily use of the instrument.

## 4.3 EXPLOSIMETER/COMBUSTIBLE GAS INDICATOR

The explosimeter or combustible gas indicator (CGI) is an air monitoring device designed to indicate a flammable/explosive atmosphere and the level of oxygen present. The CGI registers combustible gas or vapors in terms of their lower explosive limit (LEL), which is the lowest concentration at which a combustible gas may ignite (or explode) under normal atmospheric conditions. Since the instrument measures both the level of oxygen in the atmosphere and the level a combustible gas reaches before igniting, the calibration of the instrument comprises a two-step process.

The oxygen portion of the instrument is calibrated by placing the meter in normal atmospheric air and rotating the Cal Oxygen control knob until the oxygen meter reads exactly 20.8% oxygen. This calibration will be done once daily when the instrument is in use.

The CGI is calibrated to pentane at the laboratory to indicate directly the percentage LEL of pentane in air. It is recommended that the CGI be calibrated daily and whenever the detector filament is replaced.

The calibration kit included with the CGI contains a calibration gas cylinder, a flow control, and an adaptor hose.

### 4.3.1 Recalibration Instructions

- Attach the flow control to the recommended calibration gas tank (pentane).
- Connect the adapter hose to the flow control.
- Open the flow control valve.
- Connect the adapter hose fitting to the inlet of the instrument. After about 15 seconds, the LEL meter pointer should be stable and within the range specified on the calibration sheet accompanying the calibration equipment. If the meter pointer is not in the correct range, stop the flow, and remove the right hand side cover. Turn on the flow and adjust the "S" control with a small screw driver to obtain a reading as specified on the calibration sheet.
- Disconnect the adaptor hose fitting from the instrument and replace the side cover.

## 4.4 MSA SAMPLER PUMP/DRAEGER PUMP AND GAS DETECTOR TUBES

In areas where benzene and/or vinyl chloride is suspected to exist, an MSA sampler pump or Draeger gas detector tubes may be used for monitoring in addition to the HNu and/or OVA. For MSA universal sampling pumps, the pump filter disk should be removed and cleaned periodically by gently tapping or blowing on the surface to remove any foreign matter. Every 6 months, the pump piston should be relubricated with high-vacuum silicone grease. Tube holders should be replaced when they show signs of wear or loss of elasticity. The test for leaks after an extended period of idleness, or periodically during use, is as follows:

- Lock the rotating head in orifice no. 4. Insert the tube into the tube holder. Pull the handle back to lock the piston into the 100 cc position. Wait 2 minutes. Rotate the handle to release the locking mechanism. The piston should then return to the 0 cc position. If this does not occur, another test should be performed. Adjust the rotating head so that the locking button is positioned halfway between any two index numbers. Lock the piston into the 100 cc position. Wait 2 minutes and unlock it. The piston should return to the 0 cc position if the seal between the piston and cylinder is adequate.

- For a Draeger pump, check the pump for leaks every time it is used by sealing the pump with an unopened Draeger tube and completely compressing the bellows. If the bellows has not expanded completely after 30 minutes, the pump is sufficiently airtight and will deliver the required volume. Every 4 weeks, the wire mesh sieve under the rubber bung in the pump head must be cleaned. A special spanner is necessary to remove the rubber bung. The sieve should be taken out and cleaned with a brush under running water. Every time the pump is used, it should be flushed out with air by pumping a few times without a detector tube.

## 4.5 LOW-VOLUME AIR SAMPLER - MINIRAM AEROSOL MONITOR

This procedure outlines the technical requirement and operational use of the Miniram aerosol monitor.

The requirements of this procedure are applicable to all activities that include use of the Miniram aerosol monitor. The instrument is used to determine the relative concentrations of airborne particulates in a worker’s breathing zone or general area that may cause a respiratory hazard. Information is used to establish the levels of protection and other control measures such as action levels.

### 4.5.1 Mode of Operation

#### *4.5.1.1 Startup and Field Calibration Procedures*

- Check initial read-out conditions. A blank display indicates that the Miniram has not been in the measurement mode for 48 hours or more, and is in the "minimum power off" mode. An OFF display indicates that the Miniram has been in the OFF mode for less than 48 hours.
- If the Miniram shows a blank display, press OFF and wait until the display reads OFF (approximately 5 seconds after pressing OFF).

#### *4.5.1.2 Calibration Procedures*

The unit is factory-calibrated against a filter gravimetric reference using a standard test dust. Recalibration of the instrument is conducted every 6 months. The equipment storage facility should check the Miniram against a reference scatterer after calibration at the factory and after each usage. No other field calibration is warranted.

#### *4.5.1.3 Operational Check*

- Follow the startup procedures.
- Observe the three bar indicators on the Miniram display. If the OVR bar is displayed at any time during operation in the measurement mode, the Miniram detection circuit has been overloaded. A momentary overload can be caused by insertion of an object into the sensing chamber or sudden exposure to sunlight, etc. If the cause of the overload is eliminated, the OVR bar will disappear during the next 10-second display period, unless the overload persists for more than 1½ minutes over an 8-hour measurement cycle. The ID bar display is activated only for display identification purposes and not for error conditions. The BAT bar is displayed when the battery voltage becomes insufficient, indicating that the battery charger should be plugged into the Miniram.
- Place the Zero Bag on a flat surface with the red flow fitting facing up. Flatten the bag and then unzip it.
- Insert the ribbed elbow connection (attached to the filter cartridge) into the red flow fitting of the plastic bag until the connector is flush with the bottom of the red flow fitting.
- The Miniram should be in its OFF condition (observe display). If the display is blank, or the Miniram is in the MEAS mode, key OFF.

- Open the Zero Bag and place the Miniram in the center of it.

- Key ZERO through the open end of the Zero Bag. Immediately zip close the Zero Bag and begin to pump the hand bulb. The zero concentration is automatically subtracted from the measurement readings.

- The Zero Bag should inflate as the hand pumping continues, up to a height of approximately 5 inches. Continue pumping gently to maintain the bag interior pressure until the Miniram displays OFF again.

- Unzip the Zero Bag and remove the Miniram.

- Store the Zero Bag flattened and zipped closed, with the ridded elbow connector plugged in to ensure cleanliness of the bag's interior.

#### *4.5.1.4 Operation*

- Follow the startup, operational check, and calibration procedures.

- If the Miniram shows a blank display, press OFF and wait until the display reads OFF.

- If the Miniram displays OFF, press MEAS to initiate the measurement cycle (there is no need to press OFF first in this case). A concentration display that changes or blinks once every 10 seconds is in the measurement mode.

- The first read-out display is either GO or CGO if TIME is also pressed.

- Approximately 36 seconds after pressing MEAS, the first new 10-second averaged concentration reading is displayed. All subsequent readings are concentration values in mg/m$^3$, updated every 10 seconds.

- The Miniram will now run in the measurement mode for 500 minutes, after which it will stop, displaying the OFF reading, retaining in storage the concentration averaged and elapsed time information. If both MEAS and TIME are pressed at the same time (press Time first while depressing MEAS), the Miniram will display CGO. The Miniram will then operate for an 8.3-hour run, and will restart automatically and continue to measure for an indefinite number of 8.3-hour runs.

- ID: Pressing NO during the measurement period provides a momentary display of the identification number stored within the Miniram memory. The ID key, in combination with other keys, is used for several additional programming functions.

- PKB: With the Miniram in the OFF mode, the stored information can be displayed back by pressing PKB. When the PKB key is initially pressed, the display will indicate "P" for 1 second. If PKB continues to be pressed for more than 1 second, the stored data are automatically played back through the Miniram display. First, the identification number is displayed with the ID indicate bar on. Next, the shift or run number (7 through 1, starting with the last one) is shown (with the OVR indicator bar on as identification), followed by the monitoring time in minutes for that run, followed by the off time between the last and next run (in tens of minutes). Finally, the average concentration is shown in $mg/m^3$. An average reading of 9.99 indicates that a significant overload condition occurred during that run. If PBK is pressed for less than 1 second, PA will be displayed, and the stored data will be fed out the digital output jack for printout or computer storage.

- TWA: This key stands for time-weighted average. During the measurement mode, if TWA is pressed, the display will indicate the average concentration in $mg/m^3$ up to that instant, from the start of the last run.
- SA: This key stands for shift average. During the measurement mode, pressing SA will provide a display of the aerosol concentration up to that moment, averaged over an 8-hour shift period.
- TIME: During the measurement mode, if TIME is pressed, the display will show the elapsed time, in minutes, from the start of the last measurement run.

#### *4.5.1.5 Shutdown Procedures*

- Pressing the OFF key will discontinue whatever mode is underway, displaying GCA followed by the display segments CHECK and finally OFF.

#### *4.5.1.6 Cleaning Procedures*

- The interior walls and the glass windows of the sensing chamber should be cleaned when the zero reference reading exceeds 3 $mg/m^3$.
- Open the sensor chamber with both thumbs by gently pushing the sensing chamber away from the display/control panel end. This will expose the two round lenses and a rectangular lens.
- Clean the lenses with lens tissue or a Q-tip and a small amount of isopropyl alcohol. Rinse thoroughly to remove any residue from the lenses.
- Allow the sensing chamber to dry completely and reinsert the chamber back onto the Miniram with minimal pressure.

### 4.6 MONITOR DETECTORS

When monitoring the breathing zone for hydrogen sulfide ($H_2S$) and hydrogen cyanide (HCN) gases, the COMPUR 4100 SD monitor will be used. The unit will be calibrated in the field and will provide an audible alarm when the alarm threshold concentration of hydrogen sulfide or hydrogen cyanide gas is present in the work area. The instrument is calibrated as follows:

- Battery test—Switch to the battery position. If the unit has enough power for 8 hours of use, an intermittent tone will sound. The absence of this tone indicates that a change of batteries is required. Make the test as short as possible to save power.
- When the tone is heard, switch to on.
- Place the unit onto the gas generator, and remove the unit when the alarm sounds. The generator releases gas at levels capable of setting off the alarm within 10 seconds. If the alarm does not sound, the detector needs to be checked and/or serviced.
- Once the unit has passed the calibration check, attach the unit to personal clothing in the breathing zone, being careful not to cover the filter cap.

# 5. WATER CHEMISTRY MONITORING EQUIPMENT

## 5.1 TEMPERATURE, pH, SPECIFIC CONDUCTANCE, TURBIDITY, AND DISSOLVED OXYGEN

The instrument most frequently used to measure temperature, pH, specific conductance, turbidity, and dissolved oxygen (DO) in water samples is the HORIBA U-10 water quality checker. The meter should not be used when it is known that product is present in the water sample. The HORIBA U-10 water quality checker is an instrument designed for simultaneous, multiparameter measurements of water quality using one probe. However, the HORIBA U-10 turbidity probe does not meet the performance criteria specified by EPA Method 180.1 for NTU measurement, and cannot be used for turbidity measurements where EPA methods must be followed (see Subsection 5.4 for alternate instrumentation). Measurements are displayed sequentially on the hand-held digital LCD readout. Calibration procedures for the HORIBA U-10 are included in the following subsections.

### 5.1.1 Temperature

The temperature thermistor cannot be calibrated; however, a temperature accuracy check must be performed annually to confirm the accuracy of the temperature thermistor. The accuracy check date and results must be kept with the instrument. The following procedure is used to verify the accuracy of the temperature thermistor:

- Allow a container filled with water to come to room temperature.
- Place a thermometer that is traceable to the National Institute of Standards and Technology and the instrument's temperature sensor into the water and wait for both temperature readings to stabilize.
- Compare the two measurements. The instrument's temperature thermistor must agree with the reference thermometer within the accuracy of the sensor. If the measurements do not agree, the instrument may not be working properly and the manufacturer needs to be consulted.

### 5.1.2 pH

The pH of a sample is determined electrometrically using a glass electrode. The pH sensor should be calibrated using two pH standards, which should bracket the expected values in the media sampled. The following procedure is used to manually calibrate the pH sensor using two points:

- Fill the supplied beaker with the pH 7 standard solution and wait for the temperature sensor to stabilize.
- Press the “Calibrate” button and input the pH of the initial standard.
- Remove the initial pH standard, rinse the beaker and sensor with distilled water, and blot dry.
- Fill the supplied beaker with the second pH standard solution and wait for the temperature sensor to stabilize.
- Press the “Calibrate” button again, and input the pH of the second standard.
- Remove the second pH standard from the beaker, rinse the beaker with distilled water, blot dry.

### 5.1.3 Specific Conductance

The specific conductance of a sample is determined electrometrically using an alternating four-electrode sensor. The specific conductance sensor is calibrated using a single conductivity standard, which should be near or below the specific conductance of the media to be sampled. A second specific conductance standard can be added, if there is a need to check the linearity of the instrument across a range of values. The following procedure is used to calibrate the specific conductance sensor:

- Fill the supplied beaker with the specific conductance standard solution and wait for temperature sensor to stabilize.
- Press the “Calibrate” button.
- Remove the probe from the specific conductance standard and rinse with distilled water.

### 5.1.4 Dissolved Oxygen

DO is measured electrometrically using a membrane with a galvanic cell sensor. The sensor membrane and electrolyte solution should be changed prior to the sampling period. The DO sensor is calibrated using air and a single 0.0 mg/L DO standard. The following procedure is used to manually calibrate the DO sensor:

- Dry the temperature sensor.
- Place a wet sponge/towel on the bottom of the supplied beaker.
- Place the DO sensor into the container so that it does not contact the wet sponge/towel.
- Allow confined air to become saturated with water vapor (10 to 15 minutes) and the temperature to stabilize.
- Compare the DO value with the chart of **Solubility of Oxygen in Water (mg/L) at Various Temperatures (°C)** in Subsection 5.5. If they do not agree, repeat the calibration process. If they still do not agree, change sensor membrane and electrolyte solution.
- Remove the wet sponge/towel from the supplied beaker and add 0.0 mg/L DO standard solution, providing no headspace.
- Allow the temperature to stabilize and check that the DO value is 0.0 mg/L.

The following procedure is used for measuring field parameters of water with the HORIBA U-10:

- Press the POWER key to turn the instrument on.

- Gently place the probe into the water sample collected in a 5-gallon bucket. Never throw or drop the probe into the water.
- Use the SELECT key to move the upper cursor on the readout to each parameter to be measured.
- To obtain a uniform reading, slowly move the probe up and down to circulate water through it.
- Use the EXP key to select the expanded readout mode to display measurements with one additional decimal place of accuracy.
- Record measurements in the GEOLIS logbook.
- After the measurement, turn power OFF. Rinse the probe with ASTM Type II reagent-grade water.

The HORIBA U-10 will be calibrated daily by only the on-site field logistics technician. If an instrument failure occurs, field personnel will return the instrument to the on-site technician for repairs. An inventory of replacement parts will be maintained on-site to facilitate quick field repairs. Individual sensors in the probe can be replaced by the on-site field logistics technician.

In the event that the HORIBA U-10 becomes totally inoperative, field analytical measurements will be taken with the following or equivalent instruments. Note that the HORIBA U-10 turbidity probe does not meet the performance criteria specified by EPA Method 180.1 for turbidity measurement. Instead, an HF Scientific Model DRT-15CE turbidimeter will be used for turbidity measurements (see Subsection 5.4).

- pH—Analytical Measurements Model 107 portable pH meter.
- Temperature and specific conductance—YSI Model 33 meter.
- Dissolved oxygen—YSI Model 50 B DO meter.

## 5.2 SPECIFIC CONDUCTANCE METER

The YSI Model 33, or equivalent, is a portable, battery-operated, transistorized instrument with a standard probe used to measure salinity, specific conductance, and temperature in surface water, groundwater, and wastewater. The meter is calibrated daily, or each time the meter is turned on. Setup and calibration procedures follow.

Set up the instrument as follows:

- Adjust meter zero, if necessary, by turning the screw on the meter face so that the meter needle coincides with the zero on the conductivity scale.

- Calibrate the meter by turning the mode control to Redline and adjusting the Redline control so that the meter needle lines up with the redline on the meter face. If this cannot be accomplished, replace the two "D" batteries.

Check the probe for cleanliness as follows:

- Plug the probe into the probe jack on the side of the instrument.

- Place the probe into the solution and measure on the X100 or X10 scales.

- Depress the Cell Test button. The meter reading should be less than 2%; if it is greater, the probe must be cleaned.

Clean the probe as follows:

- Spray Dow Chemical's Bathroom Cleaner with Scrubbing Bubbles into the holes in the terminal end of the probe. You may also use Lysol brand Basin, Tub, and Tile Cleaner.

- Soak the probe for 5 minutes.

- Gently spray rinse the probe with DI water.

- Do not touch the electrodes inside the probe.

For a loose or slipping temperature knob:

- Read the temperature and conductivity of a solution.

- Determine the salinity of the solution from the calibration by running a line vertically from the conductance value to the appropriate °C line. From this intersection, extend a line horizontally to the edge of the graph and read the salinity value.

- Remove the °C knob.

- Switch to the salinity function knob.

- Turn shaft under the °C function knob until the meter needle reads the salinity value determined previously.

- Switch to the temperature function knob.

- Place the °C knob on the shaft without turning the shaft, with the knob pointer indicating the meter temperature reading.

- Tighten both set screws securely.
- Return meter for factory calibration as soon as possible.

## 5.3 pH METER

Analytical Measurements Model 107 pH meter is a portable pH monitoring instrument for determining the pH value of groundwater, surface water, and wastewater. Select the appropriate buffered standards that will bracket the expected values of the media sampled.

This instrument requires a daily function and accuracy check prior to being issued for field use. This test is performed as follows:

- Connect the probe to the BNC connector provided on the unit.
- Move the selector switch to the check position.
- Using the buffer knob, move the meter pointer over the full scale. If full-scale deflection cannot be obtained, the battery must be replaced before continuing.
- Move the selector switch to pH position.
- Immerse the probe in pH 7 buffer solution.
- Adjust the buffer knob so that the pointer indicates pH 7.
- Rinse the probe in distilled water.
- Immerse the probe in pH 4 buffer solution.
- Adjust the temperature knob so that the pointer indicates pH 4.
- Immerse the thermometer into pH 4 buffer solution and take a reading.
- Compare the thermometer reading to the temperature indicated by the temperature knob on the instrument. If these two values do not match, the instrument must be returned to a qualified service technician for calibration of the internal temperature compensation circuitry.
- Rinse the probe in distilled water.
- Immerse the probe in pH 10 buffer solution and record the reading.

After the unit has been calibrated, the following method is used to take field measurements:

- Immerse the thermometer into the sample and take a reading.
- Adjust the temperature knob to match the thermometer reading.
- Turn the selector switch to check position.
- Adjust the buffer knob to match the reading that was recorded during the calibration procedure.
- Turn the selector switch to the pH position and take a reading of the sample.
- Rinse the probe in distilled water.
- Record the results in the field logbook.

## 5.4 TURBIDIMETER

The HF Scientific Model DRT-15CE turbidimeter, or equivalent, is a portable instrument designed to measure the turbidity of samples of water, wastewater, liquid fuels, cooling water, and colored liquids. The instrument provides linear turbidity measurements over four switch-selectable ranges: 0 to 1.0, 10, 100, and 200 nephelometric turbidity units (NTU). It is sensitive to a change of 0.02 NTU on the 0 to 1 NTU scale. The DRT-15CE exceeds the performance criteria specified by EPA Method 180.1 for NTU measurement.

The turbidimeter requires verification of calibration daily or each time the meter is turned on (if more than once per day). A reference standard of 0.1 NTU is required for verification of calibration. If measurement of the reference standard indicates that recalibration is necessary, or if the electronic PC board, the photodetectors, or the light source have been replaced, the turbidimeter should be recalibrated as follows.

Solutions with formalin suspension values of 198, 19.8, and 2.0 NTU are necessary for calibration as follows:

- Fill, cap, and label a separate cuvette sample of each.
- Always mix the contents of each cuvette by inverting several times before placing in the optical well for a reading.
- Keep the outside surface of cuvette clean.

- When placing any standards in the well, always use the light shield to cover the well to keep out ambient light.

To gain access to the tripods, remove the accessories from the foam holder. Proceed as follows:

1. Center the reference adjust control on top of the instrument.
2. Insert the reference standard, and turn the range control on the DRT-1SC to the 20 range. Adjust the Coarse Zero trimpot until a reading of 0.10 NTU is obtained.
3. Replace the reference standard with the 2.0 NTU formalin standard, and adjust the "20 Range Adjust" trimpot to obtain a reading of 2.0 ± 0.1 NTU.
4. Replace the 2.0 NTU formalin standard with the reference standard, and adjust the control to obtain a reading of 0.10 NTU.
5. Repeat steps 3 and 4 until no further adjustments are required.
6. Insert the 19.8 NTU formalin standard, and adjust the "20 Range Adjust" trimpot to obtain a reading of 19.8 ± 0.1 NTU.
7. Turn the range control on the DRT-150 to the 200 range. Insert the 198 NTU formalin standard, and adjust the "200 Range Adjust" trimpot to obtain a reading of 198 NTU.

Additional calibration by EPA Method 180.1 will be performed after the aforementioned calibration is performed to check the accuracy of the calibration scales. The following steps will be conducted:

- For turbidities less than 40 units: shake the sample to thoroughly disperse the solids. Wait until air bubbles disappear, then pour the sample into the sample curvette. Read the turbidity directly from the instrument scale or from the appropriate calibration curve.
- For turbidities greater than 40 units: dilute the sample with one or more volumes of turbidity-free water until the turbidity falls below 40 units. The turbidity of the original sample is then computed from the turbidity of the diluted sample and the dilution factor. For example, if 5 volumes of turbidity free water were added to 1 volume of sample, and the diluted sample showed a turbidity of 30 units, then the turbidity of the original sample was 180 units.
- **Calculation**—Multiply the sample readings by the appropriate dilution to obtain a final reading.

Report the results as follows:

| NTU | Record to Nearest |
|---|---|
| 0.0 to 1.0 | 0.05 |
| 10 to 40 | 1 |
| 100 to 400 | 10 |
| 400 to 1,000 | 50 |
| >1,000 | 100 |

## 5.5 DISSOLVED OXYGEN METER

Total dissolved oxygen (DO) will be measured using a YSI 50B or YSI 51B DO meter (or equivalent). The meter will be calibrated at the beginning of each day and checked periodically during sampling. Before the YSI Model 50B DO meter can be used, the sampling team must initially set up the instrument as follows:

- Connect the probe to the meter, then place the probe in a constant oxygen environment, such as a BOD bottle or the calibration bottle supplied.
- Set the function switch to the C position. An audible tone will sound. This is a signal that the microprocessor’s Power On Self Testing (POST) diagnostic mode has been activated. Observe the display to ensure all meter segments appear. A second tone will sound in about 7 seconds to signal the end of the POST diagnosis, and the display will blank briefly.
- If the POST diagnosis uncovers a fault in the instrument operation, the display will not appear, or will freeze. Should this occur, it is necessary to return the instrument for repair to the dealer or to YSI.
- Temperature will be displayed after the second tone. Observe the reading for stability. Temperature equilibration may take up to 5 minutes.
- Set the function switch to the mg/L position and allow 15 minutes for the system to stabilize. If calibration is attempted prematurely, calibration values will drift and may be out of specification.
- It is not necessary or desirable to turn the instrument off after each measurement. In normal field use, the meter may be left on in any switch position between measurements, and turned off only at the end of the day.
- Each startup from the OFF position could require a 5- to 15-minute wait for probe stabilization.
- Once the meter has been set up initially, the following procedures should be used for best results. Because the oxygen level in the layer of liquid sample at the membrane surface of the probe is continuously being depleted, it is essential that water

movements of 1 foot per second or greater be maintained when recording measurements. A moving stream will usually provide this motion, as will moving the probe through the sample by hand. Make oxygen measurements as follows:

- Perform the initial setup and calibration procedures as described previously.
- Collect the sample in a clean, 8-ounce jar.
- Set the function switch to the position appropriate to the sample and the readout described (% or mg/L). Allow 3 to 5 minutes for the probe to come to temperature equilibration with the sample.
- Begin stirring at least 30 seconds before taking the reading. Observe the reading when the display has stabilized.
- The rightmost DISPLAY SET key is a toggle switch for showing or suppressing the last digit of the reading in both % and mg/L modes. The default mode displays the last digit. When the last digit is suppressed, the measurement will still be as accurate as it is when the last digit is displayed.
- After the CAL key is pressed, a tone will sound when the reading is stable. This does not affect the instrument's measurement in any way. The autoread function is off in the autodefault mode and works only for DO measurements. Note: If the instrument is operated in a LOBAT (low battery) condition and it is not possible to replace the batteries immediately, confirm your reading by repeating the INITIAL SETUP procedures.
- Record all readings in the GEOLIS field logbook.
- Properly dispose of water for DO measurement with containerized purge water or by another appropriate method.

Before the YSI Model 51B DO meter can be used, the sampling team must initially set up the instrument as follows:

- Place the instrument in its intended operating position. Recalibration may be necessary if instrument operating position is changed.
- With the switch in the OFF position, adjust the meter to zero using the screw in the bottom center of the meter panel.
- Switch the function knob to the ZERO setting and adjust the meter to zero using the zero control knob located beneath the meter panel.
- Switch the function knob to the FULL SCALE setting, and adjust the meter using the full scale knob beneath the meter panel (full scale is achieved whenever the meter needle aligns with the "15" mark on the mg/L scale).

- Attach the probe to the meter.
- Before calibrating, allow the probe to stabilize for 15 minutes.

The YSI Model 51B DO meter should be calibrated between each sampling point in the following manner:

- Switch the function knob to the CALIB O2 position.
- Slip the small plastic bottle (used to prevent the membrane from drying out) over the probe. Ensure that the plastic bottle contains a damp tissue or sponge in the tip.
- Allow the temperature to stabilize for 10 minutes.
- Use the CALIB knob located beneath the meter panel to adjust the meter to read the correct DO value based on the following table.

**Solubility of Oxygen in Water (mg/L) at Various Temperatures (°C)**

| Temp. | DO* | Temp. | DO | Temp. | DO | Temp. | DO | Temp. | DO |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 14.60 | 11 | 11.00 | 22 | 8.72 | 33 | 7.16 | 44 | 6.04 |
| 1 | 14.19 | 12 | 10.76 | 23 | 8.56 | 34 | 7.05 | 45 | 5.95 |
| 2 | 13.81 | 13 | 10.52 | 24 | 8.40 | 35 | 6.93 | 46 | 5.86 |
| 3 | 13.44 | 14 | 10.29 | 25 | 8.24 | 36 | 6.82 | 47 | 5.78 |
| 4 | 13.09 | 15 | 10.07 | 26 | 8.09 | 37 | 6.71 | 48 | 5.70 |
| 5 | 12.75 | 16 | 9.85 | 27 | 7.95 | 38 | 6.61 | 49 | 5.62 |
| 6 | 12.43 | 17 | 9.65 | 28 | 7.81 | 39 | 6.51 | 50 | 5.54 |
| 7 | 12.12 | 18 | 9.45 | 29 | 7.67 | 40 | 6.41 | | |
| 8 | 11.83 | 19 | 9.26 | 30 | 7.54 | 41 | 6.31 | | |
| 9 | 11.55 | 20 | 9.07 | 31 | 7.41 | 42 | 6.22 | | |
| 10 | 11.27 | 21 | 8.90 | 32 | 7.28 | 43 | 6.13 | | |

*DO value is based on atmospheric pressure of 760 mm Hg (at sea level).

When measuring DO with the YSI Model 51B meter, these steps should be followed:

- Place the probe in your sample and set the function knob to temperature. Allow sufficient time for the temperature to stabilize.
- Record the temperature and adjust the O2 SOLUBILITY FACTOR dial to the observed reading.

- Set the function knob to read O2. If an automatic stirrer is not attached to the probe, the probe will have to be manually stirred by raising and lowering the probe approximately 1 foot per second.
- Allow sufficient time for the DO reading to stabilize.
- Record the reading on the GEOLIS form.

## 5.6 FIELD ALKALINITY MEASUREMENT

Alkalinity is defined as the measurement of the ability of a solution to resist or buffer a change in pH. Alkalinity is measured by progressively lowering the pH of a solution by titrating with a strong acid such as HCl or $H_2SO_4$.

- The Hach Model AL-DT titration device, which measures alkalinity at two end points (P-alkalinity and total alkalinity), is used. To accurately measure alkalinity, the conductivity of the water must be known. Alkalinity may be approximated as half the conductivity value when conductivity is expressed in units of umhos as with the YSI Model 33 meter (e.g., water with a conductivity of 100 umhos would be expected to have a total alkalinity of approximately 50 mg/L as $CaCO_3$). Alkalinity may be approximated from conductivity values measured with the HORIBA Water Quality Checker using the following formula:

  Estimated alkalinity = [conductivity mS/cm x 1,000]/2

For example, water with a conductivity of 0.1 mS/cm would be expected to have a total alkalinity of approximately 50 mg/L as $CaCO_3$.

All information collected during the alkalinity test is recorded on the Field Alkalinity Worksheet. The measurement of alkalinity involves the following procedure:

- **Step 1:** Water samples must be collected in 250-mL plastic or glass bottles, with no headspace, and capped tightly.
- Samples should be analyzed as soon as possible.
- Maximum storage time is 24 hours on ice.
- Samples should be allowed to reach room temperature before analysis.
- If possible, the samples should be kept at the original sample temperature while being transported from the field to the area where the titration will occur.
- Estimate the alkalinity, as described previously.

- **Step 2:** Select the sample volume and the respective sulfuric acid titration cartridge from the following table:

| Estimated Alkalinity Range | Sample Volume (mL) | Cartridge ($NH_2SO_4$) | Multiplier | pH | Color |
|---|---|---|---|---|---|
| 10 to 40 | 100 | 0.16 | 0.1 | 5.1 | Blue-gray |
| 40 to 160 | 25 | 0.16 | 0.4 | 5.1 | Blue-gray |
| 100 to 400 | 100 | 1.6 | 1.0 | 4.8 | Violet-gray |
| 200 to 800 | 50 | 1.6 | 2.0 | 4.5 | Light pink |
| 500 to 2,000 | 20 | 1.6 | 5.0 | 4.5 | Light pink |
| 1,000 to 4,000 | 10 | 1.6 | 10.0 | 4.5 | Light pink |

- **Step 3:** Insert a clean delivery tube into the titration cartridge and twist the cartridge onto the titrator body.

- **Step 4:** Flush out the delivery tube by turning the small knob until a few drops drip from the tube, wipe the tip, and reset the counter to zero.

- **Step 5:** Measure the aforementioned sample volumes into a 250-mL flask and dilute to 100-mL with de-ionized water, if necessary.

- **Step 6:** Add the contents of one phenolphthalein pillow and swirl to mix.

- **Step 7:** If the solution turns pink (normally it does not), titrate to a colorless end point and record the number of drops required to calculate P-alkalinity.

- P-Alkalinity = Drops x multiplier in mg/L $CaCO_3$ (from previous table).

- **Step 8:** Add one bromocresol green-methyl red indicator pillow and swirl. Titrate from green to the color listed in the previous table and record the number of drops required to calculate total alkalinity. The color can be judged against a 50 mL solution containing 1 indicator pillow and 1 pH buffer pillow.

- **Step 9:** Total alkalinity = Drops x multiplier in mg/L $CaCO_3$ (from previous table). Record all values and final color on the alkalinity form.

- Example: A water sample has an alkalinity of approximately 100 mg/L (conductivity of 200 umhos or 0.2 mS/cm). Place 100 mL in a flask and add the phenolphthalein pillow. If the solution turns pink, add 1.6N $H_2SO_4$ buffer, and titrate until clear. Add 1 bromocresol green-methyl red indicator pillow, titrate solution to a light violet-gray end point (pH 4.8), and calculate the total alkalinity. If 120 drops are necessary, total alkalinity is 120 mg/L (120 x 1). If fewer than 30 drops with the 1.6N $H_2SO_4$ cartridge or more than 300 drops with 0.16N $H_2SO_4$ are required, the sample should be re-titrated with the other cartridge and both results reported. If the alkalinity result falls outside the estimated alkalinity range, the sample should be re-titrated using the appropriate $H_2SO_4$ cartridge and/sample volume.

- **Step 10:** Properly dispose of all liquids and decontaminate equipment according to procedures outlined in SOP C.8.
- **Step 11:** Properly dispose of liquids in either purge water containers or by other appropriate methods. Decontaminate equipment according to SOP C.8 if elevated readings were detected with the PID. If there are no elevated readings, then rinse with distilled water.

### 5.6.1 Accuracy Check

Before the field measurements can be performed, the accuracy of the field alkalinity procedure must be verified. The accuracy check consists of the following steps:

- Snap the neck off an Alkalinity Standard Solution Voluette® Ampule, 0.500 N.
- Use a TenSette® Pipet to add 0.1 mL of standard to the sample titrated in Steps 7 or 8 above. Resume titration back to the same end point. Record the number of digits needed.
- Repeat, using two more additions of 0.1 mL. Titrate to the end point after each addition.
- Each 0.1 mL addition of standard should require 25 additional digits of 1.600 N titrant or 250 digits of 0.1600 N titrant. If these uniform increases do not occur, refer to Appendix A, Accuracy Check and Standard Additions, which can be accessed via the following URL: http://ecommence.hach.com/stores/hach/pdfs/manuals/169008.pdf

# FIELD SCREENING INSTRUMENT CHECKLISTS

# FIELD SCREENING
# INSTRUMENT CHECKLISTS

**CGI/$O_2$ DETECTOR MSA MODEL 260**

**ID/Serial No.:** **Date:** **Time:** **Signature:**

| ITEM | DONE | PROCEDURES |
|---|---|---|
| Startup Procedures | | Attach the sample hose to the inlet of the instrument. |
| | | Open the instrument lid. Turn the center ON-OFF control to the far right HORN-OFF position. Both meter pointers will move, and one or both alarm lights may light. |
| | | Allow the instrument to warm up until the meter stabilizes (about a minute). |
| | | If the % oxygen stabilizes at a value other than 20.9 %, set to 20.9% by using the CALIBRATE $O_2$ control. |
| | | Set the % LEL to zero by adjusting the ZERO LEL control. |
| | | If either the alarm lights are lighted, press the Alarm Reset button. |
| | | Momentarily place a finger over sample inlet fitting or end of the sample line probe. Flow indicator float should drop out of sight indicating no flow. If float does not drop, check system for leaks. |
| | | Press the CHECK button and observe the % LEL meter. The pointer must read at 80% LEL or higher as marked by the BATTERY zone on the meter. Battery OK? If reading is less, batteries must be recharged. No tests should be attempted as the instrument will not perform properly. |
| Operation Check | | Follow the startup procedures, operational check, and the calibration procedures. Ensure the alarm is in the ON position. Observe response values for various gases indicated in the instrument manual. |
| | | For LEL and oxygen reading, hold the hose inlet at point to be tested. |
| Calibration Procedures | | Follow the startup procedures. |
| | | Connect the regulator to the calibration gas. |
| | | Connect the adapter hose from the regulator to the inlet of the CGI/$O_2$ meter. |
| | | Open the cylinder valve. |
| | | Observe the meter on the instrument. Readings will increase, then stabilize. As soon as the reading is stable, compare with the value on the calibration gas cylinder. If calibration cannot be accomplished, proceed to the calibration instructions in the MSA 260 instruction manual. |
| | | If readings are within ±10%, quickly close regulator valve and disconnect the tube from instrument inlet. |
| Comments | | Carefully remove the right side/end of the instrument case (the side opposite the inlet). With the Cal Gas attached, use a small (jewelers) screwdriver to adjust the “S” potentiometer until the meter scale reads 50% LEL. Instrument is now calibrated. |

**CGI/$O_2$ DETECTOR Gastec MODEL 1314**

**ID/Serial No.:** **Date:** **Time:** **Signature:**

| ITEM | DONE | PROCEDURES |
|---|---|---|
| Startup Procedures | | Check function switch on the control panel to ensure that it is in the OFF position. Attach sample hose to instrument by means of the quick release fitting. |
| | | LEL-PPM range button (top right) in LEL or OUT position, with black indicator showing (when the switch is IN, an orange indicator dot shows, and circuit is in the sensitive PPM range). OXY (top left) button in the OUT position (in the IN position Oxygen reads-oxygen scale instead of LEL or PPM. A colored indicator dot shows when the switch is IN). |
| | | Press the power switch to turn the instrument on. Orange indicator dot should show. Alarm will sound momentarily. |
| | | Press battery check button and note the meter is OK. If reading is close to or below Battery Check mark on the meter, recharge the battery. Is recharge needed? |
| | | In gas free location, allow instrument to warm up until meter stabilizes (about a minute). Turn PPM/LEL zero Knob to bring meter to "O". |
| | | Push the OXY (top left) switch IN so that the orange indicator shows. Meter should read 20.9% $O_2$. If not, adjust Oxygen Knob so meter reads 20.9% $O_2$. |
| Operation Check | | Breathe into hose inlet and allow the instrument to sample expired air (do not put your mouth directly on the hose). Reading should come down to 16%. Alarm sounds at 19.5% oxygen. Allow reading to return to 20.9%, then put the switch back in the OUT position. |
| Calibration | | Record date of last WESTON ES, factory, or supplier calibration. |
| Calibration Procedures using a Sample Bag (option) | | Cal gas Hexane? Cylinder concentration of hexane divided by 1.1 = _______% LEL.<br>Open pinch clamp on airbag (push the latch forward to open). |
| | | Connect tubing by attaching short piece of flexible plastic tubing from the Y valve onto the regulator. Place the longer tube with the pinch clamp onto the instrument's inlet probe. |
| | | Allow pump to evacuate bag until flat. Close pinch clamp (squeeze parallel faces together until tight/latched). |
| | | Open cylinder valve slightly so sampling bag begins to expand. Quickly open pinch clamp. As instrument takes sample, bag will start to expand further or deflate. Adjust cylinder valve so the bag remains half inflated. |
| | | Observe meter. Readings will increase, then stabilize. As soon as reading is stable, record:_________. Compare with value on the cal gas cylinder. Reading within ±10% of the cal gas concentration. |
| | | Quickly close the regulator valve and disconnect the tube from the instrument inlet. |
| Calibration using a Rotometer | | With instrument on and zeroed, use a piece of tubing to attach inlet of instrument to top part of rotometer. Attach another piece of tubing to bottom part of the rotometer. Do not connect to regulator on the calibration gas cylinder yet. Note position of rotometer ball. |
| | | Connect calibration gas cylinder regulator to the bottom tubing and open the cylinder valve. |
| | | Adjust cal gas regulator so rotometer reads at same level as above (about 2 cubic feet/hour (cfh). Observe meter reading. Reading will increase, then stabilize. As soon as reading is stable record:______. Compare with value on the cal gas cylinder. Instrument reading should be within ±10% of the cal gas. |

**CGI/$O_2$ DETECTOR Gastec MODEL 1314**

**ID/Serial No.:** **Date:** **Time:** **Signature:**

| **ITEM** | **DONE** | **PROCEDURES** |
|---|---|---|
| Internal Calibrate | | Calibrate internally when initial reading is > ±10% of cal gas concentration. Loosen top of unit by unscrewing knob on front ledge of instrument. Lift on handle, taking care not to pull wiring. Find LEL pot. With cal gas flowing, use a small screwdriver and adjust to make meter coincide with cal gas cylinder % LEL. Record %:_________. Maintenance needed when calibration can't be accomplished. |
| Operation | | Follow the startup procedures, operational check, and the calibration procedures. |
| | | PPM/LEL Range switch in the LEL (out) position, with black indicator showing, and OXY-PPM/LEL switch also in LEL (out) position. |
| | | For LEL readings in the 0-100% range, hold hose inlet at point to be tested. For oxygen readings, move the OXY-PPM/LEL switch to the IN position. |
| Comments | | |

| **FID/PID TVA 1000** | | |
|---|---|---|
| **ID/Serial No.:** | | **Date:** **Time:** **Signature:** |
| **ITEM** | **DONE** | **PROCEDURES** |
| Startup Procedure | 1. | Install hydrogen tank in side pack, turning counterclockwise until hand tight. Record pressure in tank from the gauge on top of tank: _______. Will need about 300 psi/hour of work anticipated. |
| | | Attach probe/readout assembly (sample line and electrical cable to TVA). Sample line - push in until hear latch; electrical cable—line up grove in housing with ridge inside coupling on TVA. Don't force. |
| | | Turn red hydrogen supply valve on. Quarter turn. Record pressure from output gauge: ___. Should be 11-14. |
| | | Wait 2-3 minutes for hydrogen fuel cell to fill. |
| | | Press ON Pad firmly. Screen should display: Battery Ok, NV LAN OK, Date time OK, Self Test. Wait for Beep. |
| | | Press the Control Key. Screen should show: 1=Turn pump on, 2=Ignite, 3=Turn PID off. |
| | | Press 1 to turn on pump. Should hear/feel pump turn on. |
| | | Press Control key. Screen should show: 1=Turn pump off, 2=Ignite, 3=Turn PID off. |
| | | Press 2 to ignite. |
| | | Flame-out indicator does not activate. Flame is lit. If Flame-out indicator activates, wait one minute and press Control key and 2 to ignite. Display on TVA should show: Main Menu. Display on Readout should show: Off. |
| | | When sure flame is lit, Press 1 to Run. Display on TVA should show: PID: -X.XX; FID: -X.XX/ Exit=stop. Display on Readout should show: Either PID reading or FID reading. |
| | | Allow at least 15 minutes for instrument to warm before attempting to calibrate. |
| Calibration | 2. | Record date of last WESTON ES/Factory calibration: ________. Within 12 months?<br>Return for calibration if over 12 months. If instrument not on, follow startup procedures. |
| | | At least 15 minutes elapsed since instrument turned on, pump turned on, and flame ignited? |
| | | Exit to Main menu. Screen on TVA should read: Main Menu. |
| | | Choose 2=Setup. Screen should read: Set up: 1=calibration; etc. |
| | | Choose 1=calibration. Screen should read: Calibration menu: 1=zero; 2=bckgrnd; etc. |
| | | Is humidity <50%? If yes. Choose 1=zero. Screen will indicate Zero Cal. |
| | | From calibration menu choose - 1=zero. Screen should read: 1=Both; 2=PID;3=FID. Choose 1=Both. Screen reads Apply zero gas. Enter=start. Exit=cancel. |
| | | Apply Zero gas to probe using T or Gas Bag, open zero gas regulator or gas bag valve and press Enter. Screen will show: Calibrating PID FID zero gas. |
| | | Zero is completed when screen displays - Accepted. Watch closely; accepted appears for very brief time. Screen will pop back to Calibration menu after Accepted appears. |
| | | Is humidity > 50%? If yes, choose 2-Bckgrnd. Screen will read: 1=Both; 2=PID; 3=FID. Choose 1=both. Screen will read: Bkgrnd calibration. Enter=start. Exit=cancel. Press Enter: Screen will show: Calibrating PID FID Bkgrnd. |
| | | Zero is completed when screen displays - Accepted. Watch closely; accepted appears for very brief time. TVA Screen will pop back to Calibration menu when accepted. |
| | | From the calibration menu, choose - 3=SPAN. Screen should read: 1=both, 2=PID, etc. |
| | | Choose 2=PID. Record PID SPAN gas concentration: ______. Screen will read Apply Span Gas. Enter=Start. Exit=Cancel. |
| | | Apply PID SPAN Gas to probe using T or Gas Bag, open zero gas regulator or gas bag valve and press Enter. Screen will show: Calibrating Span PID. |

| **FID/PID TVA 1000** | | |
|---|---|---|
| **ID/Serial No.:** | | **Date:** **Time:** **Signature** |
| **ITEM** | **DONE** | **PROCEDURES** |
| | | PID Calibration is completed when screen displays Accepted. Watch closely, accepted appears very briefly. Turn off PID span gas valve or close gas bag valve. Screen will pop back to Calibration Menu. |
| | | EXIT to main menu. Screen will read: Main Menu 1=Run. Press 1. |
| | | Reapply PID Span Gas and record reading on readout display for PID: ______. Within 5% of PID span gas conc? ________ If yes, continue. If no, troubleshoot until does. |
| | | Reconfirm Span Definition by exiting to calibration menu. Should read: 1=zero, .4=gascon. |
| | | Choose 4=GASCON. Readout will show PID=XX.X; FID=XX.X Span Gas: 1=both; 2=PID; 3=FID. If readout is the same as the concentration indicated on the PID SPAN gas, press Exit. |
| | | If readout is not the same, press 2=PID. Screen will display series of dashes followed by units (ppb/ppm/etc.). Reset units using up and down arrows to choose ppm and use number keys to enter numeric value of the span gas. Then press Enter. |
| | | Exit to calibration menu. Screen will read: Calibration Menu 1=zero, 2=bkgrnd, 3=span. |
| | | Choose 3=SPAN. Screen will read: 1=both, 2=PID; 3=FID. Choose 3=FID. Record FID SPAN gas concentration:_______. Screen will read: Apply span gas. Enter=start. Exit=cancel. |
| | | Apply PID SPAN Gas to probe using T or Gas Bag, open zero gas regulator or gas bag valve and press Enter. Screen will show: Calibrating Span FID. |
| | | FID Calibration is completed when screen displays Accepted. Watch closely for accepted. Turn off FID span gas valve or close gas bag valve. Screen will pop back to Calibration Menu. |
| | | EXIT to main menu. Screen will read: Main Menu 1=Run. Press 1. |
| | | Reapply FID span gas and record reading on readout display for FID: ______. Within 5% of FID span gas conc? ______ If yes, continue. If no, troubleshoot until does. |
| | | Reconfirm Span Definition by exiting to calibration menu. Should read: Calib. Menu 1=zero; 2=bkgrnd; 3=span; 4=gascon. |
| | | Choose 4=Gascon. If readout is same as concentration indicated on the PID SPAN gas, press Exit. |
| | | If the readout is not the same, press 3=FID. Screen will display series of dashes followed by units (ppb/ppm/etc.). Reset units using up and down arrows to choose ppm and use number keys to enter numeric value of the span gas. Then press Enter. |
| Shutdown Procedures | 3. | Press off button. |
| | | Turn off red hydrogen button. |
| | | If end of day or preparing to recharge, remove the hydrogen tank from the sidepack by turning clockwise. Set cylinder in case or secure place where it can not fall. |
| Filling Hydrogen Cylinder | 4. | Remove cylinder from side pack if not already done. |
| | | Verify hydrogen supply is high-grade and pressure is 2,200 psi or less. |
| | | Attach fill assembly to hydrogen tank. Ensure fill assembly valve is in off position. |
| | | Attach other end of fill assembly to TVA hydrogen cylinder. |
| | | Open hydrogen supply cylinder valve and then move fill assembly valve to fill. |
| | | Allow pressure to equalize in TVA hydrogen cylinder. |
| | | When full, move fill assembly valve to off. |
| | | Close hydrogen supply cylinder valve and disconnect fill assembly. |

## OVA FLAME IONIZATION ANALYZER DETECTOR CENTURY FOXBORO OVA

**ID/Serial No.:** **Date:** **Time:** **Signature:**

| ITEM | DONE | PROCEDURES |
|---|---|---|
| Startup Procedures | | Check the function switch on the control panel to ensure that it is in the “off” position. |
| | | Attach probe by hand tightening the screw fitting into the interface on the side of the instrument. Attach snap-in cord. Use care in aligning the prongs in the probe cord with the socket: don’t force. |
| | | Move INSTR Switch to ON and allow five minutes for warm up. |
| | | Move INSTR/BATT test switch to BATT position and ensure battery is charged by reading the indication on readout meter. Battery OK ___. Move INSTR back to the ON position. |
| | | Move calibrate switch to X10 and adjust the meter reading to zero with the calibrate adjust (zero) knob. |
| | | Turn pump switch on. Observe the sample flow rate indicator. Should be approximately 2 units. |
| | | Cover tip of probe. If flow does not drop to zero, tighten fittings/re-seat probe until it does. |
| | | Open hydrogen tank valve one turn and observe reading on hydrogen tank pressure indicator (about 150 psi pressure is needed for each hour of operation). Record hydrogen tank pressure reading: ___. If insufficient or below 500 psi, refill following procedure below. Refill required?___. |
| | | Open hydrogen supply valve ½ to 1 turn and observe reading on hydrogen supply pressure indicator. Should be between 8 and 12 psi. Record reading: ________. |
| | | Confirm that OVA meter is still reading zero. |
| | | Depress and hold red igniter button on left side of OVA for no more than 6 seconds. There will be a slight “pop” as hydrogen ignites and meter pointer will move upscale of zero. Immediately after ignition, release igniter button. Do not depress igniter button for more than 6 seconds. If burner does not ignite, let instrument run for several minutes and try again. After ignition, meter pointer will indicate background concentration. Record:_________. |
| | | To set audible alarm to action level: 1) turn on; 2) adjust meter pointer to desired alarm level, using cal adjust (zero) knob; 3) turn alarm level adjust knob on back of readout assembly until alarm just comes on; 4) adjust speaker volume with volume knob; 5) reset to 0. High level alarm set at:______.<br>To set zero/flame out alarm: With instrument on and in X10 scale: 1) use calibrate adjust knob to set needle on readout assembly to 0; 2) turn alarm level adjust knob on back of readout assembly until alarm just comes on; 3) move needle slightly above zero to stop alarm sound; 4) use calibrate adjust to test alarm, leaving needle just above 0. Zero Alarm set:______. |
| | | Move instrument to a clean area and zero using cal adjust knob. The adjustment to 1 ppm (rather than 0) is necessary in X1 range because of sensitivity of OVA. This permits minor downward fluctuations in normal background level without dropping below 0, which would actuate the flame-out alarm. It is important to remember during the subsequent survey that 1 ppm must be subtracted from all readings. |
| Operation Check | | Follow startup procedures. With instrument set on X10 scale, hold a solvent-based marker cap near probe tip. If meter deflects upscale, instrument is working. |
| Calibration | | Single Point, using methane. Follow the startup procedures and operational check. Record date of last WESTON ES, supplier/factory calibration: ____. Less than 12 months ago? If no, return to ES, factory or supplier for check and calibration. |
| | | Ensure calibration gas is methane. Should be slightly less than 100 ppm. Cal gas Concentration:___. |

### OVA FLAME IONIZATION ANALYZER CHECKLIST

**ID/Serial No.:** **Date:** **Time:** **Signature:**

| ITEM | DONE | PROCEDURES |
|---|---|---|
| | | Follow startup procedure and operation check. Set function switch to 10X scale. |
| | | Attach a regulator to a cylinder of methane gas. Connect regulator to OVA probe with a piece of clean tygon tubing and “t” or “y” connector. Turn the valve on the regulator on. |
| | | Observe meter reading. Reading will increase, then stabilize. As soon as reading is stable, compare with value on cal gas cylinder. Record reading: ______. Instrument reading should be within 10% of cal gas concentration. |
| | | **If readings deviate by more than 10% from cal gas concentration, internally adjust as follows:** |
| | | Turn off cal gas, disconnect probe assembly, and remove unit from case. |
| | | Locate trim pots on end of gray plastic block. |
| | | Re-attach probe assembly; attach cal gas and turn on. |
| | | Using trim pot R-32, adjust until readout coincides with cal gas concentration. |
| | | Turn off cal gas and disconnect. Record final/calibration reading:__________________. |
| Bias | | **If R-32 Pot is needed for calibration,** perform Bias Adjust as follows: |
| Adjust | | After calibration is complete, turn off hydrogen supply valve to put out flame. |
| | | With switch in 10X position, use the calibrate adjust knob to adjust the meter reading to 4 ppm. |
| | | Turn calibrate switch to X1 and use trim pot R-31 to adjust meter reading to 4 ppm. |
| | | Set switch to 10X again and use calibrate adjust knob to meter reading to 40 ppm. |
| | | Set the switch to 100X and use trim pot R-33 to adjust meter reading to 40 ppm. |
| | | Set switch to 10X and use calibrate adjust knob to zero. |

### OVA FLAME IONIZATION DETECTOR CHECKLIST

**ID/Serial No.:** **Date:** **Time:** **Signature:**

| ITEM | DONE | PROCEDURES |
|---|---|---|
| $H_2$ Filling | | Completed as needed. |
| | | Inspect ends of hydrogen fill hose to ensure they are free of grease and obstruction. |
| | | Ensure hydrogen cylinder is secure. Attach fill assembly to hydrogen cylinder. Tighten with wrench. |
| | | Remove OVA fill port cover. Attach fill assembly to OVA fill port. Tighten carefully with wrench. |
| | | Ensure OVA Hydrogen Fill and Cylinder Valves are closed. Place three-way switch in closed position. |
| | | Check around area for ignition sources. When there are none, then proceed. |
| | | Open hydrogen cylinder valve and quickly change three-way valve from off to bleed position. |
| | | Move fill assembly three-way valve to fill position. |
| | | Open OVA Hydrogen Fill Valve and fill OVA Hydrogen Cylinder. |
| | | When OVA Hydrogen Cylinder is full, close OVA Hydrogen Fill Valve. |
| | | Move Fill Assembly three way switch to Closed position. Close Hydrogen Cylinder Valve. |
| | | Move fill assembly three-way valve to: 1) bleed position until release stops; 2) fill position; 3) bleed position until release stops again; and 4) closed position. |
| | | Disconnect fill assembly from OVA. Disconnect fill assembly from hydrogen cylinder. |
| | | Recap and store Hydrogen Cylinder properly. |
| Comments | | |

**PHOTOIONIZATION DETECTOR - ORGANIC VAPOR METER (OVM)**

**ID/Serial No.:** **Date:** **Time:** **Signature:**

| ITEM | DONE | PROCEDURES |
|---|---|---|
| Startup Procedure | 1. | Power-up the instrument using the power plug. |
| | | Depress ON/OFF Key to ignite lamp and start pump. Depress the MODE/STORE Key. |
| | | a. Depress -/CRSR Key in response to LOG THIS VALUE? Prompt. |
| | | b. Depress -/CRSR Key to select Parameters Mode from the main Menu. |
| | | c. Depress +/INC Key to advance through the Run Mode selection parameter prompt. |
| | | d. Depress +/INC Key to advance through Auto Logging Mode selection parameter prompt. |
| | | e. Depress +/INC Key to advance through the Average Time selection parameter prompt. |
| | | f. Depress +/INC Key to advance through the Alarm Setting parameter prompt. |
| | | g. Depress +INC Key to advance through the Lamp Selection parameter prompt. |
| | | h. Depress +/INC Key to advance through the Response Factor Setting parameter prompt. |
| | | i. Depress Mode/Store Key to display readout. Check with marker for response. |
| Calibration Procedures | 2. | Follow startup procedures above. After completing. 1. h. (Depress +/INC Key to advance through Response Factor Setting parameter): |
| | | a. Depress +/INC Key again. Display will indicate "RESET" to Calibrate. |
| | | b. Depress RESET Key to initiate calibration sequence. |
| | | c. Depress -/CRSR Key to decline restoration of the backup calibration. |
| | | d. Connect the outlet of the calibration tubing assembly to the detector inlet. |
| | | e. Introduce Zero Air to the OVM by opening the flow regulator. |
| | | f. Depress the RESET Key to "Zero" the OVM. Screen will indicate zeroing. |
| | | g. Close the flow regulator. When Reset to Calibrate appears again, ready to continue. |
| | | The LCD should now read: Span PPM = 0250 (or other calibration gas). "+" TO CONTINUE. |
| | | h. Check Cylinder Concentration. If concentration is 250 ppm, continue with next row (2.i.). If concentration is not 250 ppm, go to 4. Calibration Reset, below. Record Cal Gas Conc:_____. |
| | | i. Depress +/INC to accept span concentration value. Screen will indicate "Reset to Calibrate." |
| | | j. Connect the isobutylene cylinder to the calibration tubing assembly. |
| | | k. Connect the outlet of the calibration tubing assembly to the OVM inlet. |
| | | l. Introduce the Isobutylene standard to the OVM by opening the flow regulator. |
| | | m. Push Reset key to "CALIBRATE" OVM, screen will indicate "Calibrating." When screen returns to Reset to Calibrate, close the flow regulator. Depress +/INC Key. |
| | | n. Depress MODE/STORE to return to the Run Mode. |
| | 3. | Operation Check |
| | | a. Use cap of solvent-based marker to check. If LCD display increases, instrument is operating. |
| | | b. Open cal gas cylinder regulator and watch LCD readout. Should stabilize at cal gas Concentration. Verify: ____: Record Reading:____________. |
| | | c. Close regulator and disconnect calibration assembly. |
| | | d. Let instrument clear and return to background. Record background if any:__________. |
| | 4. | Resetting Calibration Parameter |
| | | a. Simultaneously depress the RESET and -/CRSR Keys to activate the movable cursor. Repeat this until the cursor is at the ones place. |
| | | b. Simultaneously depress RESET and +/INC Keys to increment the ones place value. Repeat this step until the ones place value reads the value of the concentration of isobutylene in the calibration gas (i.e., if the cylinder reads 250 ppm isobutylene, the ones place value is 0). |

| | | |
|---|---|---|
| **PHOTOIONIZATION DETECTOR - ORGANIC VAPOR METER (OVM)** | | |
| **ID/Serial No.:** | | **Date:** **Time:** **Signature:** |
| **ITEM** | **DONE** | **PROCEDURES** |
| | | c. Simultaneously depress RESET and -/CRSR Keys. Repeat this until the cursor is at the tens place. Simultaneously depress RESET and =/INC Keys to increment the tens place value (i.e., if the cylinder reads 250 ppm isobutylene, the tens place value is 5). |
| | | d. Simultaneously depress the RESET and -/CRSR Keys to activate the movable cursor. Repeat this until the cursor is at the hundreds place. |
| | | e. Simultaneously depress RESET and +/INC Keys to increment the hundreds place value. Repeat this step until the hundreds place value reads the value of the concentration of isobutylene in the calibration gas (i.e., if the cylinder reads 250 ppm isobutylene, the hundreds place value is 2). |
| | | f. Simultaneously depress the RESET and -/CRSR Keys to activate the movable cursor. Repeat this until the cursor is at the thousands place. |
| | | g. Simultaneously depress RESET and +/INC Keys to increment the hundreds place value. Repeat this step until the hundreds place value reads thevalue of the concentration of isobutylene in the calibration gas (i.e., if the cylinder reads 250 ppm isobutylene, the thousands place value is 0). |
| | | h. The LCD should now read: Span PPM = the new value (0250 in this example). “+” TO CONTINUE. Record reading: ____. Depress +/INC to accept span concentration value. |
| Parameter Setting | 5. | a. Following parameters also have features, which can be reset or used using manufacturers’ procedures in manual: Run mode; Autologging Selection; Location Mode Selection; Average Time Selection; Alarm Setting; Lamp Selection; Response Factor Setting; Free Space Indication. |
| Comments | | |

| HNU PHOTOIONIZATION ANALYZER | | |
|---|---|---|
| **ID/Serial No.:** | | **Date:** **Time:** **Signature:** |
| **ITEM** | **DONE** | **PROCEDURES** |
| Startup Procedures | | Before attaching the probe, check the function switch on the control panel to ensure that it is in the “off” position. |
| | | Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the socket: do not force it. |
| | | Turn the function switch to the battery check position. The needle on the meter should read within or above the green area on the scale. If not, recharge the battery. |
| | | Turn the function switch to any range setting. Listen for the hum of the fan motor. |
| | | To zero the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed since this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 to 20 seconds to ensure that the zero reading is stable. If necessary, readjust the zero. |
| Operational Check | | Follow startup procedures. With the instrument set on the 0 - 20 range, hold a solvent-based magic marker cap near the probe tip. If the meter deflects upscale, the instrument is working. |
| Calibration Procedures | | Follow the startup procedure and the operational check. Record date of last WESTON ES, supplier/factory calibration:_______________. Less than 12 months ago? If no, return to ES, factory, or supplier for check and calibration. |
| | | Set the function switch to the range setting for the concentration of the calibration gas. |
| | | Attach a regulator to a cylinder of isobutylene gas. Record cal gas concentration:__________. Attach the humidifier to the instrument probe. Connect regulator to the humidifier with a piece of clean tygon tubing. Turn the valve on the regulator to the on position. Record the initial reading after it stabilizes:_____________________. |
| | | After 15 seconds, adjust the span dial until the meter reading equals the concentration of the calibration gas used in benzene equivalents. Do not calibrate the HNu to the actual concentration of isobutylene on the cal gas container. For the 10.2 eV probe (approximately 55 ppm benzene equivalent) and for the 11.7 eV probe (approximately 65 ppm benzene equivalent).Therefore, if the cal gas container label indicates 100 ppm isobutylene, the instrument should be calibrated to .55 X 100 or 55 (10.2 probe) and .65 X 100 or 65 (11.7 probe). Be careful to unlock the span dial before adjusting it. Record Span Setting after Cal:_________________.<br>If the span has to be set below 3.0, lamp and ion chamber should be inspected and cleaned. Was instrument calibrated and inspected? The 10.2 eV probe lamp can be cleaned in the field following procedures in the manual. Lamp cleaned?_____. The 11.8 eV lamp must be returned to Equipment Stores for cleaning.<br>Comments: Record reading and span after adjustment: _________________. |

| | | |
|---|---|---|
| **HNU PHOTOIONIZATION ANALYZER** | | |
| **ID/Serial No.:** | | **Date:** **Time:** **Signature:** |
| **ITEM** | **DONE** | **PROCEDURES** |
| | | The instrument reading should be within ±10% of the calibration gas. The instrument needs maintenance when calibration cannot be accomplished. |
| | | Turn the calibration gas off and remove the tubing from the instrument inlet and regulator. |
| Comments | | |

| | | |
|---|---|---|
| **REALTIME AEROSOL MONITOR - MINIRAM** | | |
| **ID/Serial No.:** | | **Date:** **Time:** **Signature:** |
| **ITEM** | **DONE** | **PROCEDURES** |
| Startup Procedures | | Check initial readout condition: Blank display indicates the Miniram has not been in the measurement mode for 48 hours or more and is in the minimum power off mode. "OFF" display indicates the Miniram has been in the off mode for less than 48 hours. |
| | | If Miniram display is blank, press OFF. Wait until display reads OFF (about 5 seconds). |
| | | If Miniram shows OFF, press MEAS directly to initiate the measurement cycle (there is no need to press OFF first, in this case). A concentration display that changes or blinks once every 10 seconds is in the measurement mode. |
| Operational Check | | Follow the startup procedures. |
| | | Observe the three bar indicators on the Miniram display. OVR displayed? ________ If no, continue.<br>If yes, the Miniram detection circuit has been overloaded. Watch the display. A momentary overload can be caused by the insertion of an object into the sensing chamber, sudden exposure to sunlight, etc. If the cause of overload is eliminated, the OVR bar will disappear during the next 10-second display period. Display cleared?____________If no, continue.<br>If yes, the overload has persisted for more than a total of 1 1/2 minutes over an 8 1/3-hour measurement cycle. Clean the lenses as described in manual. If this does not correct, contact Equipment Stores for instruction.<br>If the OVR bar is displayed at any time during operation in the measurement mode, the Miniram detection circuit has been overloaded. |
| | | ID bar display is activated only for display identification purposes and not for error conditions. |
| | | BAT bar displayed? ____________ If no, continue. If yes, battery voltage is insufficient. Recharge. |
| | | Place Zero Bag on a flat surface with the red flow fitting facing up. Flatten bag and then unzip it. |
| | | Insert the ribbed elbow connector (attached to the filter cartridge) into the red flow fitting of the plastic bag, until the connector is flush with the bottom of the red flow fitting. |
| | | The Miniram should be in its OFF condition (observe display). If the display is blanked, or if the Miniram is in the MEAS mode, key OFF. |
| | | Open the Zero Bag, then place the Miniram in the center of the Zero Bag. |
| | | Key ZERO through the open end of the Zero Bag. Immediately zip close the Zero Bag and begin to pump the hand bulb. The zero concentration is automatically subtracted from the measurement readings. |
| | | The Zero Bag should inflate as the hand pumping continues, up to a height of about five inches. Continue pumping gently to maintain the bag interior pressure, until the Miniram displays OFF again. |
| | | Unzip the Zero Bag and remove the Miniram from it. |
| | | Press MEAS button. Display will show reading displayed while pumping the Zero Bag for up to two cycles or 20 seconds. After 20-30 seconds, display should be background below 1.0. |
| | | Store the Zero Bag flattened and zipped closed, with the ribbed elbow connector plugged in to ensure cleanliness of the bag's interior. |

| REALTIME AEROSOL MONITOR - MINIRAM | | |
|---|---|---|
| **ID/Serial No.:** | | **Date:** **Time:** **Signature:** |
| **ITEM** | **DONE** | **PROCEDURES** |
| Cleaning Procedures | | The interior walls and the glass windows of the sensing chamber should be cleaned when the zero reference reading exceeds 3 mg/m$^3$. |
| | | Open the sensor chamber with both thumbs by gently pushing the sensing chamber away from the display/control panel end. This will expose the two round lenses and a rectangular lens. |
| | | Clean the lenses with lens tissue or Q-tip and small amounts of isopropyl alcohol. Rinse thoroughly to remove any residues from the lenses. |
| | | Allow the sensing chamber to dry completely and re-insert the chamber back onto the Miniram with minimal pressure. |
| Calibration Procedures | | The Miniram is factory calibrated against a filter gravimetric reference using a standard test dust. Recalibration of the instrument is conducted every 12 months. Last calibration date: ________________________. |
| Operational Procedures | | Follow the startup procedures, operational check, and calibration procedures. |
| | | The Miniram will now run in the measurement mode for 500 minutes, after which it will stop, displaying the OFF reading, retaining in storage the concentration average and elapsed time information. If both MEAS and TIME are pressed at the same time (press TIME first while depressing MEAS), the Miniram will display CGO. The Miniram will then operate for an 8.3-hour run and will restart automatically and continue to measure for an indefinite number of 8.3-hour runs. |
| | | ID: Pressing ID# during the measurement period provides momentary display of identification number stored within the Miniram memory. The ID key in combination with other keys is used for several additional programming functions. |
| | | PKB: With the Miniram in the OFF mode, the stored information can be played back by pressing PKB. When the PKB key is initially pressed, the display will indicate "P" for 1 second. If PKB continues to be pressed for more than 1 second, then the stored data is automatically played back through the Miniram display: first, the identification number is displayed with the ID indicator bar on; next the shift or run number (7 through 1, starting with the last one) is shown (with the OVR indicator bar on as identification) followed by the monitoring time in minutes for that run; followed by the off-time between the last and next run (in tens of minutes); finally, the average concentration in mg/m$^3$. An average reading of 9.99 indicates that a significant overload condition occurred during that run. If PKB is pressed for less than one second, PA will be displayed, and the stored data will be fed out through the digital output jack of the Miniram for printout or computer storage. |
| | | TWA: This key stands for time-weighted-average. During the measurement mode, if TWA is pressed, the display will indicate the average concentration in mg/m$^3$ up to that instant, from the start of the last run. |
| | | SA: This key stands for shift average. During the measurement mode, pressing SA will provide a display of the aerosol concentration, up to that moment, averaged over an 8-hour shift period. |
| | | TIME: During the measurement mode, if TIME is pressed, the display will show the elapsed time, in minutes, from the start of the last measurement run. |
| Comments | | |

## DETECTOR TUBES - DRAGER

**ID/Serial No.:** **Date:** **Time:** **Signature:**

| **ITEM** | **DONE** | **PROCEDURES** |
|---|---|---|
| Startup Procedures | | Leak check the bellows pump by compressing the bellows, then insert an uncut tube into the inlet orifice. After a minute, observe the bellows pump. A pump that has not lost its deflated shape indicates no leak; a fully extended pump indicates a leak. Some drager pumps have a chain. A loose chain indicates no leaks; a taut chain indicates a leak. The manufacture recommends a 30-minute leak check. Remove the tube. |
| Calibration Procedures | | No field calibration is required. Calorimetric tubes are factory prepared. The pump requires quarterly volumetric calibration by the manufacturer. |
| Operational | | Reset the pump counter to zero (not all drager pumps have a pump counter). |
| | | Select the pump counter to zero (not all pumps have a stroke counter). |
| | | Select the colorimetric tube box required for monitoring. Record the tube expiration date(s). Do not use tube if after expiration date. |
| | | Observe the different layers, ampoules, and colors in the sample tube. Observe the markings on the tube. |
| | | Read the instruction sheet provided by the manufacturer. |
| | | Using the instruction sheet, identify the color change indicating a positive response of the chemical of interest. |
| | | Using the instruction sheet, identify markings on the pump. |
| | | Break both ends of the tube and insert into the pump. Observe directional arrows. |
| | | Direct the tube inlet near the test source. Pump the number of pump strokes required by the manufacturer (see instructions). Record on data sheet. |
| | | Identify the cross sensitivities identified by the manufacturer. |
| | | Remove the tube from the pump. Dispose of the tube in an appropriate manner. |
| Comments | | |

| | | |
|---|---|---|
| **DETECTOR TUBES - MSA KWIK DRAW** | | |
| **ID/Serial No.:** | **Date:** **Time:** | **Signature:** |
| **ITEM** | **DONE** | **PROCEDURES** |
| Startup Procedures | | Leak check the bellows pump by compressing the bellows, then insert an uncut tube into the inlet orifice. After a minute, observe the bellows pump. A pump that has not lost its deflated shape indicates no leak; a fully extended pump indicates a leak. Some drager pumps have a chain. A loose chain indicates no leaks; a taut chain indicates a leak. The manufacture recommends a 30-minute leak check. Remove the tube. |
| Calibration Procedures | | No field calibration is required. Colormetric tubes are factory prepared. The pump requires quarterly volumetric calibration by the manufacturer or WESTON Equipment Stores. |
| Operation | | Reset the pump counter to zero (not all pumps have a stroke counter). |
| | | Select the colormetric tube box required for monitoring. Record the tube expiration date(s). Do not use tube if after expiration date. |
| | | Observe the different layers, ampules, colors in the sample tube. Observe the markings on the tube. |
| | | Read the instruction sheet provided by the manufacturer. |
| | | Using the instruction sheet, identify the color change indicating a positive response of the chemical of interest. |
| | | Using the instruction sheet, identify markings on the tube. |
| | | Break off both ends of the tube and insert into the pump. Observe directional arrows. |
| | | Direct the tube inlet near the test source. Pump the number of pump strokes required by the manufacturer (see instructions). Record readings on data sheet. |
| | | Identify the cross sensitivities identified by the manufacturer. |
| | | Remove the tube from the pump. Dispose of the tube in an appropriate manner. |
| Comments | | |

**MONITOX - HCN**

**ID/Serial No.:** **Date:** **Time:** **Signature:**

| ITEM | DONE | PROCEDURES |
|---|---|---|
| Startup Procedure | | Turn Switch to BATT position. Fluctuating tone heard within 10 seconds? |
| | | If yes, immediately turn switch to On when tone sounds. |
| Operation Check | | Check HCN generator. Remove cap from generator well. Is filter pad moist? |
| | | Place HCN generator on top of HCN Monitox so detector housing fits into generator well and body of generator rests on top of Monitox. Push down. |
| | | Green light on side of generator on? _____ If yes, HCN being generated. Monitox alarm should activate within 10 seconds. If yes, record reading on Monitox: then continue. |
| | | Red light on side of generator on? ______ If yes, replace battery. If no, continue. |
| Calibration | | Calibration is performed only by a trained technician. Follow the startup procedures and operational check. Record date of last WESTON ES, supplier/factory calibration. Less than 12 months ago? If no, return to ES, factory, or supplier for check and calibration. Daily Operation checks are performed per above. |
| Replace Battery - Monitox | a. | 1. Turn Switch OFF.<br>Remove three screws (two at bottom corners, one at top inside belt clip) on back. |
| | | 2. Turn detector over and separate two halves taking care not to pull wires. |
| | | 3. Lift out battery housing and disconnect plug. |
| | | 4. Unscrew and remove battery lids. Replace batteries with new (2 x PX 23 (5.6V)) batteries. |
| | | 5. Replace battery lids. Plug in battery plug ensuring cable and cable socket align properly. |
| | | 6. Replace battery housing and front cover; carefully adjust the cable of the front panel, so it is not damaged by replacing front panel and tightening screws. |
| | | 7. Replace front. Tighten screws and repeat battery test. |
| Replace Filter Cap | b. | 1. Follow steps a.1. and a.2. above as if replacing battery. |
| | | 2. Carefully remove sensor along with filter cap and pull filter cap off. |
| | | 3. Attach new filter cap (must have identical gas label HCN); put sensor back in position. |
| | | 4. Follow a. 6. and a.7. above. |
| Replace Battery Generator | c. | 1. Replace battery with Mallory (or equivalent) 9V battery.<br>Remove four screws on rear housing and carefully separate halves.<br>Disconnect old battery; replace with new.<br>Close two halves of case being careful not to pull or pinch wires. Replace four screws. |
| Replace Sensor Cell | d. | |
| Comments | | |

## MONITOX - COCL

**ID/Serial No.:** **Date:** **Time:** **Signature:**

| ITEM | DONE | PROCEDURES |
|---|---|---|
| Startup Procedure | | Turn Switch to BATT position. Fluctuating tone heard within 10 seconds? |
| | | If yes, immediately turn switch to On when tone sounds. |
| Operation Check | | Check COCL$_2$ Generator. Remove cap from generator well. Is filter pad moist? |
| | | Place COCL$_2$ generator on top of COCL$_2$ Monitox so detector housing fits into generator well and body of generator rests on top of Monitox. Push down. |
| | | Green light on side of generator on? _____ If yes, COCL$_2$ being generated. Monitox alarm should activate within 10 seconds. If yes, record reading on Monitox: _____ then continue. |
| | | Red light on side of generator on? _____ If yes, replace battery. If no, continue. |
| Calibration | | Calibration is performed only by a trained technician. Follow the startup procedures and operational check. Record date of last WESTON ES, supplier/factory calibration _____. Less than 12 months ago? If no, return to ES, factory, or supplier for check and calibration. |
| Replace Battery | a. | 1. Turn Switch OFF.<br>Remove three screws (two at bottom corners, one at tope inside belt clip) on back. |
| | | 2. Turn detector over and separate two halves taking care not to pull wires. |
| | | 3. Lift out battery housing and disconnect plug. |
| | | 4. Unscrew and remove battery lids. Replace batteries with new (2 x PX 23 (5.6V)) batteries. |
| | | 5. Replace battery lids. Plug in battery plug ensuring cable and cable socket align properly. |
| | | 6. Replace battery housing and front cover; carefully adjust the cable of the front panel, so it is not damaged by replacing front panel and tightening screws. |
| | | 7. Replace front. Tighten screws and repeat battery test. |
| Replace Filter Cap | b. | 1. Follow steps a.1. and a.2. above as if replacing battery. |
| | | 2. Carefully remove sensor along with filter cap and pull filter cap off. |
| | | 3. Attach new filter cap (must have identical gas label COCL$_2$); put sensor back in position. |
| | | 4. Follow steps a. 6. and a.7. above. |
| Replace Battery Generator | c. | 1. Replace battery with Mallory (or equivalent) 9V battery.<br>Remove four screws on rear housing and carefully separate halves.<br>Disconnect old battery replace with new.<br>Close two halves of case being careful not to pull or pinch wires. Replace four screws. |
| Replace Sensor Cell | d. | 1. Will be done by vendor or equipment stores. |
| Comments | | |

# STANDARD OPERATING PROCEDURE G-2

# DECONTAMINATION

# STANDARD OPERATING PROCEDURE G-2

# DECONTAMINATION

## 1. SCOPE AND APPLICATION

All personnel or equipment involved in intrusive sampling or which enter an area during intrusive sampling must be thoroughly decontaminated prior to sampling and prior to leaving the site to minimize the spread of contamination and prevent adverse health effects. This Standard Operating Procedure (SOP) describes the normal decontamination of sampling equipment and site equipment. To minimize the possibility of cross-contamination of samples (contamination of a sample by chemicals picked up at another area and transferred to an analytical sample by sampling or drilling equipment), proper decontamination procedures must be followed consistently.

Generally, solvents are used to remove organic compounds, such as VOCs and PCBs; nitric acid is used to remove residual metals; and the detergent wash and/or steam cleaning are used to remove gross contamination and soil. All material and equipment should arrive intact and in clean condition. Recommended procedures for equipment decontamination during drilling, test pit operations, sampling, and other field investigation procedures are described in the following sections.

## 2. EQUIPMENT

Plastic sheeting, buckets, etc. to collect wash water and rinsates

Approved potable water

Deionized (DI) water

Medical-grade isopropanol or equivalent, hexane

Reagent grade 0.10N nitric acid

Non-phosphate laboratory detergent (liquinox)

Aluminum foil or clean plastic sheeting

Pressure spraying, rinse bottles, brushes

Plastic garbage bags

0.01N HCl

# 3. RELATED PROCEDURES

None

# 4. PROCEDURE

## 4.1 SAMPLE BOTTLES

At the completion of each sampling activity, the exterior surfaces of the sample bottles must be decontaminated as follows:

- Be sure the bottle lids are on tight.
- Wipe the outside of the bottle with a paper towel to remove gross contamination.

## 4.2 SOIL SAMPLING EQUIPMENT

Sampling equipment that will be used includes materials such as stainless steel bowls, trowels, scoopulas, and split-spoons. Equipment to be used during sampling will be decontaminated at a centralized decontamination area site at which the equipment is being used. All sampling equipment will be decontaminated after use to prevent cross-contamination between sampling points. Decontaminated equipment will then be wrapped in aluminum foil with the shiny side facing out. No sampling debris will be left on any site.

The procedure for decontaminating sampling equipment is as follows:

- Place dirty equipment on a plastic ground sheet at the head of the decontamination line.
- Rinse equipment with potable water to remove surface dirt and mud if necessary.

- Scrub equipment with a bristle brush using a non-phosphate detergent (e.g., Liquinox) and potable water. To clean the inside of a bailer, use a bottlebrush pulled through the bailer with a polypropylene cord.

- Rinse off soap with potable water.

- Using a squirt bottle, rinse with 10% ultrapure nitric acid (use 1% nitric acid for metallic sampling materials) if equipment will be used for the collection of metals samples. Collect nitric acid rinsate in a tub or bucket.

- Rinse with ASTM Type II reagent-grade water.

- Rinse with medical-grade isopropanol. Collect solvent rinsate in a tub or bucket separate from the nitric acid rinsate.

- Rinse with medical-grade isopropanol. Collect solvent rinsate in a tub or bucket separate from the nitric acid rinsate.

- Rinse with ASTM Type II reagent-grade water.

- Allow equipment to air dry.

- Wrap equipment with aluminum foil (shiny side facing out).

- Sampling equipment used to collect samples for organic analyses will not be allowed to contact any type of plastic after decontamination.

At the end of the decontamination procedures, the proper disposal of the decontamination liquids will include the following steps:

- Discharge potable water in the decontamination area.

- Rinse soapy washtub in the decontamination area only.

- Dilute the detergent wash water and discharge it in the decontamination area.

- Overturn tubs to allow them to drain.

- Rinse tub bottoms and stack tubs for future use.

- The hexane, isopropanol, nitric acid, and DI rinse should be placed in a designated 55-gallon drum or other designated container for future characterization and disposal.

## 4.3 DRILLING EQUIPMENT

Drilling rigs will arrive on-site in clean condition and will be inspected by a WESTON geologist. After arrival at the site, all equipment, tools, and tool storage areas that will be used in the drilling, sampling, and completion of the soil borings and monitor wells will be steam cleaned before initiating drilling at any site to remove road dirt. The frequency and procedures for decontamination of drilling equipment are as follows:

- The drill rig and all equipment will be steam cleaned when they are moved to new sites, or more often if required by WESTON.
- The drill rig (i.e., deck derrick and undercarriage) will not be steamed cleaned between soil borings and wells at the same site unless gross contamination is present on the rig that could fall off and enter subsequent boreholes. It is very important during this initial decontamination of the rig to check the threads of the drilling rods and drilling bits for grease, and to remove it (with a wire brush and Liquinox detergent) if it is present. The only allowable "lubricant" on the threads is Teflon tape.
- The surfaces of the drilling equipment including drill rods, augers, bits, and associated tools (including any tape measures) will be decontaminated at a central site-specific decontamination area using the following procedures:
    - Remove all gross amounts of mud/soil using a shovel, wire brush, or other tools.
    - Transport drill rig and tools to site decontamination area.
    - If necessary, use a brush and a Liquinox detergent/potable water solution to scrub the drilling tools that may enter a subsequent borehole (if the soil/mud on the tools can be easily removed by steam cleaning, this step can be skipped).
    - Steam clean drilling tools using a Liquinox/potable water solution.
    - Steam clean drilling tools using potable water to rinse the detergent solution off the tools and drilling rig.
    - Steam clean all manmade construction materials, including temporary and permanent casing, riser pipe, and well screen, with a Liquinox/potable water solution followed by a potable water rinse.
    - Drill rods and manmade well construction materials will be decontaminated on a steel rack (1 set per rig on-site), provided by the driller, that keeps the piping 2 or 3 feet above the ground. Precautions should then be taken, by using plastic sheeting, to ensure that decontaminated casing, augers, and other equipment do not come into contact with the ground and that the storage areas on the drill rig or tender are clean.

- At the decontamination site, it may be necessary to fill out properly a Hot Work Permit, depending on the type of steam generator present.

- During split-spoon sampling, subcontractor personnel may be required to help decontaminate the used split-spoons by performing the initial gross cleaning of the split-spoon using a Liquinox (or equivalent) solution and scrub brushes. WESTON personnel will supervise the initial cleaning and then complete the balance of the decontamination procedures. If, because of sample preparation or description activities, the on-site WESTON personnel are unable to complete the decontamination in a timely manner and subcontractor personnel are waiting for split-spoons, standby charges will not be incurred. It will be the responsibility of the subcontractor personnel to complete the split-spoon decontamination, including solvent rinse, under WESTON supervision.

Note: Chargeable subcontractor decontamination time includes half of the travel time to a central decontamination area, if required, plus the actual time spent for the decontamination. If equipment requires additional decontamination because of contact with the ground or dirty portions of other equipment, this time is not chargeable. Decontamination will be performed to the satisfaction of the WESTON supervisor.

## 4.4 BACKHOE

If a backhoe is being used to excavate test pits in contaminated soil, or if analytical soil samples are to be collected from test pits, the following decontamination procedures should be followed:

- Prior to excavation of any test pit and between test pits, steam clean the backhoe bucket and arm using a non-phosphate detergent (i.e., Liquinox/potable water solution).

- Rinse the detergent solution from the backhoe bucket and arm by steam cleaning with potable water.

## 4.5 FIELD PARAMETER EQUIPMENT

- Water level indicators and transducers used for measurement of water in wells and in surface waters will be decontaminated after each use by flushing with ASTM Type II reagent-grade water prior to and after each use. If floating product or high levels of organic contamination are evident, or known to exist in a well, the full sampling decontamination procedure outlined in Subsection 4.2 will be employed.

- The HORIBA U-10, temperature, dissolved oxygen, PX, and electrical conductivity probes will be flushed with ASTM Type II reagent-grade water between measurements. No solvents will be used to clean these probes.
- Turbidimeter sample vials will be wiped dry after being filled with a sample and prior to insertion into the turbidimeter. After the measurement is taken, the sample vial and the turbidimeter will be flushed with ASTM Type II reagent-grade water.

### 4.6 SUBMERSIBLE PUMP

All submersible pumps used for sampling or for well development will be decontaminated after use to prevent cross-contamination between wells. The procedure for decontaminating submersible pumps is as follows:

- Scrub pump and cord in a tub of Liquinox and potable water.
- Pump at least 20 gallons of the soapy water through the pump.
- Rinse with potable water.
- Pump at least 20 gallons of rinse water through the pump.
- Rinse with DI water.
- Place pump in a decontaminated, plastic garbage can, or wrap it in clean plastic.

After decontamination, the proper disposal of the decontamination liquids includes the following steps:

- Drain wash water and rinse in decontamination area.
- Rinse decontamination containers with potable water.
- Allow containers to dry overnight.

## 5. PRECAUTIONS

- Dispose of all wash water, rinse water, rinsates, and other sampling wastes (tubing, plastic sheeting, etc.) in properly marked, sealable containers, or as directed.
- Once a piece of equipment has been decontaminated, be careful to keep it in such condition until needed.

- Follow the health and safety plan in regard to PPE, especially with regard to eye protection and gloves.

## 6. REFERENCES

99-0164 American Society for Testing and Materials. 1990. "Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Site." ASTM Standard D5088-90. In: American Society for Testing and Materials (ASTM). 1996. *ASTM Standards on Ground Water and Vadose Zone Investigations: Drilling, Sampling, Well Installation, and Abandonment Procedures,* West Conshohocken, PA, ASTM Publication: 03-418196-38.

# STANDARD OPERATING PROCEDURE G-3

# FIELD DOCUMENTATION

# STANDARD OPERATING PROCEDURE G-3

# FIELD DOCUMENTATION

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes procedures for maintaining sample control through proper sample documentation. When samples are collected for chemical or physical characteristics analysis, documentation such as chain-of-custody and sample analysis request forms, custody seals, and logbooks needs to be completed. The information presented in this section enables maintenance of sample integrity from time of collection through transportation and storage. It is this documentation that will verify that the samples were properly handled.

The following discussion outlines standard practices and procedures to be used when documenting a sampling episode. This includes identification of procedures required for field documentation, sample labeling, and the maintenance of chain-of-custody. Applicable requirements are identified in the following paragraphs. Proper completion of the logbook and supporting paperwork with indelible ink is necessary to support potential enforcement actions that may result from the sample analysis; therefore, maintaining sample integrity through proper documentation is essential.

All data collection will be documented in either a field notebook or appropriate Geologic Logging and Interpretation System (GEOLIS) forms in a bound logbook. Field notebooks will be assigned to individual field personnel for daily entrees. Notes in the bound field notebooks will be written in black or blue ink, and be as detailed and descriptive as possible so that a particular situation may be recalled without reliance on the collector's memory. There should be no erasure or deletions from the field notes.

The field logbook should enable the sampling activity to be reconstructed without relying on the collector's memory. Logbooks should be kept in the field member's possession or in a secure place during field work. The following topics should be recorded in the field logbook:

- Name and title of author, date, and time of entry.

- Name and address of field contact.
- Names and responsibilities of field crew members.
- Names and titles of any site visitors.
- Sample collection method.
- Number and volume of sample(s) taken.
- Information concerning sampling changes, scheduling modifications, and change orders.
- Details of sampling location.
- Date and time of collection.
- Field observations.
- Any field measurements made.
- Sample identification number(s).
- Information from containers, labels of reagents used, de-ionized water used for blanks, etc.
- Sampling methodology.
- Sample preservation.
- Sample distribution and transportation.
- Sample documentation (e.g., chain-of-custody record numbers).
- Decontamination procedures.
- Documentation for investigation-derived wastes (IDWs) (e.g., contents and approximate volume of waste, disposal method).
- Documentation of any scope of work changes required by field conditions.
- Signature and date (entered by personnel responsible for observations).

## 2. EQUIPMENT

GEOLIS Field Logbooks
Pen
GEOLIS Field Manual

# 3. RELATED PROCEDURES

None

# 4. GEOLIS FIELD LOGBOOKS

## 4.1 BOREHOLE, WELL, OR TASK COMPLETION

- A field team member must submit the original logbook to the Data Administrator for copying within 2 days after the borehole completion. The field team must clearly indicate which logs are to be copied. The Data Administrator will copy the appropriate logs and return the logbook to the field team.

- When the logbook has been filled and all logs included have been copied, the logbook will be returned to a secure place for safekeeping.

Corrections to all documentation must be done using the following procedures:

- Use a black or blue ink pen.

- Cross out the data with a single strike mark. Ensure that the original entry being struck out is still readable.

- Initial and date the strike mark.

## 4.2 DRILLING DOCUMENTATION

All borehole lithologies are logged into the section containing GEOLIS® Borehole Logging forms. One page of these forms is required to describe each lithologic change (interval) within the sampling interval. In addition to logging the various lithologic descriptions in the appropriate overburden or bedrock section, particular care must be taken to thoroughly complete each lithologic sheet while on-site. Overall drilling method descriptions, such as borehole diameter over a specific interval, drilling method over that interval, and drill fluid, should be logged in the Borehole Location Form at the beginning of each section of the field logbook.

## 4.3 BOREHOLE LOGGING AND WELL CONSTRUCTION

The GEOLIS® system is used to log, manage, and interpret soil boring, well completion data, sampling data, and other data collected in the field. The GEOLIS® system was developed to provide consistent, systematic, and complete descriptions of soil and rock. GEOLIS® consists of the GEOLIS® Soil/Rock Logging Procedures and the GEOLIS® Data Management Software package.

The GEOLIS® Soil/Rock Logging Procedures are standardized operational procedures to be used when drilling boreholes and logging soil samples. The procedures center on the following three forms that are used to log the pertinent borehole information:

- Borehole Location Form (see Figure B-1, Appendix B).
- Lithologic Logging Form (see Figure B-2, Appendix B).
- Well Construction Forms (see Figures B-3 and B-4, Appendix B).

The WESTON's GEOLIS Logging Reference Manual [00-0236], provided to each field team, describes the protocols in detail. Brief descriptions of the information logged on each form are:

- **Borehole Location Form**—Provides information on borehole specifics, such as the field and location identification numbers; start and finish dates; geologist and driller information; and types of drill rig, drilling methods, and fluids used.

- **Lithologic Logging Form**—Provides a detailed checklist for describing the soil and bedrock encountered during drilling. The Lithologic Logging Form allows the geologist or soil scientist to describe the soil or bedrock encountered using a combination of standardized parameters. Information is recorded for the following data types: standard penetration, blow counts, recovery, sampling method, analytical samples collected, organic vapor readings, and lithologic data required for classification using ASTM Method D2488.

- **Well Construction Form**—Provides a detailed checklist for pertinent well completion information and provides for a graphic presentation of well completion data.

Logbooks containing the three forms are bound and assigned uniquely to each site.

### 4.3.1 Lithologic Data

All borehole lithologies are logged into the section containing the GEOLIS® Borehole Logging Forms. One page of these forms is required to describe each lithologic change while conducting the sampling interval. In addition to logging the various lithologic descriptions in the appropriate section (bedrock or overburden), the following items must be noted on each sheet:

- Header items (client, site, borehole number, date, and logger's name).
- Sampling method.
- Water entry zones.
- Rock quality determination (RQD) for bedrock cores.
- Sample ID numbers, intervals, and sample types.
- Material origin (natural or fill).
- Observed product, odor, or sheen.
- Instrument readings.
- Information not adequately addressed in any preceding section is added in the comment section, or in the blank notes section provided in each logbook.

### 4.3.2 Well Construction

In the event that a borehole is completed as a groundwater monitoring well or piezometer, all details of the construction are logged in the Well Construction Form. Detailed instructions for completing this form are found in the GEOLIS® Logging Reference Manual (00-0236).

### 4.3.3 Subcontractor Work and Supplies

In addition to logging all pertinent borehole and well information, the field geologist is also responsible for noting the times of the contractor activities and quantities of all supplies provided by the subcontractor. This information is important for accurate subcontractor billing record keeping. This information is logged on the Drilling Activity Log Form (see Figure B-5, Appendix B). The form is designed to help check the driller's invoices, and must be reviewed and signed by the subcontractor. This is done daily, and a copy of the signed form is given to the On-Site Manager.

### 4.3.4 Well Development

This subsection describes the procedures for well development and documenting the process using the GEOLIS Well Development Form (see Figure B-6, Appendix B). The data are recorded in well development logbooks, and the procedure for collecting and reporting the data is as follows:

- Sign out the appropriate well development logbook.
- Record the data for well development and driller activities.
- Estimate final well yields.

### 4.3.5 Additional Information

GEOLIS field logbooks contain blank pages to note additional information such as site conditions; weather; the presence of any oversight, regulatory, or other visitors; and supplemental information on each day's activities, such as technical data, sketches, drilling difficulties, or approved changes to standard procedure (see Figures B-7 through B-9, Appendix B).

## 4.4 SOIL AND WATER SAMPLE DOCUMENTATION

Various GEOLIS forms are used to document soil, sediment, and water samples that are collected. These forms are listed below.

### 4.4.1 Soil and Sediment Sampling

The soil/sediment sampling form contains location data and sampling data for surface soil and/or sediment. An example is presented as Figure B-10, Appendix B.

### 4.4.2 Soil Boring Sampling

The soil boring sampling form lists the various soil samples that may have been collected from a soil boring, including sample ID, sample collection time, and depth. An example is presented as Figure B-11, Appendix B.

### 4.4.3 Test Pit Logging Form

The test pit logging form is used to record samples collected from test pits, the nature of the soil within the test pit, water entry zones, and types of material observed. An example is presented as Figure B-12, Appendix B.

### 4.4.4 Water Level Form

The water level form is used to record depth to water within monitoring wells and other types of wells. It includes measurement of NAPL thicknesses and total well depth. An example is presented as Figure B-13, Appendix B.

### 4.4.5 Well Purging

The well purging form records volumes of water removed from wells during purging and field measurement parameters such as temperature, conductivity, DO, etc. An example is presented as Figure B-14, Appendix B.

### 4.4.6 Water Sampling

The water sampling form records the sampling information for either surface water samples or groundwater samples. Information includes analytical parameters, sampling method, QA samples, splits, and field parameters. An example is presented as Figure B-15, Appendix B.

## 4.5 SAMPLING LOCATION DOCUMENTATION

The exact locations of sampling points will be documented for purposes of generating an accurate representation of the site conditions using the data generated to date, defining data gaps, and identifying potential future data needs. This is accomplished through the use of a monument.

A piece of wood should be hammered into the ground to almost ground level, making it difficult to remove, thus ensuring its permanence. The stake should then be marked with flagging tape or fluorescent paint.

The project site and location identifiers are designed to provide a method of identifying sampling points and allowing them to be posted on GIS maps for future data presentation and interpretation.

The location ID, physical location description, sampling depths, split samples, and sample comments will be entered for each location as it is established and sampled on the Sample/ Location Attribute Form (see Figure B-16, Appendix B).

All sampling locations will be surveyed for horizontal and vertical coordinates using field GPS units or by a licensed surveyor at the time of sampling or as soon after sampling as practical to ensure that the monuments have not been removed or covered over.

## 5. REFERENCES

00-0236 WESTON (Roy F. Weston, Inc.). 1995. *GEOLIS Reference Manual*.

# STANDARD OPERATING PROCEDURE G-4

# FIELD FILTRATION

# STANDARD OPERATING PROCEDURE G-4

# FIELD FILTRATION

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure outlines two different techniques for the filtration of liquid media (i.e., groundwater, surface water, and potable water). The procedures will address in-line filtration, where the filter assembly is under positive pressure, and vacuum filtration, where the filter assembly is under negative pressure. In addition, the procedures describe and recommend specific filtration equipment. Filtration of aqueous samples is performed when the removal of silt, algae, particulate, and other debris is desired. Predominantly, filtration is employed when water samples are to be tested for dissolved metals. Filtered samples for metals (dissolved fraction) and other strongly sorbed contaminants such as PCBs should be analyzed in conjunction with non-filtered samples to determine the concentration in solution versus metals associated with solids.

The following instructions will focus on positive and negative pressure filtration of aqueous media. In the instructions, specific types of filtration devices will be referenced. Because most filtration will be for the purpose of determining “dissolved” versus total metals, these instructions assume a filter pore size of 0.45 µm. Analytical methods used to determine dissolved metal concentrations have historically used 0.45-µm filters to separate dissolved and particulate phases. Filters less than 0.45 µm may be necessary in certain circumstances.

## 2. EQUIPMENT

See individual methods for equipment.

## 3. RELATED PROCEDURES

G-2 Decontamination

# 4. PROCEDURE

## 4.1 POSITIVE PRESSURE FILTRATION

Aqueous samples that may require positive pressure filtration include groundwater samples, surface water samples, and potable water supply samples. To filter an aqueous sample using the positive pressure technique, a pump, filter, and tubing are required. The following are examples of equipment that may be used for positive pressure in-line filtration. Positive pressure filtration is the preferred filtering method.

### 4.1.1 Pump

Pump System

High Flow Range: 3 - 2,300 mL/min

Low Flow Range: 06 - 460 mL/min

System Flow Control: ± 10%

### 4.1.2 Filter Assembly

Groundwater Sampling Capsule

0.45-µm Pore Size

1/4" - 1/2" Tapered Barb Fitting

Continuous Use Pressure: 60 psi @ Ambient

Maximum Momentary Pressure: 100 psi @ Ambient

### 4.1.3 Filtration Procedure

- Use polytetrafluoroethylene (PTFE) tubing for pump and filter connections.
- Connect the 0.45-µm in-line filter to the discharge tubing from the pump. Make sure the flow arrow on the filter is pointing in the correct direction.
- Place the pump into the water body (e.g., groundwater, surface water) to be sampled. This placement of the pump will prevent the water from coming into contact with the atmosphere, which might cause the dissolved metals to precipitate out, thus biasing

the data low. If a peristaltic pump is used, the end of the pump's tubing is placed below the water body surface.

- Apply pressure to the liquid sample (via pump) to force it through the filter into a sample container.
- Replace the in-line filter when the flow becomes too restricted because of buildup on the filter. To replace the filter:
  - Discontinue pumping (turn off pump).
  - Relieve the pressure in the system (line between the pump and the filter).
  - Disconnect the filter and replace with a new one.

## 5. POTENTIAL PROBLEMS

One inherent problem associated with the filtration of aqueous environmental samples is the filter becoming clogged. The following are some considerations regarding liquid filtration:

- Always have extra filters available at the sampling site.
- Pre-filter dirty samples with a larger pore size filter.
- For highly turbid samples, a negative filtration system may be more efficient.
- Avoid pouring sediments from the bottom of the collection flask into the filter funnel.
- When the filtrate flow becomes too slow because of filter loading, change the filter. Avoid increasing the pressure and rupturing the filter membrane.

# STANDARD OPERATING PROCEDURE G-5

# FIELD MEASUREMENTS

# STANDARD OPERATING PROCEDURE G-5

# FIELD MEASUREMENTS

## 1. SCOPE AND APPLICATION

This section presents a description of the field procedures that must be followed before collecting any type of water sample. The procedures in this section are usually performed by the sampling team.

## 2. EQUIPMENT

Procurement of equipment and/or supplies for field efforts will be coordinated with the Equipment Manager. Equipment used for measuring the basic physical and chemical properties of water include:

- Water level probe (including oil/water interface probe and modified tape measure for total depth measurement).
- Turbidity meter.
- Conductivity/temperature meter.
- Dissolved oxygen meter.
- Alkalinity kit.
- pH meter.
- Photoionization detector (PID) such as an HNu.

### 2.1 TEMPERATURE, PH, ELECTRICAL CONDUCTIVITY, TURBIDITY, AND DISSOLVED OXYGEN

The instrument most frequently used to measure temperature, pH, electrical conductivity, turbidity, and dissolved oxygen is the HORIBA U-10 water quality checker. The HORIBA U-10 water quality checker is an instrument designed for simultaneous, multiparameter measurements of water quality using one probe. Measurements are displayed sequentially on the hand-held digital LCD readout. The following procedure is used for taking analytical measurements of water sampled with the HORIBA U-10:

- Press the POWER key to turn the instrument on.
- Gently place the probe into the water sample collected in a 5-gallon bucket. Never throw or drop the probe into the water.
- Use the SELECT key to move the upper cursor on the readout to each parameter to be measured.
- To obtain a uniform reading, slowly move the probe up and down to circulate water through it.
- Use the EXP key to select the expanded readout mode to display measurements with one additional decimal place of accuracy.
- Record measurements in the GEOLIS logbook.
- After the measurement, turn power OFF. Rinse the probe with ASTM Type II reagent-grade water.

The HORIBA U-10 will be calibrated daily by only the on-site field logistics technician. If an instrument failure occurs, field personnel will return the instrument to the on-site technician for repairs. An inventory of replacement parts will be maintained on-site to facilitate quick field repairs. Individual sensors in the probe can be replaced by the on-site technician. Note: The meter should not be used when it is known that product is present in the water sample.

In the event that the HORIBA U-10 becomes totally inoperative, field analytical measurements will be taken with the following or equivalent instruments:

- pH—Analytical Measurements' Model 107 portable pH meter.
- Temperature and electrical conductivity—YSI Model 33 meter.
- Turbidity—HF Scientific Model DRT 15 turbidimeter.
- Dissolved oxygen—YSI Model 50 B DO meter.

## 2.2 ELECTRICAL CONDUCTIVITY METER

The YSI Model 33, or equivalent, is a portable, battery-operated, transistorized instrument with a standard probe used to measure salinity, electrical conductivity, and temperature in surface water, groundwater, and wastewater. The meter is calibrated daily, or each time the meter is turned on. Setup and calibration procedures follow.

Set up the instrument as follows:

- Adjust meter zero, if necessary, by turning the screw on the meter face so that the meter needle coincides with the zero on the conductivity scale.
- Calibrate the meter by turning the mode control to Redline and adjusting the Redline control so that the meter needle lines up with the redline on the meter face. If this cannot be accomplished, replace the two “D” batteries.

Check the probe for cleanliness as follows:

- Plug the probe into the probe jack on the side of the instrument.
- Place the probe into the solution and measure on the X100 or X10 scales.
- Depress the Cell Test button. The meter reading should be less than 2%; if it is greater, the probe must be cleaned.

Clean the probe as follows:

- Spray Dow Chemical’s Bathroom Cleaner with Scrubbing Bubbles into the holes in the terminal end of the probe. You may also use Lysol brand Basin, Tub, and Tile Cleaner.
- Soak the probe for 5 minutes.
- Gently spray rinse the probe with DI water.
- Do not touch the electrodes inside the probe.

For a loose or slipping temperature knob:

- Read the temperature and conductivity of a solution.
- Determine the salinity of the solution from the calibration by running a line vertically from the conductance value to the appropriate °C line. From this intersection, extend a line horizontally to the edge of the graph and read the salinity value.
- Remove the °C knob.
- Switch to the salinity function knob.

- Turn shaft under the °C function knob until the meter needle reads the salinity value determined previously.
- Switch to the temperature function knob.
- Place the °C knob on the shaft without turning the shaft, with the knob pointer indicating the meter temperature reading.
- Tighten both set screws securely.
- Return meter for factory calibration as soon as possible.

## 2.3 PH METER

Analytical Measurements' Model 107 pH meter is a portable pH monitoring instrument for determining the pH value of groundwater, surface water, and wastewater.

This instrument requires a daily function and accuracy check prior to being issued for field use. This test is performed as follows:

- Connect the probe to the BNC connector provided on the unit.
- Move the selector switch to the check position.
- Using the buffer knob, move the meter pointer over the full scale. If full-scale deflection cannot be obtained, the battery must be replaced before continuing.
- Move the selector switch to pH position.
- Immerse the probe in pH 7 buffer solution.
- Adjust the buffer knob so that the pointer indicates pH 7.
- Rinse the probe in distilled water.
- Immerse the probe in pH 4 buffer solution.
- Adjust the temperature knob so that the pointer indicates pH 4.
- Immerse the thermometer into pH 4 buffer solution and take a reading.
- Compare the thermometer reading to the temperature indicated by the temperature knob on the instrument. If these two values do not match, the instrument must be returned to a qualified service technician for calibration of the internal temperature compensation circuitry.

- Rinse the probe in distilled water.
- Immerse the probe in pH 10 buffer solution and record the reading.

After the unit has been calibrated, the following method is used to take field measurements:

- Immerse the thermometer into the sample and take a reading.
- Adjust the temperature knob to match the thermometer reading.
- Turn the selector switch to check position.
- Adjust the buffer knob to match the reading that was recorded during the calibration procedure.
- Turn the selector switch to the pH position and take a reading of the sample.
- Rinse the probe in distilled water.
- Record the results in the field logbook.

## 2.4 TURBIDIMETER

The Fisher Model DRT-15 turbidimeter, or equivalent, is a portable instrument designed to measure the turbidity of samples of water, wastewater, liquid fuels, cooling water, and colored liquids. The instrument provides linear turbidity measurements over four switch-selectable ranges: 0 to 1.0, 10, 100, and 200 nephelometric turbidity units (NTU). It is sensitive to a change of 0.02 NTU on the 0 to 1 NTU scale.

The turbidimeter requires verification of calibration daily or each time the meter is turned on (if more than once per day). A reference standard of 0.1 NTU is required for verification of calibration. If measurement of the reference standard indicates that recalibration is necessary, or if the electronic PC board, the photodetectors, or the light source have been replaced, the turbidimeter should be recalibrated as follows.

Solutions with formalin suspension values of 198, 19.8, and 2.0 NTU are necessary for calibration as follows:

- Fill, cap, and label a separate cuvette sample of each.

- Always mix the contents of each cuvette by inverting several times before placing in the optical well for a reading.

- Keep the outside surface of cuvette clean.

- When placing any standards in the well, always use the light shield to cover the well to keep out ambient light.

To gain access to the tripods, remove the accessories from the foam holder. Proceed as follows:

1. Center the reference adjust control on top of the instrument.
2. Insert the reference standard, and turn the range control on the DRT-1SC to the 20 range. Adjust the Coarse Zero trimpot until a reading of 0.10 NTU is obtained.
3. Replace the reference standard with the 2.0 NTU formalin standard, and adjust the "20 Range Adjust" trimpot to obtain a reading of 2.0 ± 0.1 NTU.
4. Replace the 2.0 NTU formalin standard with the reference standard, and adjust the control to obtain a reading of 0.10 NTU.
5. Repeat steps 3 and 4 until no further adjustments are required.
6. Insert the 19.8 NTU formalin standard, and adjust the "20 Range Adjust" trimpot to obtain a reading of 19.8 ± 0.1 NTU.
7. Turn the range control on the DRT-150 to the 200 range. Insert the 198 NTU formalin standard, and adjust the "200 Range Adjust" trimpot to obtain a reading of 198 NTU.

Additional calibration by EPA Method 180.1 will be performed after the aforementioned calibration is performed to check the accuracy of the calibration scales. The following steps will be conducted:

- For turbidities less than 40 units: shake the sample to thoroughly disperse the solids. Wait until air bubbles disappear, then pour the sample into the sample curvette. Read the turbidity directly from the instrument scale or from the appropriate calibration curve.

- For turbidities greater than 40 units: dilute the sample with one or more volumes of turbidity-free water until the turbidity falls below 40 units. The turbidity of the original sample is then computed from the turbidity of the diluted sample and the dilution factor. For example, if 5 volumes of turbidity free water were added to 1 volume of sample, and the diluted sample showed a turbidity of 30 units, then the turbidity of the original sample was 180 units.

- **Calculation**—Multiply the sample readings by the appropriate dilution to obtain a final reading.

Report the results as follows:

| NTU | Record to Nearest |
|---|---|
| 0.0 to 1.0 | 0.05 |
| 10 to 40 | 1 |
| 100 to 400 | 10 |
| 400 to 1,000 | 50 |
| >1,000 | 100 |

## 2.5 DISSOLVED OXYGEN METER

Total dissolved oxygen (DO) will be measured using a YSI 50B or YSI 51B DO meter (or equivalent). The meter will be calibrated at the beginning of each day and checked periodically during sampling. Before the YSI Model 50B DO meter can be used, the sampling team must initially set up the instrument as follows:

- Connect the probe to the meter, then place the probe in a constant oxygen environment, such as a BOD bottle or the calibration bottle supplied.

- Set the function switch to the C position. An audible tone will sound. This is a signal that the microprocessor’s Power On Self Testing (POST) diagnostic mode has been activated. Observe the display to ensure all meter segments appear. A second tone will sound in about 7 seconds to signal the end of the POST diagnosis, and the display will blank briefly.

- If the POST diagnosis uncovers a fault in the instrument operation, the display will not appear, or will freeze. Should this occur, it is necessary to return the instrument for repair to the dealer or to YSI.

- Temperature will be displayed after the second tone. Observe the reading for stability. Temperature equilibration may take up to 5 minutes.

- Set the function switch to the mg/L position and allow 15 minutes for the system to stabilize. If calibration is attempted prematurely, calibration values will drift and may be out of specification.

- It is not necessary or desirable to turn the instrument off after each measurement. In normal field use, the meter may be left on in any switch position between measurements, and turned off only at the end of the day.

- Each startup from the OFF position could require a 5- to 15-minute wait for probe stabilization.
- Once the meter has been set up initially, the following procedures should be used for best results. Because the oxygen level in the layer of liquid sample at the membrane surface of the probe is continuously being depleted, it is essential that water movements of 1 foot per second or greater be maintained when recording measurements. A moving stream will usually provide this motion, as will moving the probe through the sample by hand. Make oxygen measurements as follows:
  - Perform the initial setup and calibration procedures as described previously.
  - Collect the sample in a clean, 8-ounce jar.
  - Set the function switch to the position appropriate to the sample and the readout described (% or mg/L). Allow 3 to 5 minutes for the probe to come to temperature equilibration with the sample.
  - Begin stirring at least 30 seconds before taking the reading. Observe the reading when the display has stabilized.
  - The rightmost DISPLAY SET key is a toggle switch for showing or suppressing the last digit of the reading in both % and mg/L modes. The default mode displays the last digit. When the last digit is suppressed, the measurement will still be as accurate as it is when the last digit is displayed.
  - After the CAL key is pressed, a tone will sound when the reading is stable. This does not affect the instrument’s measurement in any way. The autoread function is off in the autodefault mode and works only for DO measurements. Note: If the instrument is operated in a LOBAT (low battery) condition and it is not possible to replace the batteries immediately, confirm your reading by repeating the INITIAL SETUP procedures.
  - Record all readings in the GEOLIS field logbook.
  - Properly dispose of water for DO measurement with containerized purge water or by another appropriate method.

Before the YSI Model 51B DO meter can be used, the sampling team must initially set up the instrument as follows:

- Place the instrument in its intended operating position. Recalibration may be necessary if instrument operating position is changed.
- With the switch in the OFF position, adjust the meter to zero using the screw in the bottom center of the meter panel.

- Switch the function knob to the ZERO setting and adjust the meter to zero using the zero control knob located beneath the meter panel.
- Switch the function knob to the FULL SCALE setting, and adjust the meter using the full scale knob beneath the meter panel (full scale is achieved whenever the meter needle aligns with the "15" mark on the mg/L scale).
- Attach the probe to the meter.
- Before calibrating, allow the probe to stabilize for 15 minutes.

The YSI Model 51B DO meter should be calibrated between each sampling point in the following manner:

- Switch the function knob to the CALIB O2 position.
- Slip the small plastic bottle (used to prevent the membrane from drying out) over the probe. Ensure that the plastic bottle contains a damp tissue or sponge in the tip.
- Allow the temperature to stabilize for 10 minutes.
- Use the CALIB knob located beneath the meter panel to adjust the meter to read the correct DO value based on the following table.

**Solubility of Oxygen in Water (mg/L) at Various Temperatures ($^oC$)**

| Temp. | DO* | Temp. | DO | Temp. | DO | Temp. | DO | Temp. | DO |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 14.60 | 11 | 11.00 | 22 | 8.72 | 33 | 7.16 | 44 | 6.04 |
| 1 | 14.19 | 12 | 10.76 | 23 | 8.56 | 34 | 7.05 | 45 | 5.95 |
| 2 | 13.81 | 13 | 10.52 | 24 | 8.40 | 35 | 6.93 | 46 | 5.86 |
| 3 | 13.44 | 14 | 10.29 | 25 | 8.24 | 36 | 6.82 | 47 | 5.78 |
| 4 | 13.09 | 15 | 10.07 | 26 | 8.09 | 37 | 6.71 | 48 | 5.70 |
| 5 | 12.75 | 16 | 9.85 | 27 | 7.95 | 38 | 6.61 | 49 | 5.62 |
| 6 | 12.43 | 17 | 9.65 | 28 | 7.81 | 39 | 6.51 | 50 | 5.54 |
| 7 | 12.12 | 18 | 9.45 | 29 | 7.67 | 40 | 6.41 | | |
| 8 | 11.83 | 19 | 9.26 | 30 | 7.54 | 41 | 6.31 | | |
| 9 | 11.55 | 20 | 9.07 | 31 | 7.41 | 42 | 6.22 | | |
| 10 | 11.27 | 21 | 8.90 | 32 | 7.28 | 43 | 6.13 | | |

*DO value is based on atmospheric pressure of 760 mm Hg (at sea level).

When measuring DO with the YSI Model 51B meter, these steps should be followed:

- Place the probe in your sample and set the function knob to temperature. Allow sufficient time for the temperature to stabilize.
- Record the temperature and adjust the O2 SOLUBILITY FACTOR dial to the observed reading.
- Set the function knob to read O2. If an automatic stirrer is not attached to the probe, the probe will have to be manually stirred by raising and lowering the probe approximately 1 foot per second.
- Allow sufficient time for the DO reading to stabilize.
- Record the reading on the GEOLIS form.

## 2.6 FIELD ALKALINITY MEASUREMENT

Alkalinity is defined as the measurement of the ability of a solution to resist or buffer a change in pH. Alkalinity is measured by progressively lowering the pH of a solution by titrating with a strong acid such as HCl or $H_2SO_4$.

- The Hach Model AL-DT titration device, which measures alkalinity at two end points (P-alkalinity and total alkalinity), is used. To accurately measure alkalinity, the conductivity of the water must be known. Alkalinity may be approximated as half the conductivity value when conductivity is expressed in units of umhos as with the YSI Model 33 meter (e.g., water with a conductivity of 100 umhos would be expected to have a total alkalinity of approximately 50 mg/L as $CaCO_3$). Alkalinity may be approximated from conductivity values measured with the HORIBA Water Quality Checker using the following formula:

  Estimated alkalinity = [conductivity mS/cm x 1,000]/2

For example, water with a conductivity of 0.1 mS/cm would be expected to have a total alkalinity of approximately 50 mg/L as $CaCO_3$.

All information collected during the alkalinity test is recorded on the Field Alkalinity Worksheet. The measurement of alkalinity involves the following procedure:

- **Step 1:** Water samples must be collected in 250-mL plastic or glass bottles, with no headspace, and capped tightly.
- Samples should be analyzed as soon as possible.
- Maximum storage time is 24 hours on ice.

- Samples should be allowed to reach room temperature before analysis.
- If possible, the samples should be kept at the original sample temperature while being transported from the field to the area where the titration will occur.
- Estimate the alkalinity, as described previously.
- **Step 2:** Select the sample volume and the respective sulfuric acid titration cartridge from the following table:

| Estimated Alkalinity Range | Sample Volume (mL) | Cartridge ($NH_2SO_4$) | Multiplier | pH | Color |
|---|---|---|---|---|---|
| 10 to 40 | 100 | 0.16 | 0.1 | 5.1 | Blue-gray |
| 40 to 160 | 25 | 0.16 | 0.4 | 5.1 | Blue-gray |
| 100 to 400 | 100 | 1.6 | 1.0 | 4.8 | Violet-gray |
| 200 to 800 | 50 | 1.6 | 2.0 | 4.5 | Light pink |
| 500 to 2,000 | 20 | 1.6 | 5.0 | 4.5 | Light pink |
| 1,000 to 4,000 | 10 | 1.6 | 10.0 | 4.5 | Light pink |

- **Step 3:** Insert a clean delivery tube into the titration cartridge and twist the cartridge onto the titrator body.
- **Step 4:** Flush out the delivery tube by turning the small knob until a few drops drip from the tube, wipe the tip, and reset the counter to zero.
- **Step 5:** Measure the aforementioned sample volumes into a 250-mL flask and dilute to 100-mL with de-ionized water, if necessary.
- **Step 6:** Add the contents of one phenolphthalein pillow and swirl to mix.
- **Step 7:** If the solution turns pink (normally it does not), titrate to a colorless end point and record the number of drops required to calculate P-alkalinity.
- P-Alkalinity = Drops x multiplier in mg/L $CaCO_3$ (from previous table).
- **Step 8:** Add one bromocresol green-methyl red indicator pillow and swirl. Titrate from green to the color listed in the previous table and record the number of drops required to calculate total alkalinity. The color can be judged against a 50 mL solution containing 1 indicator pillow and 1 pH buffer pillow.
- **Step 9:** Total alkalinity = Drops x multiplier in mg/L $CaCO_3$ (from previous table). Record all values and final color on the alkalinity form.

- Example: A water sample has an alkalinity of approximately 100 mg/L (conductivity of 200 umhos or 0.2 mS/cm). Place 100 mL in a flask and add the phenolphthalein pillow. If the solution turns pink, add 1.6N $H_2SO_4$ buffer, and titrate until clear. Add 1 bromocresol green-methyl red indicator pillow, titrate solution to a light violet-gray end point (pH 4.8), and calculate the total alkalinity. If 120 drops are necessary, total alkalinity is 120 mg/L (120 x 1). If fewer than 30 drops with the 1.6N $H_2SO_4$ cartridge or more than 300 drops with 0.16N $H_2SO_4$ are required, the sample should be re-titrated with the other cartridge and both results reported. If the alkalinity result falls outside the estimated alkalinity range, the sample should be re-titrated using the appropriate $H_2SO_4$ cartridge and/sample volume.

- **Step 10:** Properly dispose of all liquids and decontaminate equipment according to procedures outlined in SOP C.8.

- **Step 11:** Properly dispose of liquids in either purge water containers or by other appropriate methods. Decontaminate equipment according to SOP C.8 if elevated readings were detected with the PID. If there are no elevated readings, then rinse with distilled water.

### 2.6.1 Accuracy Check

Before the field measurements can be performed, the accuracy of the field alkalinity procedure must be verified. The accuracy check consists of the following steps:

- Snap the neck off an Alkalinity Standard Solution Voluette® Ampule, 0.500 N.

- Use a TenSette® Pipet to add 0.1 mL of standard to the sample titrated in Steps 7 or 8 above. Resume titration back to the same end point. Record the number of digits needed.

- Repeat, using two more additions of 0.1 mL. Titrate to the end point after each addition.

- Each 0.1 mL addition of standard should require 25 additional digits of 1.600 N titrant or 250 digits of 0.1600 N titrant. If these uniform increases do not occur, refer to Appendix A, Accuracy Check and Standard Additions, which can be accessed via the following URL: http://ecommence.hach.com/stores/hach/pdfs/manuals/169008.pdf

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| SS-1 | Determination of the Presence of Free Product |

# 4. PHYSICAL PARAMETERS

## 4.1 WATER LEVEL MEASUREMENT

Groundwater level measurements will be taken prior to purging or sampling using an electric water level probe. The following procedure will be used for obtaining water level measurements from monitoring wells and piezometers:

- Approach the well with a working HNu or equivalent, a well key, and a water level indicator (switched on). Where practical, the surface of the water column should be visually examined for the presence of hydrocarbons; if present, the thickness of the hydrocarbon layer will be measured using an oil/water probe.
- Open the well cap just enough to insert the probe of the PID or FID and take a reading. A decision to upgrade personnel protective equipment (PPE) may be necessary based on the PID or FID readings in the breathing zone.
- Remove well cap(s) and insert the water level probe or oil/water interface probe into the well.
- Note the water level measurement to the nearest 0.01 foot with respect to the established survey point on top of the well casing.
- Take water level measurements three times per well or until measurements are within 0.01 foot.
- Record measurements on the GEOLIS Water Level Form.
- Decontaminate the water level probe (including the oil/water probe, if necessary) with ASTM Type II reagent-grade water (do not rinse with any solvents unless product was encountered).
- Measure the total depth of well using the modified tape measure. Measuring tapes must be fully decontaminated between each well.
- Note total depth and any other observations concerning well condition in the GEOLIS field logbooks.

# 5. CHEMICAL PARAMETERS

Water purged before sampling must be measured for temperature, pH, electrical conductivity, turbidity, dissolved oxygen, field alkalinity, and total VOCs.

## 5.1 TOTAL VOC MEASUREMENT

Total VOCs can be screened from either water or soil samples using an HNu photoionization or equivalent equipment. The following procedure should be followed:

- Fill a sample jar half full with the water sample.
- Cap the sample jar and agitate.
- Open the cap while placing PID or appropriate probe under the cap.
- Record the highest measured reading (PID or FID) in the GEOLIS logbook.
- Discard the water sample and jar according to proper site procedures.

The in-field measurement of a sample's VOC content is only a qualitative and not a quantitative measurement. Measurement of sample vapor does not preclude the need to collect air vapor measurements in the breathing zone for safety purposes.

The standard operating procedure for monitoring the other chemical parameters is presented in SOP G-1, Calibration of Field Screening Instruments.

# STANDARD OPERATING PROCEDURE G-6

# FIELD SAMPLE NUMBERING

# STANDARD OPERATING PROCEDURE G-6

# FIELD SAMPLE NUMBERING

## 1. SCOPE AND APPLICATION

The objective of this Standard Operating Procedure (SOP) is to define the procedures for the identification of field sample identifiers (ID), which will be used on sample containers and field data collection sheets (e.g., Geolis). The purpose of the field sample identifiers is to provide additional information about the sample to end users of the data. It is expected that this approach will add supplemental value for users who are evaluating data in tabular form, without the benefit of any other spatial reference.

Sample labels are required to properly identify samples and evidence. The data obtained from samples collected for a sampling or monitoring activity may be used for remedial measures. All samples must be properly labeled with the label affixed to the container prior to transportation to the laboratory.

In order to provide additional information in the sample identifier, a set of requirements and guidance has been prepared to assist the data users in the execution of a scheme for building intelligence into the sample nomenclature. A Field Sample ID protocol has been implemented since the inception of the sampling program in July 1998. The mechanisms for recording the field sample ID are the Sample Attribute Form (SAF), the field data collection sheet or Geolis, the sample container label, and the chain-of-custody (COC) forms.

Over time, edits, deletions, and additions have been made to the field sample ID to respond to feedback and comments provided by the client and the field teams. The original field sample ID had a simple format indicating date of sample collection, sampling team, and sample sequence. The original field sample ID was deemed inadequate for present and future needs, and the ID was modified to incorporate additional sample attribute information. The new field sample ID includes site, location, QC type, and depth or date of sample collection. From a data management perspective, the key requirement for the field sample ID is that it represent a unique name.  A SAF is required to record some of the more detailed attributes of the sample (see the attached SAF).  The sample attribute information will be recorded directly onto a SAF or transcribed from another field data collection device (e.g., Geolis).  The field sample ID and its corresponding attribute information will be captured electronically and linked within the project database.

Information on sample labels should be limited to the following:

- **Field Sample Identification Number—**Each sample, including field control samples, collected for a project should be assigned a unique 18 character name (see below).
- **Samplers—**Each sampler's name and signature or initials.
- **Preservative—**Whether a preservative is used and the type of preservative.
- **Analysis—**The type of analysis requested.
- **Date/Time—**The date and time the sample was taken.
- **Type of Sample—**The sample identified as either discrete or composite.

## 2. EQUIPMENT

Sample labels

Pen with indelible ink

## 3. RELATED PROCEDURES

G-10 Sample Documentation

# 4. PROCEDURE

## 4.1 FIELD SAMPLE IDENTIFICATION NUMBER

The field sample ID is 15 characters long (with a few exceptions) and is composed of four parts:

| Part1 | | Part 2 | | Part 3 | | Part 4 |
|---|---|---|---|---|---|---|
| **XX** | **-** | **XXXXXXXX** | **-** | **X** | **-** | **XXXX** |
| [Site | - | Location ID | - | QC Type | - | Depth/Date/Other] |

### 4.1.1 Field Sample ID, Part 1: <u>Site</u>

Part 1 of the field sample ID will be two characters representing a site within an Operable Unit (OU) or PE for performance evaluation samples. Table 1 lists and describes the appropriate site codes to be used.

**Table 1**

**Site Codes and Descriptions**

| Site | Site Description | OU Number |
|---|---|---|
| AS | Allendale School | OU 3 |
| CR | Connecticut River | OU 2 |
| E1 | East Street Area 1 | OU 1 |
| E2 | East Street Area 2 | OU 1 |
| H0 | East Branch Housatonic River – Upstream of Newell Street | OU 2 |
| H1 | East Branch Housatonic River – Newell Street to Lyman Street | OU 2 |
| H2 | East Branch Housatonic River – Lyman Street to Confluence with West Branch | OU 2 |
| H3 | Housatonic River – Confluence to Woods Pond | OU 2 |
| H4 | Woods Pond | OU 2 |
| H5 | Housatonic River – Woods Pond to Rising Pond | OU 2 |
| H6 | Housatonic River – Downstream of Rising Pond | OU 2 |
| H7 | Housatonic River – Other | OU 2 |

## Table 1

## Site Codes and Descriptions (Continued)

| Site | Site Description | OU Number |
|---|---|---|
| H8 | Housatonic Tributary | OU 2 |
| H9 | Reference Locations – Outside Housatonic Drainage Basin | OU 2 |
| HL | Hill 78 Site | OU 1 |
| HW | Housatonic River – West Branch | OU 2 |
| LS | Lyman Street Area | OU 1 |
| N1 | Newell Street Area I | OU 5 |
| N2 | Newell Street Area II | OU 5 |
| O1 | General OU 1 – Not site specific | OU 1 |
| O5 | General OU 5 – Not site specific | OU 5 |
| O6 | General OU 6 – Not site specific | OU 6 |
| OA | Oxbow A | OU 6 |
| OB | Oxbow B | OU 6 |
| OC | Oxbow C | OU 6 |
| OJ | Oxbow J | OU 6 |
| OK | Oxbow K | OU 6 |
| OT | Other – Not site specific (used when sending feed or bait for analyses) | None |
| PE | PE Sample – Not site specific | None |
| SL | Silver Lake | OU 4 |
| UB | Unkamet Brook Area | OU 1 |

### 4.1.2 Field Sample ID, Part 2: Location ID

Part 2 of the field sample ID will be eight characters that represent the location ID. Location IDs will be unique identifiers representing the spatial reference for samples. The first one to three characters of the eight-character location ID (Part 2 of the Sample ID) are reserved for location or sample type. Table 2 lists and describes the location/sampling types available.

# Table 2

## Location/Sampling Types and Descriptions

| Location/ Sampling Type | Description |
|---|---|
| AR | Air/Meteorology Monitoring Location |
| BH | Soil Boring Location |
| BS | Non-Transect: River Bank: Surface/Shallow Soil Sampling Location |
| F | Transect: Floodplain: Surface/Shallow Soil Sampling Location |
| FL | Non-Transect: Floodplain: Surface/Shallow Soil Sampling Location |
| GW | Ground Water Sampling Location |
| LM | Long-Term Remediation Pump Sampling Location |
| MI | Macroinvertebrate Sampling Location |
| OT | Other Location |
| PC | Paint Chip Sampling Location |
| PR | Piezometer Location |
| RB | Transect: River Bank: Surface/Shallow Soil Sampling Location |
| S | Transect: Sediment Sampling Location |
| SD | Transect: Sediment Sampling Location |
| SDN | Transect: Negative River Mile Sediment Sampling Location |
| SDW | Transect: Sediment (West Branch) Sampling Location |
| SE | Non-Transect: Sediment Sampling Location |
| SL | Non-Transect: Surface/Shallow Soil Sampling Location |
| SLC | Non-Transect: Composite Surface/Shallow Soil Sampling Location |
| SP | Sump/Pipe/Tank Sampling Location |
| ST | Storm Water Sampling Location |
| SW | Surface Water/Seep Sampling Location |
| TA | Amphibian Tissue Sampling Location |
| TB | Bird Tissue Sampling Location |
| TD | Duck/Decapod Tissue Sampling Location |
| TF | Fish/Mussel Tissue Sampling Location – Fillet (Fish) – Whole Body (Mussel) |
| TI | Invertebrate Tissue Sampling Location |

## Table 2

## Location/Sampling Types and Descriptions (Continued)

| Location/ Sampling Type | Description |
|---|---|
| TM | Mammal Tissue Sampling Location |
| TO | Fish Tissue Sampling Location – Offal |
| TP | Test Pit |
| TS | Tissue Sampling Location – Bird |
| TV | Fish Tissue Sampling Location – Ovaries |
| TW | Fish Tissue Sampling Location – Whole Body |
| VG | Vegetation Sampling Location |
| WD | Waste/Disposal Location |
| WL | Well Location |
| WM | Surface Water Measurement Location |
| WS | Wright State Sampling Program – Macroinvertebrate |
| XI | Wipe Sampling Location |

There will be four different location ID schemes available, depending on the type of sample collected. The location ID schemes apply to:

A. Transect samples.
B. Non-transect samples.
C. Biological samples.
D. Performance Evaluation (PE) samples

### *4.1.2.1 Transect Samples*

The location ID scheme for transect samples consists of four parts:

1. The location/sampling type will consist of one to three characters (F, RB, S, SD, SDN, SDW) referenced in Table 2.

2. Two numbers, indicating the river mile will occupy the next two character positions. (The Newell Street Bridge is the zero river mile for the East Branch and downstream of the confluence; upstream of the bridge will be N1, N2, N3, etc., indicating negative

miles; the confluence is the zero river mile for the West Branch and upstream will be W1, W2, W3, etc.)

3. Three numbers that represent the sequential transect number will occupy the next three characters.

4. One number (or two numbers for floodplain [F] and sediment [S]) will indicate the position along the transect according to the following scheme:

   - For SD, SDN, and SDW location types: 1 for left channel (facing upstream), 2 for mid channel, and 3 for right channel.

   - For RB location types: Start at 1 for the top of slope on the left bank (facing upstream), 2 for the mid slope on the left bank, 3 for the toe of slope on the left bank, 4 for the toe of slope on the right bank, 5 for mid slope on the right bank, and 6 for the top of slope on the right bank.

   - For F and S location types: Samples will be a numerical sequence along the transect from the left position to the right position. It is possible, however, that more than three samples will be collected along the transect (from left to right), e.g., for S location types, 1 indicates the far left and continues to 22, the far right. The first two characters of the location ID would be SD if the last two did not exceed one character. The D is sacrificed to make space for the last two characters that indicate the position along the transect. This is also true for F location types.

Table 3 provides some common examples of transect location IDs and how they would be represented in Part 2 of the Field Sample ID.

## Table 3

## Example Transect Location IDs

| Location ID | Part 1 | Part 2 | Part 3 | Part 4 | Explanation |
|---|---|---|---|---|---|
| F1391028 | F | 13 | 910 | 28 | The 28th floodplain location on transect 910 between river mile 12 and 13. |
| RB030932 | RB | 03 | 093 | 2 | The middle of slope left bank location on transect 93 between river mile 2 and 3. |
| S1391222 | S | 13 | 912 | 22 | The 22nd sediment location on transect 912 between river mile 12 and 13. |
| SD010173 | SD | 01 | 017 | 3 | The right of the stream sediment location on transect 17 between river mile 0 and 1. |
| SDW22162 | SDW | 2 | 216 | 2 | The middle of the stream sediment location on transect 216 between river mile 1 and 2 on the West Branch. |

#### *4.1.2.2 Non-Transect Samples*

The location ID for a non-transect sample consists of two parts:

1. The first part will be two characters that represent the location/sample type (see Table 2).
2. The second part will be six numbers that are a numerical sequence for each location code. Note: In reference areas, a body of water code (see Table 4) may be used to indicate which reference area was sampled. The first two characters are the location code, the third and fourth characters indicate the body of water (see Table 4), and the last four characters consist of the numerical sequence for each location. Woods Pond is not a reference area, but a body of water code (WP) that was used during fish collection.

**Table 4**

**Body of Water Codes and Site Descriptions**

| Water Body Code | Water Body Code Description | OU Number |
|---|---|---|
| 3M | 3-Mile Pond | OU 2 |
| MP | Muddy Pond | OU 2 |
| GP | Goodrich Pond | OU 2 |
| RP | Rising Pond | OU 2 |
| WL | Washington Lake | OU 2 |
| WP | Woods Pond | OU 2 |

Table 5 provides some common examples of non-transect location IDs and how they would be represented in Part 2 of the field sample ID.

**Table 5**

**Examples of Non-Transect Location IDs**

| Location ID | Part 1 | Part 2 | Part 3 | Explanation |
|---|---|---|---|---|
| SW000016 | SW | 000016 | NA | A non-transect surface water/seep collected from Crane Paper Company. |
| SE000372 | SE | 000372 | NA | The 372nd non-transect sediment location. |
| SE3M0009 | SE | 3M | 0009 | The 9th non-transect sediment location in 3-Mile Pond. |

Surface water samples will be collected from the same locations on a monthly schedule. Table 6 provides the site and description for each surface water location ID to be used.

### Table 6

### Surface Water Sites, Locations, and Descriptions

| Location ID | Site | Location Description |
|---|---|---|
| SW000001 | H5 | Lenoxdale Bridge |
| SW000002 | H4 | Above Woods Pond Dam |
| SW000003 | H3 | Woods Pond Headwaters |
| SW000004 | H3 | New Lenox Road Bridge |
| SW000005 | H3 | Adjacent to Joseph Drive |
| SW000006 | H3 | Holmes Road Bridge |
| SW000007 | HW | Above West Branch Confluence |
| SW000008 | H2 | Pomeroy Avenue Bridge |
| SW000009 | H2 | Elm Street Bridge |
| SW000010 | H1 | Lyman Street Bridge |
| SW000011 | H1 | Newell Street Footbridge |
| SW000012 | H0 | Newell Street Bridge |
| SW000013 | H0 | Goodrich Pond Tributary |
| SW000014 | H0 | Unkamet Brook |
| SW000015 | H0 | Hubbard Avenue Bridge |
| SW000016 | H0 | Crane Paper Company |
| SW000017 | H3 | Waste Water Treatment Plant |

### *4.1.2.3 Biological Samples*

The biological sample location ID consists of four parts:

- The first part will be two characters that are the location sample type (see Table 2).
- The second part will be two numbers that are the river mile or two characters for a water body code (see Table 4).
- The third part will be two characters that indicate species type (see Table 7).

- The fourth part will be two numbers that are a numerical sequence for each location code and species combination. Composite samples will have a C and a number.

This is the general format for most fish tissue samples. Some samples will deviate from this biological sample ID format, depending on what information needs to be incorporated into the sample ID. Specifically, reproductive studies generally require tracking male and female specimens and individual numbers of each sex.

Table 7 lists and describes the available biological species codes.

## Table 7

## Species Codes and Descriptions

| Species | Description | Species | Description | Species | Description |
|---|---|---|---|---|---|
| **Amphibians** | | | | | |
| BA | American Toad | RP | Leopard Frog | RS | Wood Frog |
| BF | Bull Frog | RC | Green Frog | AM | Spotted Salamander |
| **Fish** | | | | | |
| AE | American Eel | LB | Largemouth Bass | BT | Brown Trout |
| BB | Brown Bullhead | LS | Longnose Sucker | CC | Common Carp |
| BC | Black Crappie | NP | Northern Pike | CH | Creek Chub |
| BD | Blacknose Dace | PS | Pumpkin Seed | CP | Chain Pickerel |
| BG | Bluegill | RB | Rock Bass | CS | Common Shiner |
| BM | Bluntnose Minnow | RS | Redbreasted Sunfish | FF | Fallfish |
| FM | Fathead Minnow | SB | Smallmouth Bass | WS | White Sucker |
| GF | Goldfish | WC | White Catfish | YB | Yellow Bullhead |
| GS | Golden Shiner | WP | White Perch | YP | Yellow Perch |
| RT | Rainbow Trout | WR | White Crappie | | |
| **Mammals** | | | | | |
| BL | S. Bog Lemming | MJ | Meadow Jumping Mouse | RV | Red-backed Vole |
| DO | Deer Mouse | MS | Masked Shrew | SM | Star-nosed Mole |
| EC | Chipmunk | MV | Meadow Vole | SS | Short-tailed Shrew |
| EM | Eastern Mole | NR | Norway Rat | WJ | Woodland Jumping Mouse |
| FQ | Flying Squirrel | OS | Smokey Shrew | WO | White-footed Mouse |
| HM | Hairy-tailed Mole | PS | Pigmy Shrew | WS | Northern Water Shrew |
| HO | House Mouse | PV | Pine Vole | | |
| LT | Long-tailed Shrew | RQ | Red Squirrel | | |

## Table 7

### Species Codes and Descriptions (Continued)

| Species | Description | Species | Description | Species | Description |
|---|---|---|---|---|---|
| **Other** | | | | | |
| CF | Caddis Fly | LI | Liter Invertebrate | OV | Crayfish |
| DE | Detritis | MA | Macrophytes | PD | Periphyton (Sediment) |
| EC | Elliptio Mussel | MD | Mink Study Feed | PM | Periphyton (Macrophyton) |
| EW | Earthworm | MF | Mink Study Fish | PP | Phytoplankton |
| FA | Filamentous Algae | MW | Mink Study Water | ZP | Zooplankton |

Examples of biological sample locations are as follows:

- **TF05CS06—**The sixth common shiner tissue fillet sample collected between river mile 4 and 5.
- **TFGPGF15—**The fifteenth goldfish tissue fillet sample collected from Goodrich Pond.
- **TFWPBBC6—**The sixth composite brown bullhead tissue fillet sample collected from Woods Pond.
- **H9-TAMPBFTO-F007—**The seventh tissue amphibian or female bullfrog sample, collected from Muddy Pond for analysis of the offal portion (TA – tissue, amphibian; MP – Muddy Pond; BF – bull frog; TO – tissue, offal; F – female; 007 – The seventh bull frog collected at Muddy Pond).

### *4.1.2.4 PE Samples*

Performance evaluation (PE) samples are developed and designated ID numbers by the United States Environmental Protection Agency (EPA). The EPA ID for a PE sample can range from five to eight characters. Zeros will be added to the end of a EPA sample ID with fewer than eight characters to comply with the WESTON sample ID format.

The location ID for PE samples consists of one part:

- The location code will be the Lot Number or EPA ID number for the PE sample.

Examples of performance evaluation sample location IDs are as follows:

EPA sample ID = TT0257

WESTON sample ID = TT025700-6-9C19

(TT0257 = EPA sample ID, 00 = Zeros added to meet the eight character requirement of the location ID. The latter portion of the ID in the example above includes Field Sample ID Part 3 descr ibed in the next section of this protocol, 6 = QC type for a PE sample, 9C19 = Date [10/19/99])

To assure objective results, the laboratory will not be informed of WESTON's sample ID code for PE samples.

### 4.1.3 Field Sample ID, Part 3: Sample QC Type

Part 3 of the field sample ID will be a single number representing the sample QC type. Table 8 lists and describes the seven possible QC types.

**Table 8**

**QC Codes and Descriptions**

| QC Code | Description |
|---|---|
| 0 | Normal Sample |
| 1 | Field Duplicate Sample |
| 2 | Equipment Blank Sample |
| 3 | Trip Blank Sample |
| 4 | Ambient Blank Sample |
| 5 | Filtered Sediment Sample |
| 6 | Performance Evaluation (PE) Sample |

### 4.1.4 Field Sample ID, Part 4: Starting Sample Depth or Collection Date

Part 4 of the field sample ID will vary, depending on whether the sample has an associated depth. Samples with an associated depth will have Part 4 as a starting depth. The starting depth of collection will be expressed in tenths of feet (e.g., 0105 represents a starting depth of 10.5 feet).

If Part 4 does not designate depth, it will indicate date collected or other useful information. All sample dates are expressed in 24-hour (military) time. The 4-character date code will be:

- Position one signifies the last number of the year in which the sample was collected.
- Position two is a letter corresponding to a month (J=January, F=February, M=March, A=April, Y=May, U=June, L=July, G=August, S=September, C=October, N=November, D=December).
- Positions three and four signify the day of the month the sample was collected (e.g., **8S19** is the code for 19 September 1998).

## 4.2 MISCELLANEOUS VARIATIONS

### 4.2.1 Dredging Elutriate Test (DRET elutriates) (samples collected Jan-Feb 1999)

For DRET elutriate samples, an A at the end of the sample ID indicates an unfiltered or total sample. The letter B at the end of the ID indicates a filtered (0.45 μm) sample. Samples prepared multiple times (example SE000011 prepared in triplicate) are designated with an additional numeric suffix after the A or B (A1, A2, A3, B1, B2, B3).

### 4.2.2 Pore Water Samples Prepared at Waterways Experiment Station (WES)

The pore water samples were given suffixes of C, D, or E (assigned by WES). Samples prepared in duplicate are designated with an additional numeric suffix (C1, C2 or D1, D2).

### 4.2.3 Pore Water Samples Prepared at Soil Technology (Samples Collected January-February 1999)

The pore water samples were given suffixes of A to designate the solid phase. (An AW suffix = sediment sample prior to separation. An AD suffix = solid phase after separation). A suffix of B designates the liquid phase.

### 4.2.4 Sequential Batch Leaching Procedure (SBLT) Samples Prepared by WES (Samples Collected January – February 1999)

For SBLT samples, each of the five days of leachate generation was designated by a letter suffix beginning with V for Day 1, W for Day 2, and continuing to Z for Day 5. Samples prepared in triplicate were designated by an A, B, C in the first of the four depth interval digits. For example, a sample prepared in triplicate on Day 1 of leachate generation would appear:

**XX-XXXXXXXX-X-A010V**

**XX-XXXXXXXX-X-B010V**

### 4.2.5 EE/CA Resampling (Samples Collected April – May 1999)

For the samples that have been recollected from previous EE/CA locations, the letter B has been added to the end of the field sample ID.

### 4.2.6 Vegetation Samples

A unique field sample ID containing 16 characters has been established for squash and corn vegetation samples. Part two of the field sample ID (location ID), begins with VG, indicating the sample is a vegetation sample. The last five characters consist of the date the sample is collected and the fraction of the vegetation that is sent for analysis. Vegetation samples end in one of the following letters:

- **Squash**

  W = Whole squash
  F = Flesh portion of squash only (outside rind and inside pulp/seed removed)

P = Pulp and seed mass of squash

- **Corn**

E = Ear of corn only (without husks)
S = Cornstalk and leaf material

### 4.2.7 Sediment Fractionation Samples

- **EE/CA Sediment Samples**

The EE/CA sediment samples collected in January 1999 were separated into the following particle size fractions by GZA GeoEnvironmental, Inc. (GZA):

Sediment greater than 6.3 mm was given a -1 suffix.
Sediment greater than 75 µm was given a -2 suffix.
Sediment less than 75 µm was given a -3 suffix.

- **Stormwater Sediment Bags**

Sediment from filter bags collected during storm events were separated into the following particle size fractions by Soil Technologies, Inc:

Sediment greater than 250 µm was given an F1 suffix.
Sediment between 63-250 µm was given an F2 suffix.
Sediment between 10-63 µm was given an F3 suffix.
Sediment between 5-10 µm was given an F4 suffix.

- **Baseline Monitoring Sediment Bags**

Sediment from baseline monitoring filter bags was separated by Soil Technologies, Inc. into the following particle size fractions:

Sediment greater than 250 µm was given an F1 suffix.
Sediment between 63-250 µm was given an F2 suffix.
Sediment between 5-63 µm was given an F3 suffix.

- **Composite Sediment Samples for Fractionation**

Composite sediment samples for fractionation were separated by Soil Technologies, Inc. into the following particle size fractions:

Sediment greater than 250 µm was given a C1 suffix.
Sediment between 63-250 µm was given a C2 suffix.
Sediment less than 63 µm was given a C3 suffix.

### 4.2.8 Re-Collected Samples

For the samples that have been re-collected from previous locations, an -RE has been added to the end of the field sample ID.

### 4.2.9 Stormwater Samples

A unique field sample ID containing 20 characters has been established for stormwater samples. Part four of the sample ID ends with nine characters instead of four. The last nine characters consist of the date and time the sample is collected and the collection method. Stormwater samples will have an M or I after the last eight characters. The M indicates that the sample was collected manually using a depth integrated sampler, and the I indicates that the sample was collected using a pump (ISCO pump). The location is the same for the two samples, but the collection method is different.

Table 9 provides the list of sites and a description for each stormwater location.

## Table 9

## Stormwater Locations, Sites, and Descriptions

| Location ID | Site | Description |
|---|---|---|
| ST000002 | H0 | Hubbard Avenue Bridge |
| ST000003 | H0 | Unkamet Brook |
| ST000004 | H2 | Pomeroy Avenue Bridge |
| ST000005 | HW | West Branch Confluence |
| ST000006 | H3 | Sackett Brook |
| ST000007 | H3 | New Lenox Street Bridge |
| ST000008 | H3 | Roaring Brook |
| ST000009 | H4 | Woods Pond Footbridge |

## 4.3 SAMPLE ATTRIBUTE FORM

A Sample Attribute Form (SAF) will be used to record the following information:

- Location ID.
- Program/group codes.
- Location description codes.
- Transect number.
- Date the sample was collected.
- Global Positioning System (GPS) information.
- Field Sample ID.
- Starting and ending depths or dates.
- If the sample is split, then to whom it is split and the split sample ID.
- Additional comments or observations about the sample.
- Analysis.

Sample attributes are obtained from the Geolis (field notebook) and transcribed to a SAF. The SAF is used in conjunction with the field chain-of-custody (COC). The following information is entered at the bottom of the SAF: Form Relinquished by, Form Received by, Date Form Completed, and Time Form Completed. A SAF is attached to this field sample ID protocol.

## 4.4 PROGRAM CODES

Program or group codes are four digit numerical codes that have been created for each sample collected in the field. The program code identifies the relevant work plan sampling program for the sample. Program codes were created to enable the database user to query and extract samples from the database according to work plan sampling programs of interest. Samples could be associated with one or more (up to four) program codes. Table 10 lists the available program codes and descriptions.

## Table 10

## Program Codes and Descriptions

| Program Code | Program Code Description | | Program Code | Program Code Description | |
|---|---|---|---|---|---|
| 0001 | Systematic Sampling | | 0038 | Canoe Meadows | Recreational |
| 0002 | Modeling Transects | | 0039 | Decker Canoe | Recreational |
| 0003 | Discrete River Sampling | | 0040 | Devos Farm | Recreational |
| 0004 | Terraces and Bars | | 0041 | Oct Mtn Access | Recreational |
| 0005 | Monthly Surface Water | | 0042 | Paintball | Recreational |
| 0006 | Stormflow Sampling | | 0043 | Sportsman Club | Recreational |
| 0007 | Air Sampling | | 0045 | Noble Farm | Agriculture |
| 0008 | Non-Routine Surface Water | | 0046 | Woods Pond | Recreational |
| 0009 | Vernal Pools | | 0047 | Lee | Agriculture |
| 0010 | Fractionated Samples | | 0048 | Lee | Commercial |
| 0012 | Deep Cores | | 0049 | Lee | Recreational |
| 0013 | Benthic Macroinvertebrate | | 0050 | Stockbridge | Recreational |
| 0014 | Tree Swallow | | 0051 | Stockbridge Golf | Recreational |
| 0015 | Sediment Toxicity | | 0052 | Lenoxdale | Recreational |
| 0016 | Mussel Exposure | | 0053 | Great Barrington | Agriculture |
| 0017 | Residential | | 0054 | Great Barrington | Commercial |
| 0018 | Butler Farm | Agriculture | 0055 | Great Barrington | Recreational |
| 0020 | EE/CA Cobble Box | | 0056 | Sheffield | Commercial |
| 0021 | Squash | | 0057 | Barts Cobble | Recreational |
| 0022 | Corn | | 0058 | Sheffield | Recreational |
| 0023 | Fiddleheads | | 0059 | Well Sampling | |
| 0024 | Small Mammals | | 0060 | Duck Blinds | Recreational |
| 0025 | Impoundments | | 0061 | Sheffield | Agriculture |
| 0026 | Soil Invertebrates | | 0062 | Sediment Core Transects | |
| 0027 | Macrophytes | | 0063 | Allendale School | |
| 0028 | Long-Term Remediation Monitoring | | 0064 | Soil Sampling / Soil Boring | |
| 0029 | SBLT | | 0065 | Round Robin | |
| 0030 | DRET | | 0066 | Pittsfield | Recreational |
| 0031 | Landfill | | 0067 | Groundwater Sampling | |
| 0032 | Leopard / Wood Frogs | | 0068 | Lenoxdale | Commercial |
| 0033 | AT&T | Commercial | 0069 | Waste Disposal | |
| 0034 | Electric Company | Commercial | 0070 | Drainage Swale 1 | |
| 0035 | Miss Halls School | Commercial | 0071 | Fish | |
| 0036 | Sewer ROW | Commercial | 0072 | Duck | |
| 0037 | Tenn. Gas Co | Commercial | 0099 | None | |

EE/CA = Engineering Evaluation/Cost Analysis

Examples of field sample IDs follow:

- **H1-RB010191-1-0010—**A field duplicate river bank soil sample collected at 1.0 feet starting depth at the top of the left bank along transect 19 in the East Branch of the Housatonic River from Newell to Lyman Streets between river mile 0 and 1.

- **H3-SD040592-0-0000—**A transect sediment sample collected at 0 feet starting depth at mid stream along transect 59 in the Housatonic River from the confluence of the East and West Branches to Woods Pond between river mile 3 and 4.

- **H3-SD040592-0-0005—**A transect sediment sample collected at 0.5 feet starting depth at mid channel along transect 59 in the Housatonic River from the confluence of the East and West Branches to Woods Pond between river mile 3 and 4.

- **E2-BH000023-0-0015—**A non-transect soil boring sample number 23 collected at 1.5 feet starting depth in East Street Area 2.

- **E2-BH000023-1-0015—**A field duplicate of soil boring sample number 23 collected at 1.5 feet starting depth in East Street Area 2.

- **E2-BH000023-2-0015—**A soil boring equipment blank collected on the same day as soil boring sample **E2-BH000023-0-0015**.

- **E2-BH000023-3-0015—**A trip blank packed with soil boring sample **E2-BH000023-0-0015**.

- **H4-TFWPCC21-0-8C06—**The 21st common carp tissue fillet sample collected from Woods Pond on 6 October 1998.

- **PE-TT008890-6-8G28—**A PE sample with Lot Number TT00889 and it was analyzed with samples relinquished on 28 August 1998.

- **H4-ST000009-0-9Y20-2200I—**A stormwater sample that was collected from the Woods Pond Footbridge using an ISCO pump on 20 May 1999 at 2200**.**

# Sample Attribute Form (Front)

**LOCATION ID**

| GPS: | | Comments |
|---|---|---|
| YES | | |
| NO | | |

**Program Code:**

**Location Description Code:**

**Transect Number:**

**Date Sample Collected:** ______________

**Comments:** ______________________________

| Site | | Location ID | | QC Type | | Starting Depth or Date Collected | Depth (in feet) | | | If the sample is split: |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | starting | ending | | Split To: |
| | - | | - | | - | | | | | Split Sample ID |
| Comments: | | | | | | | | | | |

| Site | | Location ID | | QC Type | | Starting Depth or Date Collected | Depth (in feet) | | | If the sample is split: |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | starting | ending | | Split To: |
| | - | | - | | - | | | | | Split Sample ID |
| Comments: | | | | | | | | | | |

| Site | | Location ID | | QC Type | | Starting Depth or Date Collected | Depth (in feet) | | | If the sample is split: |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | starting | ending | | Split To: |
| | - | | - | | - | | | | | Split Sample ID |
| Comments: | | | | | | | | | | |

| Site | | Location ID | | QC Type | | Starting Depth or Date Collected | Depth (in feet) | | | If the sample is split: |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | starting | ending | | Split To: |
| | - | | - | | - | | | | | Split Sample ID |
| Comments: | | | | | | | | | | |

| Site | | Location ID | | QC Type | | Starting Depth or Date Collected | Depth (in feet) | | | If the sample is split: |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | starting | ending | | Split To: |
| | - | | - | | - | | | | | Split Sample ID |
| Comments: | | | | | | | | | | |

| Site | | Location ID | | QC Type | | Starting Depth or Date Collected | Depth (in feet) | | | If the sample is split: |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | starting | ending | | Split To: |
| | - | | - | | - | | | | | Split Sample ID |
| Comments: | | | | | | | | | | |

| Form Relinquished By: | Form Received By: | Date Form Completed | Time Form Completed |
|---|---|---|---|
| | | | |
| | | | |

# Sample Attribute Form (Back)
## (Continued)

**Program Codes and Sampling Program Descriptions**

| Program Code | Sampling Program Descriptions | |
|---|---|---|
| 0001 | Systematic Sampling | |
| 0002 | Modeling Transects | |
| 0003 | Discrete River Sampling | |
| 0004 | Terraces and Bars | |
| 0005 | Monthly Surface Water | |
| 0006 | Stormflow Sampling | |
| 0007 | Air Sampling | |
| 0008 | Non-Routine Surface Water | |
| 0009 | Vernal Pools | |
| 0010 | Fractionated Samples | |
| 0012 | Deep Cores | |
| 0013 | Benthic Macroinvertebrate | |
| 0014 | Tree Swallow | |
| 0015 | Sediment Toxicity | |
| 0016 | Mussel Exposure | |
| 0017 | Residential | |
| 0018 | Butler Farm | Agriculture |
| 0020 | EE/CA Cobble Box | |
| 0021 | Squash | |
| 0022 | Corn | |
| 0023 | Fiddleheads | |
| 0024 | Small Mammals | |
| 0025 | Impoundments | |
| 0026 | Soil Invertebrates | |
| 0027 | Macrophytes | |
| 0028 | Long-Term Remediation Monitoring | |
| 0029 | SBLT | |
| 0030 | DRET | |
| 0031 | Landfill | |
| 0032 | Leopard / Wood Frogs | |
| 0033 | AT&T | Commercial |
| 0034 | Electric Company | Commercial |
| 0035 | Miss Halls School | Commercial |
| 0036 | Sewer ROW | Commercial |
| 0037 | Tenn. Gas Co | Commercial |
| 0038 | Canoe Meadows | Recreational |
| 0039 | Decker Canoe | Recreational |
| 0040 | Devos Farm | Recreational |
| 0041 | Oct Mtn Access | Recreational |
| 0042 | Paintball | Recreational |
| 0043 | Sportsman Club | Recreational |
| 0045 | Noble Farm | Agriculture |
| 0046 | Woods Pond | Recreational |
| 0047 | Lee | Agriculture |
| 0048 | Lee | Commercial |
| 0049 | Lee | Recreational |
| 0050 | Stockbridge | Recreational |
| 0051 | Stockbridge Golf | Recreational |
| 0052 | Lenoxdale | Recreational |
| 0053 | Great Barrington | Agriculture |
| 0054 | Great Barrington | Commercial |
| 0055 | Great Barrington | Recreational |
| 0056 | Sheffield | Commercial |
| 0057 | Barts Cobble | Recreational |
| 0058 | Sheffield | Recreational |
| 0059 | Well Sampling | |
| 0060 | Duck Blinds | Recreational |
| 0061 | Sheffield | Agriculture |
| 0062 | Sediment Core Transects | |
| 0063 | Allendale School | |
| 0064 | Soil Sampling / Soil Boring | |
| 0065 | Round Robin | |
| 0066 | Pittsfield | Recreational |
| 0067 | Ground Water Sampling | |

**Location and Description Codes**

| | | |
|---|---|---|
| **Biological Samples** | | |
| **Tissue** | | |
| TB | = | Brain |
| TF | = | Fillet |
| TL | = | Liver |
| TO | = | Offal |
| TR | = | Breast |
| TV | = | Ovaries |
| TW | = | Whole Body |
| **Other** | | |
| MI | = | Macro Invertebrate |
| BX | = | Other Biological |
| | | |
| **Sediment Samples** | | |
| DL | = | Lake or Pond |
| DO | = | Sewer/Pipe Outfall |
| DR | = | River/Stream |
| DX | = | Other Sediment |
| | | |
| **Soil Samples** | | |
| **Surface/Shallow** | | |
| SF | = | Flood Plain |
| SP | = | Paved/Covered |
| SR | = | Riverbank |
| SU | = | Unpaved |
| **Soil Boring : Total Depth** | | |
| BB | = | Bedrock |
| BF | = | Fill |
| BG | = | Glacial Till |
| BL | = | Lower Alluvium |
| BM | = | Middle Alluvium |
| BT | = | Top of Till |
| BU | = | Upper Alluvium |
| BW | = | Water Table |
| SX | = | Other Soil |
| | | |
| **Water Samples** | | |
| **Monitoring Well: Screens** | | |
| MB | = | Bedrock |
| MFW | = | Fill and Water Table |
| MG | = | Within Till |
| MLV | = | Lower Alluvium |
| MMA | = | Middle Alluvium |
| MT | = | Top of Till |
| MUA | = | Upper Alluvium |
| MW | = | Water Table |
| MWT | = | Water Table and Till |
| **Other** | | |
| PW | = | Public/Residential Well |
| RW | = | Recovery Well |
| WS | = | Surface Water |
| WSD | = | Surface Water Suspended Sediment |
| WX | = | Other Water |
| | | |
| **Other** | | |
| AR | = | Air |
| WD | = | Waste Disposal |
| XI | = | Wipe |
| VG | = | Vegetation |
| OX | = | Other |

# STANDARD OPERATING PROCEDURE G-7

# MANAGEMENT OF INVESTIGATION DERIVED WASTES (IDW)

# STANDARD OPERATING PROCEDURE G-7

# MANAGEMENT OF INVESTIGATION DERIVED WASTES (IDW)

## 1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe the requirements for residuals management. The requirements of these procedures are applicable to residuals management for wastes generated as a result of field sampling and characterization activities. The goal of residuals management is to minimize the amount of waste generated while following applicable regulations. Field personnel should review and understand all applicable federal, state, and local regulations regarding IDW. Regulations may prohibit disposal of certain IDW on-site.

Prior to commencing sampling of remediation, the Field Team Leader will select an area, preferably secure, for drum storage in consultation with the On-Site Manager.

Any drum used will be a U.S Department of Transportation (DOT) approved drum that will be required to containerize waste. Drums will not be stacked on top of each other and will be stored in rows not larger than 2 drums wide, with labels facing outward for identification. Decontamination fluids and other low-volume fluids may be temporarily stored and transported in 5-gallon buckets with lids.

Different residual materials (e.g., soil and water) will not be drummed together, but will be placed in separate drums. Field screening will be used to drum materials with similar levels of contamination together, if possible.

## 2. EQUIPMENT

Wrangler type boxes

DOT-approved drums

Drum liners

Funnels

5-gallon buckets

PID

Labeling material

## 3. RELATED PROCEDURES

G-1 Calibration of Field Screening Instruments

## 4. RESIDUALS MANAGEMENT

All residual waste must be placed in drums. IDW-filled drums will be transported to the secure staging area at the on-site WESTON office.

The IDW-filled drums must be sampled to determine whether they contain materials classified as RCRA hazardous wastes. IDW-filled drums containing RCRA hazardous wastes must be shipped off-site within 90 days.

### 4.1 RESIDUAL SOIL

Soil cuttings and excess samples must be drummed. They will be placed in DOT-approved drums with drum liners, and will be sealed and labeled in accordance with labeling practice.

### 4.2 RESIDUAL LIQUIDS

If it is determined that residual liquid such as water from well development and decontamination water must be containerized, it will be placed in a temporary holding tank or DOT-approved 55-gallon drums as appropriate. Drums will be sealed and labeled in accordance with labeling procedures. Decontamination solvents and test kit solvents will be segregated from aqueous material and allowed to evaporate as much as possible before being containerized in solvent-specified drums. Liquids drums will contain removable bungs. Funnels will be used to prevent spillage when adding liquids to the drums.

### 4.3 RESIDUAL DISPOSABLES

Project-specific provisions should be made prior to disposal of residuals. Do not assume bagged waste can be disposed in any dumpster. All non-contaminated disposable wastes such as bags, washed gloves, and material scrap, will be kept separate from other wastes. This material will be bagged or otherwise contained and disposed of in a dumpster or other appropriate location.

Contaminated disposable wastes may include disposable personal protective equipment (PPE) and contaminated equipment. This material will be placed in wrangler-type boxes unless field screening results of soil and/or waste residuals indicate non-elevated results.

## 5. DISPOSAL

Wastes that have been drummed based on field criteria may be sampled for laboratory analysis to determine the appropriate type of disposal facility. The number of samples collected will depend on the homogeneity of the drummed material, the nature of the source areas, and the requirements of the disposal facility.

IDW characterized or listed as hazardous waste will be disposed in a manner consistent with all local, state, and federal guidelines.

### 5.1 LABELING

Drums will be labeled on the side using a weather-resistant paint pen. The following information will be included:

- Sampling location identification.
- Sampling area designation.
- Point of contact with phone number.
- Type of material.
  - OB—Overburden soil and cuttings.
  - GW—Groundwater from wells.
  - DW—Decontamination water.

  - DS—Disposables.
  - BR—Bedrock cuttings.
  - SO—Decontamination solvents.

- Water content.

  - SAT—Saturated.
  - UNSAT—Unsaturated.

- For drums containing liquids, indicate the approximate fill line on the outside of the drum. Do not fill more than two-thirds full with liquids.

- Range of field screening results and instrument type.

- Date the drum was filled and sealed.

Example label: MW-1010
E1-OB-UNSAT
10– 30 OVM
12-AUG-98

# STANDARD OPERATING PROCEDURE G-8

# OVERSIGHT OF GENERAL ELECTRIC FIELD ACTVITIES

# STANDARD OPERATING PROCEDURE G-8

# OVERSIGHT OF FIELD ACTIVITIES

## 1. SCOPE AND APPLICATION

The objective of this standard operating procedure (SOP) is to provide guidance and general reference information for the oversight of the General Electric Company (GE) field activities related to the provisions of the Consent Decree (00-0388) and the reissued RCRA permit at the GE/Housatonic River site in Pittsfield, Massachusetts. The oversight personnel will verify that the GE field activities are performed in accordance with the Consent Decree and ensure that the field work is consistent with GE's *Field Sampling Plan/Quality Assurance Project Plan* (FSP/QAPP) (Blasland, Bouck & Lee, 2002, 00-0545), GE's project-specific Work Plan, and generally accepted scientific and engineering methods. These GE field activities may include, but are not limited to, the following tasks:

- Soil, sediment, groundwater, and surface water sampling.
- Lithologic logging.
- Groundwater and non-aqueous phase liquid (NAPL) monitoring.
- Well installation and development.
- Soil and sediment excavation.
- Geophysical surveys.
- Hydraulic testing.
- Sheetpile installation.
- Engineered barrier installation.
- Sampling of building materials.
- Building demolition.
- On-Plant Consolidation Area (OPCA) and other disposal operations.

The procedures outlined in this SOP apply to Weston Solutions, Inc. (WESTON) personnel and their subcontractors assigned to oversee GE field activities at the GE/Housatonic River project site. Any deviation from this SOP will be documented in weekly oversight reports provided to EPA.

The overall application of this SOP will be under the direct control and supervision of the EPA Project Coordinator, as specified in the Consent Decree. The EPA Project Coordinator will have all the vested authority of a Remedial Project Manager (RPM) or On-Scene Coordinator (OSC) as specified by the National Contingency Plan (NCP). The EPA Project Coordinator will determine which field activities, performed by GE or its contractors, will be monitored by the oversight personnel and at what frequency these activities will be monitored. These directives will be documented in an Oversight Plan, written for a specific oversight task in a given area, and/or a specific timeframe, as appropriate. The Oversight Plan will include a summary of the work to be performed, including the latest revisions to the GE Work Plan. Proposed sample locations will be tabulated, with indications whether each sample location should be subject to oversight or not, and guidance about where split and/or supplemental samples will be collected.

## 2. EQUIPMENT

Field logbook

Map of oversight area

Oversight Plan

Oversight Checklist (OPCA, Field Investigation, or Construction/Remediation checklist, as appropriate)

Oversight Soil Boring Log Form (if applicable)

GE FSP/QAPP sections specific to oversight task

GE Work Plan sections specific to oversight task

Digital camera with date stamp or video camera

Mobile or cellular phone

Split sample containers (if applicable)

Appropriate health and safety protective gear

Appropriate health and safety monitoring equipment

## 3. RELATED PROCEDURES

The following GE/Housatonic River Project SOPs provide further project-specific guidance for performing oversight of GE activities:

| | |
|---|---|
| G-3 | Field Documentation |
| G-6 | Field Sample Numbering |
| G-9 | Quality Assurance/Quality Control Sampling |
| G-10 | Sample Documentation |
| G-11 | Sample Packing and Shipping |

In addition to the SOPs listed above, information on sample containers and preservation techniques is presented in Table 6-1 of the QAPP (WESTON, 2001, 00-0507).

In addition to GE FSP/QAPP sections and GE Work Plan sections specific to the oversight task, certain federal, state, and/or professional technical guidance documents may be referenced in the GE FSP/QAPP sections or the GE Work Plan. Copies of these reference materials should also be available to field oversight personnel, in the event that the GE FSP/QAPP sections or the GE Work Plan do not provide sufficient instructions to field teams. Finally, WESTON's Field SOPs for performing similar tasks should be available to field oversight personnel to provide additional background and guidance.

## 4. PROCEDURE

The EPA Project Coordinator will determine which GE field activities will require monitoring by oversight personnel, based on discussions with GE concerning the upcoming schedule of field activities at the GE/Housatonic River site. Based on discussions with the EPA Project Coordinator, the WESTON Oversight Manager is responsible for documenting which GE field activities will require monitoring by oversight personnel in a task-specific Oversight Plan. The WESTON Oversight Manager will inform the WESTON On-Site Manager of the personnel needs for the oversight task. The WESTON On-Site Manager will then assign qualified

WESTON or subcontractor personnel to oversee the various GE field activities specified by the EPA Project Coordinator. The WESTON On-Site Manager is responsible for assigning personnel to conduct the oversight who have the professional qualifications, training, and experience necessary to provide EPA with effective oversight. The WESTON Oversight Manager is responsible for providing the Oversight Plan to oversight personnel and for providing any necessary clarifications of the EPA Project Coordinator's objectives.

## 4.1 RESPONSIBILITIES

Because of the scale of the project, several different people may serve as the EPA Project Coordinator. It will be important for oversight staff to establish which EPA person is serving as the Project Coordinator of the specific GE field task they are assigned to oversee. The Oversight Plan written by WESTON's Oversight Manager will indicate the correct EPA Project Coordinator for each task.

The primary responsibility of the oversight personnel is to serve as an assistant to the EPA Project Coordinator. It is critical that the oversight personnel closely follow the EPA Project Coordinator's specific requirements (contained in the Oversight Plan) for each oversight task. The goal is to provide the EPA Project Coordinator with the assurance (plus supporting documentation) that the work conducted by GE was consistent with GE's Work Plan, FSP/QAPP, generally accepted scientific and engineering methods, and/or any EPA-approved revisions.

Specific responsibilities of the oversight personnel include:

- Perform the oversight duties in a professional, responsible, and non-confrontational manner.
- Coordinate the oversight work closely with the EPA Project Coordinator and keep him/her informed, via the WESTON Oversight Manager. In circumstances where the WESTON Oversight Manager is unavailable, an alternate WESTON Manager will be designated as a point of contact, or oversight personnel will be directed to communicate directly with the EPA Project Coordinator.
- Have a good working knowledge of the Oversight Plan, GE Work Plan, FSP/QAPP, and any additional technical guidance documents relevant to the specific oversight task. Have all documents available for reference.

- Resolve any minor issues and changes directly with the GE or GE Contractor field staff, document the outcome of the discussions, and inform the WESTON Oversight Manager. The WESTON Oversight Manager will inform the EPA Project Coordinator of the results of such actions in the Summary of Field Oversight Activities weekly report. The oversight staff has no direct authority over the GE field team and cannot stop work, revise procedures, or alter the GE Work Plan. In some cases, technical issues that cannot be resolved between WESTON oversight personnel and the GE or GE Contractor field staff can be resolved between the WESTON Oversight Manager and the GE or GE Contractor Technical Manager without the involvement of the EPA Project Coordinator.

- Document the name, employer, education, and experience of each GE or GE Contractor field team member involved in performing the field activities. Evaluate the GE or GE Contractor field team and inform the WESTON Oversight Manager if the GE or GE Contractor field team may not have sufficient training, knowledge, and/or experience to conduct the work properly.

- Observe and document how the GE or GE Contractor field teams perform their tasks in relation to the requirements of the GE Work Plan and the field procedures detailed in the GE FSP/QAPP.

- Question and discuss with the GE or GE Contractor field team any task being conducted that does not appear to conform to either the GE Work Plan or the FSP/QAPP. Document any deviations from the GE Work Plan or FSP/QAPP. Inform the WESTON Oversight Manager, as soon as possible, if the deviation is potentially significant. It is much more important to prevent work from being performed incorrectly through quick intervention by the WESTON Oversight Manager and/or EPA Project Coordinator than to document that work was performed incorrectly.

- Immediately inform the EPA Project Coordinator if an emergency situation occurs that might present an immediate threat to public health or welfare or the environment due to a release or threatened release of waste material. Only the EPA Project Coordinator has the authority to halt work or take necessary response actions.

- Discuss any technical or procedural observations or suggestions pertaining to field activities directly with the GE or GE Contractor field team and/or supervisor before talking to the WESTON Oversight Manager. If the issue cannot be resolved in the field, contact the WESTON Oversight Manager, who will contact the GE supervisor or Technical Manager before contacting the EPA Project Coordinator. In cases that do not affect schedule or cost, EPA has requested that WESTON technical managers and GE or GE Contractor technical managers resolve the issue. Where cost or schedule might be affected, the EPA Project Coordinator will contact the GE Project Coordinator to resolve the issue. The WESTON Oversight Manager may contact the EPA Project Coordinator directly, in concert with the oversight personnel, or may direct the oversight personnel to contact the EPA Project Coordinator directly.

- Conduct all oversight work according to the provisions of the WESTON Health and Safety Plan. Conform to all health and safety guidance and requests from the GE field team unless such guidance contradicts provisions of the WESTON Health and Safety Plan. Inform the WESTON On-Site Manager and the EPA Project Coordinator if there are any health and safety issues that need to be resolved with GE or its subcontractors.

- Collect field split/supplemental samples as requested by the EPA Project Coordinator in the Oversight Plan, following the sampling procedures detailed and referenced within this Field Oversight SOP.

- Document the GE field effort **daily** by completing the following paperwork:

  - Daily Foreman's Report
  - Oversight Checklist (version appropriate to task)
  - Logbook entries
  - Photographic log
  - Oversight Soil Boring Log Forms (if applicable)
  - Chain-of-Custody Forms (for split/supplemental samples)
  - Sample Attribute Forms (for split/supplemental samples)
  - Field Oversight Summary Tables on the Pittsfield, MA (PMA) office local area network (LAN)
  - Field Oversight Summary Figures posted at the PMA office

## 4.2 PREPARATION

The oversight personnel must obtain and read the relevant project and GE documents related to the specific oversight task. The oversight person must read, understand, and sign the WESTON Health and Safety Plan. The oversight staff must read and be familiar with the relevant sections of the GE project-specific Work Plan and FSP/QAPP.

The oversight personnel should be familiar with the areas where the GE field work will be conducted and have adequate maps to record GE sampling or monitoring locations. Appropriate maps can be obtained at the Pittsfield project office prior to commencing oversight work.

Once a person has been assigned to oversee a GE field activity, the WESTON On-Site Manager will provide the oversight person with a GE or GE subcontractor contact (name and telephone number). The oversight person will be responsible for contacting the GE representative and coordinating the work schedule and access to the property where GE will be performing the field work.

GE Main Plant, GE Plastics Division, and neighboring companies (General Dynamics and Altresco) require that personnel working on their properties undergo biennial Hazard Communication training courses, which are typically held weekly on Monday mornings. After completing the course specific to the area, each person is presented with a laminated card, which must be available whenever the person is performing work on the property. The WESTON On-Site Manager will coordinate the scheduling of the Hazard Communication training courses for all oversight personnel.

## 4.3 OVERSIGHT

Effective oversight can be a difficult balancing act. The oversight personnel must establish a good working relationship with the GE field teams, but at the same time observe their work in a critical manner. The oversight must not interfere with the GE or GE Contractor field team's work, while all aspects of GE's field effort must be observable by the oversight personnel. The oversight personnel must act in a professional, responsible, and non-confrontational manner to meet these contrasting needs.

The following list contains specific guidance on how to conduct the oversight:

- Attempt to observe all aspects of the GE field operations, including their morning set-up prior to mobilizing to the field (e.g., check equipment storage, calibration, and security) and their end of day activities after returning to their field office (e.g., check sample preparation, sample shipping, and decontamination operations).

- Use the appropriate Oversight Checklist, along with personal knowledge and experience, to review the work being conducted by GE or GE Contractors. If a GE field procedure is unfamiliar, call the WESTON Oversight Manager or a technical manager to discuss the technical aspects of the unfamiliar procedure.

- Concentrate the oversight on potential problem times or areas and during critical technical operations such as:

  - When/where new GE or GE Contractor field teams, field team members, or subcontractors (e.g., drillers) first arrive.

  - When/where inexperienced GE or GE Contractor field team members are working.

  - At the start and end of the day—when errors often occur.

  - At the start and end of the week—when people are hurrying or are new to the field task.
  - During analytical sampling.
  - When or where NAPL observations are anticipated or detected.
  - Along the riverbanks, brooks, and drainage areas where contamination may impact the Housatonic River.
  - At the end of the day, especially when oversight is less than 100%, in order to document project progress for the day.

- Do not perform any GE Work Plan or FSP/QAPP tasks or procedures for the GE field team (e.g., decontamination, sample labeling, or NAPL tests). GE and its subcontractors are responsible for the work. The oversight personnel are there to observe and document only.
- Share data, observations, and descriptions with the GE field team and in general try to be cooperative.
- Question the GE or GE Contractor field team regarding procedures that do not comply with their FSP/QAPP, SOP, or other technical guidance in such a way that your comment is constructive. Questions like "Don't you need to change your gloves?" or "Isn't the conductivity reading supposed to be within 10% of the previous reading to be considered stable?" help the GE or GE Contractor field team do a better job.
- All aspects of the GE field work must be observable by the oversight personnel. Make sure to set up where all the GE work can be observed. If the GE or GE Contractor field team does not allow the oversight personnel to view any aspect of their work, contact the WESTON Oversight Manager or the EPA Project Coordinator after trying to settle the issue with the GE or GE Contractor field team or supervisor.

## 4.4 REPORTING AND COMMUNICATION

Each oversight team will be assigned a cellular phone to keep in contact with the Pittsfield office, WESTON Oversight Manager and technical managers, and the EPA Project Coordinator. All oversight personnel will report to the WESTON Oversight Manager. The oversight personnel are required to contact and discuss the oversight work with the WESTON Oversight Manager prior, during, and after the task is completed.

Prior to going into the field, each oversight team needs to determine which WESTON, WESTON SSERC Team subcontractor, or subcontractor technical and project managers are responsible for the oversight of the specific GE task being conducted. WESTON's Oversight Manager will provide the necessary project contacts for each field task as part of the Oversight Plan. If technical or project management problems or questions arise during oversight, the oversight personnel must have the names and phone numbers of the appropriate contacts and call the responsible managers.

At a minimum, oversight teams will fill out a Daily Foreman's Report following each day of oversight. The Daily Foreman's Report will be provided to the WESTON On-Site Manager, who may, as necessary, submit copies to the EPA Project Coordinator, the oversight files at the PMA office, plus the relevant WESTON, WESTON SSERC Team subcontractor, or WESTON subcontractor technical and project managers.

In addition, on a daily basis, each oversight team is responsible for updating the Fieldwork Summary Tables on the PMA LAN. Prior to the initiation of the oversight task, one or more MS Excel workbooks will be prepared in the Projects/Task Order 4 directory to collect data regarding borings performed, wells monitored, samples collected, etc. A draft copy of the Fieldwork Summary Table, with its specific path included in the footer, will be attached to the Oversight Plan. These tables must be updated with the samples collected by GE, split/supplemental samples collected by WESTON, and any comments regarding sample locations or observations (e.g., NAPL or poor sample recovery) at the end of each day of oversight, as they provide a mechanism for the WESTON Oversight Manager and technical managers to track project progress on a daily basis. They also allow coordination between oversight teams regarding location IDs (from the Master Boring Table), groundwater sample IDs (from the Master Groundwater Sample Table), and tracking of the number of WESTON split/supplemental samples collected to determine the need for QA/QC samples.

In addition, on a daily basis, each oversight team is responsible for updating the Fieldwork Summary Figure maintained at the PMA field office. Where applicable, this figure is a large-scale print of the most recent revision of GE's proposed activity locations. This figure will supersede any figures contained in available background documents, reflecting any final negotiated changes to the GE Work Plan. The location of each activity/sample collected should be confirmed or modified to reflect actual conditions (e.g., offset due to sampler refusal or subsurface utility). The initials of the WESTON oversight person, the date, and the depth(s) of sample(s) collected from the location, including the analyses to be performed, should be noted in shorthand form next to each sample location. On a weekly basis, an ArcView shape file source of the figure, if prepared, may be updated to reflect the changes to the activity locations, for inclusion in the Summary of Oversight Activities Weekly Report.

In the case of soil borings, the information collected regarding subsurface conditions will be transcribed from the personal logbook on a daily basis onto Oversight Soil Boring Logs, or collected digitally using a personal data assistant (PDA) and downloaded daily via additional software to create soil boring logs. The soil boring logs will be transmitted weekly or sooner to the technical manager(s) for the task, in order to facilitate technical support for the oversight personnel.

Finally, each oversight team should send a brief, daily e-mail message to the appropriate WESTON Oversight Manager and/or technical manager, summarizing work progress for the day. The message may simply list the number of locations sampled and any extraordinary observations or deviations from the GE Work Plan. Details regarding specific samples collected, depths, and times are available to the WESTON Oversight Manager or technical manager in the Fieldwork Summary Tables on the WESTON Intranet, and are unnecessary in the brief e-mail.

Additional monthly or end of task oversight reports will be provided to EPA, when requested by the EPA Project Coordinator.

## 4.5 FIELD SPLIT AND FIELD AUDIT SAMPLING

To help determine the reproducibility (precision) of GE sample analysis results, both field split samples and field audit samples may be used during oversight activities. The EPA Project Coordinator will determine when, where, and for which specific GE field activities both field split samples and field audit samples are used. The required number and/or locations of field split samples and field audit samples will be included in the Oversight Plan.

Split samples are blind duplicates or co-located samples collected by the GE field teams. GE field teams will collect the samples, using standard GE FSP/QAPP procedures, in sample containers provided by WESTON oversight personnel. The split samples are shipped by the WESTON oversight personnel to the EPA oversight laboratory for analysis.

Field audit samples are samples of a known concentration (prepared by an EPA-contracted laboratory) that are taken into the field by the oversight personnel and handed over to the GE field team for shipping, handling, and analysis by GE's laboratory, along with GE's other field samples. The WESTON On-Site Manager, at the request of the EPA Project Coordinator, will order field audit samples from the appropriate project laboratory.

Both field split samples and field audit samples will be numbered, labeled, documented, packed, handled, and shipped according the project SOPs G-6, G-9, G-10, and G-11 referenced earlier in this document.

Documentation of field split sampling must include recording of the associated GE sample ID numbers and the list of analyses requested by GE so that the two sets of sample results can be compared once the laboratory analyses are completed. The split sample information (including the GE sample ID number) is recorded in the Fieldwork Summary Table for the activity and the Sample Attribute Form.

## 4.6 DOCUMENTATION

There is a strong possibility that documentation produced during the oversight activities may come under legal review and/or be entered as evidence in a court of law. Therefore, it is critical that the documentation be as complete, clear, secure, and properly controlled as possible. Documentation will be in compliance with project SOP G-3, Field Documentation. Documentation needs to be entered using water-resistant ink. Corrections need to be crossed out with a single line and initialed by the oversight person. Field sheets and logbook entries must be dated and signed. The area of the GE/Housatonic River site in which the oversight was conducted must be included at the top of the page, for ease of finding references in the future. Oversight documentation needs to be kept in a safe and secure location during and after the oversight activities. The logbook needs to be bound with numbered pages.

All aspects of the GE field team activities, including deviations from the procedures identified in the GE Work Plan and FSP/QAPP, as well as activities that conform to the GE Work Plan, FSP/QAPP, and accepted industry practices, must be documented.

Photographs or videos of field activities will be taken to document the procedures used by GE's field teams. Photographs of any instances of non-compliance with the GE Work Plan and FSP/QAPP should be taken plus photographs of any technically important samples (e.g., top of till, NAPL samples, and unusual lithologies). Video coverage may better represent the performance of specific procedures, so it should be given strong consideration when documenting important or non-compliance issues.

The forms and logs used to document the oversight activities are listed below (sample forms are included at the end of this SOP).

- **Oversight Plan Form**—Completed for each field task.
- **Foreman's Report—**Completed daily.
- **Fieldwork Summary Table**—Updated daily.
  - Date
  - Samples collected by GE
  - Split/supplemental samples collected by oversight team
  - Comments
- **Master Field Sample Figure**—Updated daily (paper) and weekly (electronically, where applicable) for each task observed.
  - Date
  - Samples collected by GE
  - Location of sample(s)
- **Oversight Checklist**—Completed weekly for each task observed.
  - Fieldwork completed according to GE Work Plan?
  - Fieldwork completed according to procedures in GE FSP/QAPP?
  - Fieldwork completed using industry standard practices?
- **Logbook Entries—**Completed daily as situations arise or personnel change.
  - Site weather and conditions

  - GE field team qualifications
  - Health and safety issues
  - Technical issues and observations
  - Details of site incidents and activities
  - Record of conversations with key personnel
  - Description of potential or actual problems
  - Record of changes in project plans and procedures negotiated with field personnel
  - Detailed oversight observations

- **Photographic Log**—Completed when taking photographs. Photo information can be recorded in the logbook.

  - Date and time of each photo

  - Sequential number of photograph and film roll number

  - Location and orientation (i.e., compass direction) of each photo. Include an object such as a ruler for scale in the photo when photographing samples

  - Show photo location on a site map

  - Description of activity, person, or item captured by the photo

  - Name and signature of person responsible for the photo

- **Oversight Soil Boring Log Form**—Completed for each subsurface boring. Refer to SOPG-3, Field Documentation, for additional reference information.

  - Location information
  - Soil/rock sampling information
  - Lithologic information
  - NAPL information

- **Chain-of-Custody Form**—Completed for split samples only. Refer to SOP G-10, Sample Documentation, for procedures.

- **Sample Attribute Form**—Completed for split samples only. Refer to SOP G-6, Field Sample Numbering, for procedures.

## 5. REFERENCES

Blasland, Bouck & Lee, Inc., January 2002. *Field Sampling and Analysis Plan/ Quality Assurance Project Plan*, Volumes 1, 2, and 3. Prepared for General Electric Company. (00-0545)

EPA (U.S. Environmental Protection Agency). Office of Waste Programs Enforcement. 1991. *Guidance on Oversight of Potentially Responsible Party Remedial Investigations and Feasibility Studies*, Volumes 1 and 2: Final. (99-0398)

United States District Court, 1999. *Consent Decree, United States of America, State of Connecticut, Commonwealth of Massachusetts - Plaintiffs v. General Electric Company - Defendant*. (00-0388)

WESTON (Roy F. Weston, Inc.). March 2001. *Quality Assurance Project Plan.* Environmental Remediation Contract, GE/Housatonic River Project. Volumes I, II, IIA, and IV. DCN GE-021601-AAHM. (00-0507)

# Oversight Plan Form

**Oversight Plan –** *Site Name*

**Date:** *Date*

**Work Order Number:** 20124.001.098.4XXX.0X

| | | |
|---|---|---|
| **EPA Project Coordinator** | *Name* | *Phone Number* |
| **WESTON Oversight Manager** | *Name* | *Phone Number* |
| **WESTON Technical Manager** | *Name* | *Phone Number* |
| **GE Project Manager** | *Name* | *Phone Number* |
| **GE Contractor Technical Mgr.** | *Name* | *Phone Number* |
| **GE Contractor Contact** | *Name* | *Phone Number* |

**GE Work Plan(s) Referenced:**

*List appropriate GE plans*

*Field Sampling Plan/Quality Assurance Project Plan, GE/BB&L, dated 31 January 2002*

**Additional References:**

*List appropriate WESTON and Agency documents.*

**Data Quality Objectives:** Refer to WESTON Field Sampling Plan, Section 4.1

**Summary of Work to be Performed:**

**Level of Oversight: XX%**

**Areas of Interest:**

**Split/Supplemental Sampling:**

**Notification Criteria:**

Minor Deviations from GE Work Plan:

Major Deviations from GE Work Plan:

**Attachments:**

Table of Proposed Sample Locations, with Proposed Split/Supplemental Samples
Field Investigation Oversight Checklist
Proposed Sample Location Map

# Foreman's Report

**Foreman:**________________ **Date:**___________

**Signature:**__________________ **OU 1:**_____________

**OU 2:**_____________

**REMOVAL REACH:**_____________

**SSERC:**_____________

| | |
|---|---|
| **Crew:** | |
| 1. | 5. |
| 2. | 6. |
| 3. | 7. |
| 4. | 8. |

**WORK PERFORMED**

**Reach:** 1 2 3 4 5 6 7 8 9 **Type of Sampling:** Sediment Floodplain Bank
Other:__________________

**Work Plan Name of Sampling:**___________________________

**Work Completed:** ______________________________________________________________

| Transect/ Area | No. of Samples | Transect/ Area | No. of Samples | BBL Split Samples |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**Total No. of Samples Taken:**

**Health and Safety Issues:**

**Observations:**

# Sample Fieldwork Summary Table
# Summary of Pre-Design Investigation Soil Sampling
# Former Oxbows A and C

| Boring Date | GE Samples | | | | | | | | WESTON Split Samples | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GE Sample ID | Sample Depth (ft bgs) | PCBs | Appendix IX + 3 | | | | | WESTON Boring/Sample ID | Plan Oversight | PCBs | Appendix IX + 3 | | | |
| | | | | VOCs | SVOCs | Inorganics | PCDDs/PCDFs | Pest/Herb | | | | VOCs | SVOCs | Inorganics | |
| | RAA11- B24 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- B25 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- C17 | 0-1 | | X | X | X | X | | | | | | | | |
| | | 1-3 | | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- C18 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- C19 | 0-1 | | X | X | X | X | | | X | | | | | |
| | | 1-3 | | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- C21 | 0-1 | | X | X | X | X | | | X | | | | | |
| | | 1-3 | X | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- C22 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- C23 | 0-1 | | X | X | X | X | | | | | | | | |
| | RAA11- C24 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- C25 | 0-1 | | X | X | X | X | | | X | | | | | |
| | | 1-3 | X | X | X | X | X | | | | | | | | |
| | | 3-6 | X | X | X | X | X | | | | | | | | |
| | | 6-10 | X | X | X | X | X | | | | | | | | |
| | | 10-15 | X | X | X | X | X | | | | | | | | |
| | RAA11- D14 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- D15 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- D16 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- D17 | 0-1 | X | X | X | X | X | | | | | | | | |
| | | 10-15 | | X | X | X | X | | | | | | | | |
| | RAA11- D18 | 0-1 | | | | | | | | X | | | | | |
| | | 1-3 | | | | | | | | | | | | | |
| | | 3-6 | | | | X | | | | | | | | | |
| | RAA11- D19 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- D22 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- D24 | 0-1 | X | X | X | X | X | X | | X | | | | | |
| | | 1-3 | | | | | | | | | | | | | |
| | | 3-6 | | | | | | | | | | | | | |
| | | 6-10 | | | | | | | | | | | | | |
| | | 10-15 | | | | X | | | | | | | | | |
| | RAA11- D26 | 0-1 | | X | X | X | X | | | | | | | | |
| | RAA11- E13 | 0-1 | X | X | X | X | X | | | | | | | | |
| | | 1-3 | X | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- E14 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- E15 | 0-1 | X | X | X | X | X | X | | | | | | | |
| | | 1-3 | X | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | X | X | X | X | | | | | | | | |
| | RAA11- E16 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- E17 | 0-1 | X | X | X | X | X | | | X | | | | | |
| | | 1-3 | X | X | X | X | X | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |

# Sample Fieldwork Summary Table
# Summary of Pre-Design Investigation Soil Sampling
# Former Oxbows A and C

| Boring Date | GE Samples | | | | | | | | WESTON Split Samples | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Appendix IX + 3 | | | | | | | | Appendix IX + 3 | | | |
| | GE Sample ID | Sample Depth (ft bgs) | PCBs | VOCs | SVOCs | Inorganics | PCDDs/PCDFs | Pest/Herb | WESTON Boring/Sample ID | Plan Oversight | PCBs | VOCs | SVOCs | Inorganics | |
| | RAA11- E18 | 0-1 | X | | | | | | | | | | | | |
| | | 1-3 | | | | | | | | | | | | | |
| | | 3-6 | | X | X | X | X | | | | | | | | |
| | | 6-10 | | X | X | X | X | | | | | | | | |
| | | 10-15 | | | | | | | | | | | | | |
| | RAA11- E19 | 0-1 | X | X | X | X | X | | | X | | | | | |
| | | 1-3 | X | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | X | | X | X | |
| | RAA11- E20 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- E21 | 0-1 | | X | X | X | X | X | | X | | | | | |
| | | 1-3 | | X | X | X | X | X | | | | | | | |
| | | 3-6 | | X | X | X | X | | | | | | | | |
| | | 6-10 | | | | | | | | | | | | | |
| | | 10-15 | | | | | | | | | | | | | |
| | RAA11- E23 | 0-1 | | X | X | X | X | | | X | | | | | |
| | | 1-3 | X | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- E25 | 0-1 | | X | X | X | X | | | X | | | | | |
| | | 1-3 | X | X | X | X | X | | | | | | | | |
| | | 3-6 | X | X | X | X | X | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- E27 | 0-1 | | X | X | X | X | | | X | | | | | |
| | | 1-3 | | | | | | | | | | | | | |
| | | 3-6 | | | | | | | | | | | | | |
| | | 6-10 | | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- F12 | 0-1 | X | X | X | X | X | X | | | | | | | |
| | RAA11- F13 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- F14 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- F15 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- F16 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- F17 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- F18 | 0-1 | X | X | X | X | | | | | | | | | |
| | RAA11- F19 | 0-1 | X | X | X | X | | | | | | | | | |
| | RAA11- F20 | 0-1 | X | X | X | X | | | | | | | | | |
| | RAA11- G16 | 0-1 | X | X | X | X | | | | | | | | | |
| | RAA11- G17 | 0-1 | X | | | | | | | | | | | | |
| | | 1-3 | X | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | X | X | X | | | | | | | | | |
| | RAA11- G18 | 0-1 | X | X | X | X | | | | | | | | | |
| | RAA11- G19 | 0-1 | X | | | | | | | | | | | | |
| | | 1-3 | X | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | X | X | X | | | | | | | | | |
| | RAA11- G20 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- H16 | 0-1 | X | X | X | X | | | | | | | | | |
| | RAA11- H17 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- F21 | 0-1 | | X | | | | | | | | | | | |
| | | 1-3 | | | | | | | | | | | | | |
| | | 3-6 | | | | | | | | | | | | | |
| | | 6-10 | | | | | | | | | | | | | |
| | | 10-15 | | | | X | X | | | | | | | | |
| | RAA11- F26 | 0-1 | | X | X | X | X | | | | | | | | |
| | RAA11- F27 | 0-1 | X | | | | | | | | | | | | |

# Sample Fieldwork Summary Table
## Summary of Pre-Design Investigation Soil Sampling
## Former Oxbows A and C

| Boring Date | GE Samples | | | | | | | | WESTON Split Samples | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GE Sample ID | Sample Depth (ft bgs) | PCBs | Appendix IX + 3 | | | | | WESTON Boring/Sample ID | Plan Oversight | PCBs | Appendix IX + 3 | | | |
| | | | | VOCs | SVOCs | Inorganics | PCDDs/PCDFs | Pest/Herb | | | | VOCs | SVOCs | Inorganics | |
| | RAA11- G12 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- G13 | 0-1 | X | X | X | X | X | | | | | | | | |
| | | 1-3 | X | X | X | X | X | | | | | | | | |
| | | 3-6 | X | X | X | X | X | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | X | X | X | X | | | | | | | | |
| | RAA11- G14 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- G15 | 0-1 | X | X | X | X | X | | | | | | | | |
| | | 1-3 | X | X | X | X | X | | | | | | | | |
| | | 3-6 | X | X | X | X | X | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- G21 | 0-1 | X | X | X | X | X | X | | X | | | | | |
| | | 1-3 | X | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | | | | | X | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- G22 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- G23 | 0-1 | | X | X | X | X | | | X | | | | | |
| | | 1-3 | X | X | X | X | X | | | | | | | | |
| | | 3-6 | X | X | X | X | X | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | X | X | | |
| | RAA11- G25 | 0-1 | | X | X | X | X | | | X | | | | | |
| | | 1-3 | X | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | X | X | X | X | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- G27 | 0-1 | X | X | X | X | X | | | | | | | | |
| | | 1-3 | X | X | X | X | X | | | | | | | | |
| | | 3-6 | X | X | X | X | X | | | | | | | | |
| | | 6-10 | X | | | | | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- H11 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- H12 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- H13 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- H14 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- H15 | 0-1 | X | X | | | X | | | | | | | | |
| | RAA11- H18 | 0-1 | X | X | | | X | | | | | | | | |
| | | 1-3 | X | | | | | | | | | | | | |
| | | 3-6 | X | | | | | | | | | | | | |
| | | 6-10 | X | | | | X | | | | | | | | |
| | | 10-15 | X | | | | | | | | | | | | |
| | RAA11- H19 | 0-1 | X | | | | | | | | | | | | |
| | RAA11- H20 | 0-1 | X | X | X | X | X | | | | | | | | |
| | RAA11- H21 | 0-1 | X | | | | | | | | | | | | |

# Field Investigation Oversight Checklist

**Date:** ___________________

**Name(s) of Oversight Personnel:** __________________________________________________

**Name(s) & Company of GE Field Crew:**______________________________________________

Questions that are **bolded** are taken from the GE FSP/QAPP. These should be answered in the affirmative. Non-bolded questions and comments appear as guidance for WESTON field oversight personnel.

## General Field Activity Checklist

1. Y☐ N☐ NA☐ Have parts of the OPCA been changed by weather within the last 24 hours (i.e., erosion/deposition)?
2. **Y☐ N☐ NA☐ Were copies of the GE OPCA Management Plan and a site plan with proposed locations available on site?**
3. **Y☐ N☐ NA☐ Have each of the GE samplers signed off on the H&S and WP?**
4. **Y☐ N☐ NA☐ Was monitoring equipment properly cleaned and calibrated?**
5. Y☐ N☐ NA☐ Were calibrations recorded?
6. Y☐ N☐ NA☐ Was each piece of monitoring equipment coded or numbered? Were the codes recorded with the sample in the field notebook?
7. Y☐ N☐ NA☐ Have Safety Zones and local decon areas been properly set-up?
8. Y☐ N☐ NA☐ Was field equipment (sampling tools, well casing, sample jars, decon water) stored in a clean, secured location overnight…away from exhaust fumes, decon fluids, and fuel (volatiles)?
9. Y☐ N☐ NA☐ Was decon/rinse water from an acceptable source and have appropriate samples been taken to assure its quality?
10. Y☐ N☐ NA☐ Were decon/rinse water sources recorded?
11. Y☐ N☐ NA☐ Periodically visit the central decon area to observe decon processes. Were proper decon procedures followed?
12. Y☐ N☐ NA☐ Were photos being taken of the sampling/drilling activities? Photos should electronically capture time and date and descriptions of each photo should be entered into the field notebooks.
13. Y☐ N☐ NA☐ Were field forms and field notebooks being checked and secured on a daily basis?

## Well Installation and Development

Not Applicable☐

1. **Y☐ N☐ Were all well installation equipment and materials (including the rig) properly decontaminated?**
2. **Y☐ N☐ Was ASTM practice D 5092-90 (design and installation of groundwater monitoring wells) followed?**
3. Y☐ N☐ Were wells developed to their total, finished depth?
4. Y☐ N☐ Was the sand pack and bentonite seal tremied (rather than gravity fed) into the hole?
5. Y☐ N☐ Was development done immediately after installation or after 24 - 48 hours?
6. Y☐ N☐ Was the development pump located above the screened interval?

# Field Investigation Oversight Checklist

**7.** Y☐ N☐ **Were quantities of sand, bentonite and cement used in well construction being recorded per hole?**

8\. Y☐ N☐ Were depth measurements being taken around the entire circumference of the borehole annulus when determining sand and/or bentonite levels?

9\. Y☐ N☐ Was a different sand pack size/mix used in wells based in different lithologic material types (till vs. outwash)?

**10.** Y☐ N☐ **Were well construction figures or tables available for determining mid-screen pump placement?**

**11.** Y☐ N☐ **Were wells installed in accordance with the GE SAP and Work Plan?**

## Groundwater Purging and Monitor Well Sampling - Low Flow Pump Method

Not Applicable☐

1\. Y☐ N☐ Was the well secure prior to and after sampling (i.e., padlocked or in a locked/gated area)

**2.** Y☐ N☐ **Was the EPA Low Flow sampling method followed?**

3\. Y☐ N☐ Was the well surface seal in good condition prior to sampling?

4\. Y☐ N☐ Was well properly developed prior to sampling?

**5.** Y☐ N☐ **Were well construction/depth and historic water level tables available on site?**

6\. Y☐ N☐ Was a total depth taken of the well to determine if it had silted up since installation?

**7.** Y☐ N☐ **Was a low flow pump used to purge the well at 100 – 500 milliliters/minutes?**

**8.** Y☐ N☐ **Was an appropriate volume of groundwater removed?**

**9.** Y☐ N☐ **Were water level measurements taken and recorded before and after pump installation and at 2 to 5 minute intervals thereafter?**

**10.** Y☐ N☐ **Was any drawdown recorded?**

**11.** Y☐ N☐ **Was sample collected only after field indicator parameters remained within 10% for 3 consecutive readings?**

**12.** Y☐ N☐ **Was sample turbidity <50 NTU?**

**13.** Y☐ N☐ **Were samples collected in proper order (VOC-TOC-SVOC-metals and cyanide, other)?**

**14.** Y☐ N☐ **Was the sample collected before the any flow-through-cell?**

**15.** Y☐ N☐ **Were water levels taken after purging and after sampling to determine well response?**

**16.** Y☐ N☐ **Was an after-sampling groundwater volume collected and tested for field indicator parameters?**

17\. Y☐ N☐ Were there any signs of NAPL or odor connected with the purge water prior or after sampling?

**18.** Y☐ N☐ **Were samples collected from wells in order of increasing contamination? (If known)**

**19.** Y☐ N☐ **Did equipment blanks include blanks of the pump and tubing?**

**20.** Y☐ N☐ **Were equipment blanks taken after sampling wells with the highest concentrations (if known)?**

21\. Y☐ N☐ Were the proper numbers and types of QC samples collected?

## Groundwater Purging and Monitor Well Sampling - Bailer Method

Not Applicable☐

1\. Y☐ N☐ Was the well secure prior to and after sampling (i.e., padlocked or in a locked/gated area)?

2\. Y☐ N☐ Was the well surface seal in good condition prior to sampling?

# Field Investigation Oversight Checklist

3. Y☐ N☐ Was well properly developed prior to sampling?
4. Y☐ N☐ **Were well construction/depth and historic water level tables available on site?**
5. Y☐ N☐ Was a total depth taken of the well to determine if it had silted up since installation?
6. Y☐ N☐ **Was the bailer and rope properly decontaminated (wrapped in aluminum, plastic)?**
7. Y☐ N☐ **Was the well properly surged/purged?**
8. Y☐ N☐ **Was an appropriate volume of groundwater removed?**
9. Y☐ N☐ **Was sample collected after field indicator parameters remained within 10% for 3 consecutive readings?**
10. Y☐ N☐ **Were samples collected in proper order (VOC-TOC-SVOC-metals and cyanide, other)?**
11. Y☐ N☐ **Was an after-sampling groundwater volume collected and tested for field indicator parameters?**
12. Y☐ N☐ Were water levels taken after purging and after sampling to determine well response?
13. Y☐ N☐ Were the proper numbers and types of QC samples collected?
14. Y☐ N☐ Were there any signs of NAPL or odor connected with the purge water prior or following sampling?

## Surface Water Sampling

Not Applicable☐

1. Y☐ N☐ Were sampling devices properly decontaminated and packaged (wrapped in aluminum, plastic) prior to sampling?
2. Y☐ N☐ **Were sampling locations identified on appropriate sampling log or field notebook?**
3. Y☐ N☐ **Did sampling take place during a precipitation event (it shouldn't)?**
4. Y☐ N☐ **Were samples collected from locations in a downstream to upstream order?**
5. Y☐ N☐ **Were volatile samples collected directly from the water sampler to 40 ml vials?**
6. Y☐ N☐ **Were samples collected in the proper order (VOC-TOC-SVOC-metals and cyanide, other)?**
7. Y☐ N☐ Was the sample collected upstream of personnel entry point (to avoid suspended sediments kicked up by entry)?
8. Y☐ N☐ **Were samples requiring filtration, filtered using a peristaltic pump, new tubing and a 0.45 micron filter? (PCB samples are to be filtered in the lab, not the field)**
9. Y☐ N☐ **Was water temperature (~1 ft below water surface) and ambient air temperature measured and recorded following sampling?**
10. Y☐ N☐ **Was a peristaltic pump and new tubing used to collect samples at depth from ponds, lakes or impoundments?**
11. Y☐ N☐ Were water level reference levels taken at the beginning and end of each day?
12. Y☐ N☐ **Was the depth of water at the sampling location recorded?**
13. Y☐ N☐ Were the proper numbers and types of QC samples collected?

## Surface Soil Sampling

Not Applicable☐

1. Y☐ N☐ **Were grass, sod, leaves and/or dense root matter removed prior to sample collection?**
2. Y☐ N☐ **Was PID screening done on sample splits?**
3. Y☐ N☐ Was a sufficient quantity of sample recovered?

4. Y☐ N☐ Were the proper numbers and types of QC samples collected?

### Sediment Sampling

Not Applicable☐

1. Y☐ N☐ Were water level reference levels taken at the beginning and end of each day?
**2. Y☐ N☐ Was the depth of water above the sampling location recorded?**
3. Y☐ N☐ Was a description of the river bottom (i.e., soft, gravelly, hard, mushy) collected?
4. Y☐ N☐ Was the sample taken on a bar or terrace or in the thalweg of the channel?
5. Y☐ N☐ Were any obstructions in the river (fallen trees, beaver dams) noted relative to the sampling point?
6. Y☐ N☐ Did observations include changes in color (not just lithology), noticeable odors or visible product, staining and aggregate/colloidal materials present?
7. Y☐ N☐ Are samples for all intervals or sampled intervals being archived for later reference?
8. Y☐ N☐ Were photos being taken of cores for later reference?
**9. Y☐ N☐ Were reconnaissance and/or sediment probing conducted prior to sediment sampling?**
**10. Y☐ N☐ Were locations identified on air photos or maps prior to sampling?**
**11. Y☐ N☐ Were sampling locations identified on appropriate sampling log or field notebook?**
12. Y☐ N☐ Were all probing results recorded or just those associated with soft, penetrable deposits?
13. Y☐ N☐ Were blank Lexan cores properly decontaminated and packaged prior to sampling?
**14. Y☐ N☐ Was the top of the recovered core sample marked “top”?**
**15. Y☐ N☐ Was the sample tube and cap properly labeled immediately after it was capped and sealed?**
**16. Y☐ N☐ Was a sample label affixed to the tube immediately after collecting the sample?**
17. Y☐ N☐ Was lithologic and bedding information for each core recorded on forms or in the field notebook? (samples are collected based on depth, not lithology type or bedding)
**18. Y☐ N☐ Were saws, knives, scrapers and other implements involved with the extrusion and sample partitioning process properly decontaminated?**
**19. Y☐ N☐ Were Appendix IX +3 VOC samples placed immediately into the sample jars?**
20. Y☐ N☐ Were the proper numbers and types of QC samples collected?

### Soil Boring Installation and Sampling

Not Applicable☐

**1. Y☐ N☐ Were soil samples collected at the intervals and depths prescribed in the GE WP?**
**2. Y☐ N☐ Was ASTM sampling method D 1588 (split-spoon sampling) or D 6282-98 (Direct Push soil sampling) followed (as appropriate)?**
3. Y☐ N☐ Were split-spoon 30-inch drop distances being maintained for standard 2-inch by 2-foot split-spoon and 140-lb hammer?
4. Y☐ N☐ Were representative samples collected at all locations?
5. Y☐ N☐ Was a sufficient quantity of sample recovered at each sampling interval (>50%) for representative analytical samples? The GE analytical samples need to represent the entire sampling interval (i.e., 0-1, 1-3, 1-6, 6-10, 6-15 ft bgs, etc.). If GE sample recovery is too low (<50%) then the analytical samples may be biased.

# Field Investigation Oversight Checklist

**6.** Y☐ N☐ **Were subsurface soil samples thoroughly and properly described according to ASTM practice D 2488-93 (description and identification of soils)?** Observations should include changes in color (not just lithology), moisture content, noticeable odors or visible product, staining and whether aggregate materials are present.

**7.** Y☐ N☐ **Was PID field screening done?**

**8.** Y☐ N☐ **Were VOC samples selected based on the results of PID field screening tests?**

**9.** Y☐ N☐ **Were Appendix IX +3 samples selected based on the results of PID and/or visual inspection, or proximity to the water table surface?**

10. Y☐ N☐ Were the proper numbers and types of QC samples collected?

11. Y☐ N☐ Were samples for all intervals or sampled intervals being archived for later reference?

## Soil Sample Compositing

Not Applicable☐

1. Y☐ N☐ Was compositing of soils done in accordance with the GE SAP?

**2.** Y☐ N☐ **Were representative soil samples from individual depth increments collected and screened with a PID?**

**3.** Y☐ N☐ **Was the discrete soil sample depth interval with the highest PID reading sent for Appendix IX +3 VOC analysis?**

4. Y☐ N☐ Were any samples archived for later examination or physical testing?

5. Y☐ N☐ **Were the proper numbers and types of QC samples collected?**

## NAPL Soil Sampling

Not Applicable☐

1. Y☐ N☐ If product (NAPL) is suspected in an interval being sampled, were samples collected? By what procedure? Was a shake test or another field procedure used to discern whether the product was an LNAPL or DNAPL?

2. Y☐ N☐ Are field instruments checked and calibrated on a regular basis (at least twice a day)?

3. Y☐ N☐ Is GE doing any kind of NAPL test whenever the top of the water table or a confining unit is encountered?

4. Y☐ N☐ In soil samples where NAPL was suspected was the sample headspace screened and a shake test performed in addition to a visual examination?

5. Y☐ N☐ Were the proper numbers and types of QC samples collected?

6. Y☐ N☐ When NAPL was detected, were soil/NAPL analytical samples collected for analysis?

## Sample Documentation, Handling, Packaging and Shipping

Not Applicable☐

1. Y☐ N☐ Were appropriate containers used for samples?

**2.** Y☐ N☐ **Were samples kept at 4 °C after being collected?**

3. Y☐ N☐ Were sample containers stored, labeled and properly handled/packed and shipped?

**4.** Y☐ N☐ **Was a chain-of-custody form made out for the samples?**

**5.** Y☐ N☐ **Were appropriate and pertinent field details and descriptions recorded on field forms and in field notebooks?**

6. Y☐ N☐ Were proper chain-of-custody procedures followed? Were the samples never left unsecured during the day?

# On-Plant Consolidation Area (OPCA) Oversight Checklist

**Date:** ____________________

**Name(s) of Oversight Personnel:** ____________________________________________________

**Name(s) & Company of GE Field Crew:** ________________________________________________

Questions that are **bolded** are taken from the GE OPCA Management Plan. These should be answered in the affirmative. Non-bolded questions and comments appear as guidance for WESTON field oversight personnel.

## General Field Activity Checklist

1. Y☐ N☐ NA☐ Have parts of the OPCA been changed by weather within the last 24 hours? (i.e., erosion/deposition)
2. Y☐ N☐ NA☐ **Were copies of the GE OPCA Management Plan and a site plan with proposed locations available on site?**
3. Y☐ N☐ NA☐ **Have each of the GE samplers signed off on the H&S and WP?**
4. Y☐ N☐ NA☐ **Was monitoring equipment properly cleaned and calibrated?**
5. Y☐ N☐ NA☐ Were calibrations recorded?
6. Y☐ N☐ NA☐ Was each piece of monitoring equipment coded or numbered? Were the codes recorded with the sample in the field notebook?
7. Y☐ N☐ NA☐ Have Safety Zones and local decon areas been properly set-up?
8. Y☐ N☐ NA☐ Were weather conditions recorded?
9. Y☐ N☐ NA☐ Were photos being taken of the OPCA activities? Photos should electronically capture time and date and descriptions of each photo should be entered into the field logbooks.
10. Y☐ N☐ NA☐ Were field forms and field logbooks being checked and secured on a daily basis?

## Cell Preparation and Utility Relocation

Not Applicable☐

1. Y☐ N☐ Were utility relocations performed as described in Section 1.1 of the OPCA Oversight QA Guidance and as shown on GE drawing(s)?
2. Y☐ N☐ Were access roads installed as described in Section 1.2 of the OPCA Oversight QA Guidance and as shown on GE drawing(s)?
3. Y☐ N☐ Were site preparation activities performed as described in Section 1.3 of the OPCA Oversight QA Guidance and as shown on GE drawing(s)?
4. Y☐ N☐ Was subgrade prepared as described in Section 1.4 of the OPCA Oversight QA Guidance and as shown on GE drawing(s)??
5. Y☐ N☐ Was the geotextile inspected, installed, and repaired (if necessary) as described in Section 1.5 of the OPCA Oversight QA Guidance and as shown on GE drawing(s)?
6. Y☐ N☐ Was the flexible membrane liner inspected, deployed, seamed, and tested as described in Section 1.6 of the OPCA Oversight QA Guidance and as shown on GE drawing(s)?
7. Y☐ N☐ Was the geosynthetic drainage composite inspected, deployed, seamed, and anchored as described in Section 1.7 of the OPCA Oversight QA Guidance and as shown on GE drawing(s)?
8. Y☐ N☐ Was the leachate collection system installed as described in Section 1.8 of the OPCA Oversight QA Guidance and as shown on GE drawing(s)?

# On-Plant Consolidation Area (OPCA) Oversight Checklist

9. Y☐ N☐ Were depth measurements being taken around the entire circumference of the borehole annulus when determining sand and/or bentonite levels?

10. Y☐ N☐ Was a different sand pack size/mix used in wells based in different lithologic material types? (tills vs. outwash?)

11. Y☐ N☐ **Were well construction figures or tables available for determining mid-screen pump placement?**

12. Y☐ N☐ **Were wells installed in accordance with the GE SAP and Work Plan?**

**Waste Placement** Not Applicable☐

1. Y☐ N☐ Was the well secure prior to and after sampling (i.e., padlocked or in a locked/gated area)

2. Y☐ N☐ **Was the EPA Low Flow sampling method followed?**

3. Y☐ N☐ Was the well surface seal in good condition prior to sampling?

4. Y☐ N☐ Was well properly developed prior to sampling?

5. Y☐ N☐ **Were well construction/depth and historic water level tables available on site?**

6. Y☐ N☐ Was a total depth taken of the well to determine if it had silted up since installation?

7. Y☐ N☐ **Was a low flow pump used to purge the well at 100 – 500 milliliters/minutes?**

8. Y☐ N☐ **Was an appropriate volume of groundwater removed?**

9. Y☐ N☐ **Were water level measurements taken and recorded before and after pump installation and at 2 to 5 minute intervals thereafter?**

10. Y☐ N☐ **Was any drawdown recorded?**

11. Y☐ N☐ **Was sample collected after field indicator parameters remained within 10% for 3 consecutive readings?**

12. Y☐ N☐ **Was sample turbidity <50 NTU?**

13. Y☐ N☐ **Were samples collected in proper order (VOC-TOC-SVOC-metals and cyanide, other)?**

14. Y☐ N☐ **Was the sample collected before the any flow-thru-cell?**

15. Y☐ N☐ **Were water levels taken after purging and after sampling to determine well response?**

16. Y☐ N☐ **Was an after-sampling groundwater volume collected and tested for field indicator parameters?**

17. Y☐ N☐ Were there any signs of NAPL or odor connected with the purge water prior or after sampling?

18. Y☐ N☐ **Were samples collected from wells in order of increasing contamination? (If known)**

19. Y☐ N☐ **Did equipment blanks include blanks of the pump and tubing?**

20. Y☐ N☐ **Were equipment blanks taken after sampling wells with the highest concentrations (if known)?**

21. Y☐ N☐ Were the proper numbers and types of QC samples collected?

22. Y☐ N☐ Was the well secure prior to and after sampling (i.e., padlocked or in a locked/gated area)?

23. Y☐ N☐ Was the well surface seal in good condition prior to sampling?

24. Y☐ N☐ Was well properly developed prior to sampling?

25. Y☐ N☐ **Were well construction/depth and historic water level tables available on site?**

26. Y☐ N☐ Was a total depth taken of the well to determine if it had silted up since installation?

# On-Plant Consolidation Area (OPCA) Oversight Checklist

27. Y☐ N☐ **Was the bailer and rope properly deconned (wrapped in aluminum, plastic)?**
28. Y☐ N☐ **Was the well properly surged/purged?**
29. Y☐ N☐ **Was an appropriate volume of groundwater removed?**
30. Y☐ N☐ **Was sample collected after field indicator parameters remained within 10% for 3 consecutive readings?**
31. Y☐ N☐ **Were samples collected in proper order (VOC-TOC-SVOC-metals and cyanide, other)?**
32. Y☐ N☐ **Was an after-sampling groundwater volume collected and tested for field indicator parameters?**
33. Y☐ N☐ Were water levels taken after purging and after sampling to determine well response?
34. Y☐ N☐ Were the proper numbers and types of QC samples collected?
35. Y☐ N☐ Were there any signs of NAPL or odor connected with the purge water prior or following sampling?

**Surface Water Sampling** Not Applicable☐

1. Y☐ N☐ Were sampling devices properly deconned and packaged (wrapped in aluminum, plastic) prior to sampling?
2. Y☐ N☐ **Were sampling locations identified on appropriate sampling log or field notebook?**
3. Y☐ N☐ **Did sampling take place during a precipitation event (it shouldn't)?**
4. Y☐ N☐ **Were samples collected from locations in a downstream to upstream order?**
5. Y☐ N☐ **Were volatile samples collected directly from the water sampler to 40 ml vials?**
6. Y☐ N☐ **Were samples collected in the proper order (VOC-TOC-SVOC-metals and cyanide, other)?**
7. Y☐ N☐ Was the sample collected upstream of personnel entry point? (to avoid suspended sediments kicked up by entry)
8. Y☐ N☐ **filter? (PCB samples are to be filtered in the lab not the field)**
9. Y☐ N☐ **Was water temperature (~1 ft below water surface) and ambient air temperature measured and recorded following sampling?**
10. Y☐ N☐ **Was a peristaltic pump and new tubing used to collect samples at depth from ponds, lakes or impoundments?**
11. Y☐ N☐ Were water level reference levels taken at the beginning and end of each day?
12. Y☐ N☐ **Was the depth of water at the sampling location recorded?**
13. Y☐ N☐ Were the proper numbers and types of QC samples collected?

**Surface Soil Sampling** Not Applicable☐

1. Y☐ N☐ **Were grass, sod, leaves and/or dense root matter removed prior to sample collection?**
2. Y☐ N☐ **Was PID screening done on sample splits?**
3. Y☐ N☐ Was a sufficient quantity of sample recovered?
4. Y☐ N☐ Were the proper numbers and types of QC samples collected?

# On-Plant Consolidation Area (OPCA) Oversight Checklist

**Sediment Sampling** Not Applicable☐

1. Y☐ N☐ Were water level reference levels taken at the beginning and end of each day?
2. Y☐ N☐ **Was the depth of water above the sampling location recorded?**
3. Y☐ N☐ Was a description of the river bottom (i.e., soft, gravelly, hard, mushy) collected?
4. Y☐ N☐ Was the sample taken on a bar or terrace or in the thalwag of the channel?
5. Y☐ N☐ Were any obstructions in the river (fallen trees, beaver dams) noted relative to the sampling point?
6. Y☐ N☐ Did observations include changes in color (not just lithology), noticeable odors or visible product, staining and aggregate/colloidal materials present?
7. Y☐ N☐ Are samples for all intervals or sampled intervals being archived for later reference?
8. Y☐ N☐ Were photos being taken of cores for later reference?
9. Y☐ N☐ **Were reconnaissance and/or sediment probing conducted prior to sediment sampling?**
10. Y☐ N☐ **Were locations identified on air photos or maps prior to sampling?**
11. Y☐ N☐ **Were sampling locations identified on appropriate sampling log or field notebook?**
12. Y☐ N☐ Were all probing results recorded or just those associated with soft, penetrable deposits?
13. Y☐ N☐ Were blank Lexan cores properly deconned and packaged prior to sampling?
14. Y☐ N☐ **Was the top of the recovered core sample marked "top"?**
15. Y☐ N☐ **Was the sample tube and cap properly labeled immediately after it was capped and sealed?**
16. Y☐ N☐ **Was a sample label affixed to the tube immediately after collecting the sample?**
17. Y☐ N☐ Was lithologic and bedding information on each core recorded on forms or in the field notebook? (samples are taken based on depth, not lithology type or bedding)
18. Y☐ N☐ **Partitioning process properly deconned?**
19. Y☐ N☐ **Were VOC samples placed immediately into the sample jars?**
20. Y☐ N☐ Were the proper numbers and types of QC samples collected?

**Soil Boring Installation and Sampling** Not Applicable☐

1. Y☐ N☐ **Were soil samples collected at the intervals and depths prescribed in the GE WP?**
2. Y☐ N☐ **Was ASTM sampling method D 1588 (split spoon sampling) or D 6282-98 (Direct Push Soil Sampling) followed (when appropriate)?**
3. Y☐ N☐ Were split-spoon drop distances being maintained? (for standard 2-inch by 2-foot split spoon and 140-lb. hammer).
4. Y☐ N☐ Were representative samples collected at all locations?
5. Y☐ N☐ Was a sufficient quantity of sample recovered at each sampling interval for representative analytical samples? The GE analytical samples need to represent the entire sampling interval (i.e., 0-1, 1-3, 1-6, 6-10, 6-15, etc.). If GE sample recovery is too low (<50%) then the analytical samples may be biased.

6. Y☐ N☐ **Were subsurface soil samples thoroughly and properly described according to ASTM practice D 2488-93 (description and identification of soils)?** Observations should include changes in color (not just lithology), noticeable odors or visible product, staining and whether aggregate materials are present.

7. Y☐ N☐ **Was PID field screening done?**

8. Y☐ N☐ **Were VOA samples selected based on the results of PID field screening tests?**

9. Y☐ N☐ **Were Appendix IX +3 samples selected based on the results of PID and/or visual inspection, or proximity to the water table surface?**

10. Y☐ N☐ Were the proper numbers and types of QC samples collected?

11. Y☐ N☐ Were samples for all intervals or sampled intervals being archived for later reference?

### Soil Sample Compositing

Not Applicable☐

1. Y☐ N☐ Was compositing of soils done in accordance with the GE SAP?

2. Y☐ N☐ **Were representative soil samples from individual depth increments collected and screened with a PID?**

3. Y☐ N☐ **Was the discrete soil sample depth interval with the highest PID reading sent for Appendix IX +3 VOC analysis?**

4. Y☐ N☐ Were any samples archived for later examination or physical testing?

5. Y☐ N☐ Were the proper numbers and types of QC samples collected?

### NAPL Soil Sampling

Not Applicable☐

1. Y☐ N☐ If product (NAPL) is suspected in an interval being sampled, were samples collected? By what procedure? Was a shake test or another field procedure used to discern whether the product was an LNAPL or DNAPL?

2. Y☐ N☐ Are field instruments checked and calibrated on a regular basis (at least twice a day)?

3. Y☐ N☐ Is GE doing any kind of NAPL test whenever the top of the water table or a confining unit is encountered?

4. Y☐ N☐ In soil samples where NAPL was suspected was the sample headspace screened and a shake test performed in addition to a visual examination?

5. Y☐ N☐ Were the proper numbers and types of QC samples collected?

6. Y☐ N☐ When NAPL was detected, were soil/NAPL analytical samples collected for analysis?

### Sample Documentation, Handling, Packaging and Shipping

Not Applicable☐

1. Y☐ N☐ Were appropriate containers used for samples?

2. Y☐ N☐ **Were samples kept at 4 °C after being collected?**

3. Y☐ N☐ Were sample containers stored, labeled and properly handled/packed and shipped?

4. Y☐ N☐ **Was a chain-of-custody form made out for the samples?**

5. Y☐ N☐ **Were appropriate and pertinent field details and descriptions recorded on field forms and in field notebooks?**

6. Y☐ N☐ Were proper chain-of-custody procedures followed? Were the samples never left unsecured during the day?

| Weston Solutions, Inc. | GEOTECHNICAL OVERSIGHT SOIL BORING LOG | Page 1 of X |
|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **Area**<br>**Location ID** | | **Boring No.**<br>**Surface Elevation** | ft amsl | **Groundwater Level**<br>**Date** | <br>**Depth (ft)** |
| **Date Drilled** | | **Boring Method** | | | |
| **Env Co/Drilling Co.** | | **Completion Depth** | ft bgs | | |
| **Drill Foreman** | | **Location** | | | |
| **Logged By** | | Pittsfield, Massachusetts | | | |

| Depth (ft bgs) | Sample Depth Interval | Sample Type* | Sample Blow Count (per 6-inches)** | N-Value** | Visual Description | Elevation (ft amsl) | Pen/ Rec | PID Screen (ppm) | Laboratory Tests*** |
|---|---|---|---|---|---|---|---|---|---|
| | 0-1 | SS | 1 4 6 10 | 5 | | | | | |
| | 2-4 | SS | | | | | | | |
| 5 | 4-6 | SS | | | | | | | |
| | 6-8 | SS | | | | | | | |
| 10 | 8-10 | SS | | | | | | | |
| | 10-12 | SS | | | | | | | |
| | 12-14 | SS | | | | | | | |
| 15 | 14-16 | SS | | | | | | | |
| | 16-18 | SS | | | | | | | |
| 20 | 18-20 | SS | | | | | | | |
| | 20-22 | SS | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

*Sample type:
SS-Split Spoon
ST-Shelby Tube
RC-Rock Core
SC-Soil Core
DPT-Direct Push Technology

**ASTM D-1586 Standard Penetration Test

***Laboratory Tests:
MC-Moisture Content
AL-Atterberg Limits
S-Sieve Analysis
SH-Sieve/Hydrometer Analysis
SG-Specific Gravity
OC - Organic Content
C-Consolidation
UU-Unconsolidated Undrained Triaxial
CU-Consolidated Undrained Triaxial
UCS-Unconfined Compressive Strength
K-Hydraulic Conductivity
BD - Bulk Density

**Weston Solutions, Inc.**

# OVERSIGHT SOIL BORING LOG

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| | | | | | |
|---|---|---|---|---|---|
| **Area**<br>**Location ID** | | **Boring No.**<br>**Surface Elevation** | ft amsl | **Groundwater Level**<br>**Date** | **Depth (ft)** |
| **Date Drilled** | | **Boring Method** | | | |
| **Env Co./Drilling Co.** | | **Completion Depth** | ft bgs | | |
| **Drill Foreman** | | **Location** | | | |
| **Logged By** | | Pittsfield, Massachusetts | | | |

| Depth (ft bgs) | Sample Depth Interval | Sample Type* | Sample Blow Count (per 6-inches)** | N-Value** | Visual Description | Elevation (ft amsl) | Pen/ Rec | PID Screen (ppm) | Laboratory Tests*** |
|---|---|---|---|---|---|---|---|---|---|
| 5 | | | | | | | | | |
| 10 | | | | | | | | | |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

*Sample type: DPT-Direct Push Technology

**ASTM D-1586 Standard Penetration Test

***Laboratory Tests:
VOCs - Volatile Organic Compounds
SVOCs - Semi-volatile Organic Compounds
PCBs - Polychlorinated biphenyls
PCDD/PCDFs - Dioxins and Furans
Pest/Herb - Pesticides and Herbicides
Metals
Inorganics - Cyanide and Sulfide

# STANDARD OPERATING PROCEDURE G-9

# QUALITY ASSURANCE/QUALITY CONTROL SAMPLING

# STANDARD OPERATING PROCEDURE G-9

# QUALITY ASSURANCE/QUALITY CONTROL SAMPLING

## 1. SCOPE AND APPLICATION

Quality assurance/quality control measures are those activities undertaken to demonstrate the accuracy (how close to the true value the results are) and precision (how reproducible the results are) in monitoring. Quality Assurance (QA) generally refers to a broad plan for maintaining quality in all aspects of a program. Quality Control (QC) consists of the steps taken to determine the validity of specific sampling and analytical procedures. Quality Assessment is the assessment of the overall precision and accuracy of the data, after it is analyzed.

Field duplicates are duplicate samples collected at the same place and are used to estimate sampling and laboratory analysis precision. Field Blanks are composed of reagent-grade water that is treated as a sample and used to identify errors or contamination in sample collection and analysis.

## 2. EQUIPMENT

ASTM Type II reagent-grade water

## 3. RELATED PROCEDURES

G-3 Field Documentation

G-6 Field Sample Numbering

# 4. PROCEDURES

## 4.1 FIELD DUPLICATES

For each sampling round, one duplicate sample is collected for every 20 routine samples. These duplicate samples are taken immediately following the collection of the samples. They are intended to duplicate the routine sample collected. Soil duplicates from split-spoons will be collected by splitting the soil in the spoon lengthwise and dividing the soil into the standard and duplicate containers. When collecting a duplicate from a California split-spoon, the duplicate is collected from a brass tube immediately adjacent to the standard tube. Soil and sediment field duplicate samples for organics other than volatiles are thoroughly homogenized in stainless steel bowls and then transferred into their appropriate sample containers before shipment to the analytical off-site laboratory or field on-site laboratory. A note needs to be made in the appropriate GEOLIS logbook that a duplicate sample was collected, and a description of how the duplicate sample was collected needs to be added. Duplicates will be handled in the same manner as all other samples.

SOP G-6, Field Sample Numbering, identifies the numbering scheme.

## 4.2 EQUIPMENT BLANKS

Equipment blank samples are collected daily and analyzed to determine the effectiveness of decontamination practices. Equipment blanks (also called rinse blanks) are collected at a frequency of 5 to 10% of samples. If fewer than 20 samples are collected in a day, 1 equipment blank sample will be collected. Equipment blank samples are collected as follows:

- Sample bottles for equipment blanks are of the same type as routine sample bottles and will be prepared prior to sampling.
- Pour ASTM Type II reagent-grade water over and/or into the decontaminated sampling equipment. Then pour the water from the sampling equipment into the equipment blank sample jars.
- After all bottles are filled, label the sampling equipment with the associated routine sample ID number and use that sampling equipment to collect the environmental sample at that particular sampling location.

- Note in the GEOLIS logbook that an equipment blank was collected for that particular sampling location.

Once collected, handle equipment blank samples in the same manner as routine samples.

## 4.3 TRIP BLANKS

The purpose of a trip blank sample is to determine whether factors during transport may have affected the sample quality of volatile organic compounds (VOCs).

A trip blank prepared in the laboratory consists of two VOC sample bottles filled with ASTM Type II reagent-grade water. Trip blanks will be obtained the morning prior to sampling and will accompany the associated routine sample bottles in the same cooler. When the day of sampling is completed, the trip blanks will be handled in the same manner as routine samples and returned to the laboratory. Trip blanks will be collected at a frequency of 1 per day of VOC sample shipment. A note should be made in the GEOLIS logbook that a trip blank accompanied the particular samples.

## 4.4 AMBIENT BLANKS

The purpose of an ambient blank is to determine whether ambient environmental conditions in the sample collection area have affected the quality of the samples. Ambient blanks will be collected at sites where VOC sampling is being performed as requested by the PM. A note should be made in the GEOLIS logbook that an ambient blank was collected at the particular well.

Ambient blanks will be collected as follows:

- Once on-site, remove the caps from four VOC sample bottles pre-filled with ASTM Type II reagent-grade water and place them in an area where they will not interfere with sampling operations.
- Expose ambient blanks to the atmosphere for the duration of purging and sampling at the well location.

## 4.5 QA SPLIT VERIFICATION SAMPLES

QA split sampling involves the collection of soil and sediment samples that are taken from the exact same sample location and are thoroughly homogenized in stainless steel bowls before being transferred into the appropriate sample containers. QA split samples that are analyzed at the on-site laboratory for PCBs are collected at a frequency of 10% and sent to the appropriate Corps-validated off-site laboratory for confirmation of the on-site laboratory's results. QA split samples are a strong indicator of the data quality as well as of the sample homogeneity and the quality of the sampling techniques. QA split samples should be evenly distributed over all sample locations so that all of the sampling location data points are supported by these verification and confirmatory results. Verification samples are handled in the same manner as routine samples.

## 4.6 MS/MSD SAMPLES

Matrix spike/matrix spike duplicate (MS/MSD) samples are collected for the laboratory to perform internal QC checks. MS/MSD sampling involves collection of triple the volume of a routine groundwater sample. No additional volume is required for soil. MS/MSD samples are collected at a rate of 1 for every 20 samples. They are collected as separate samples immediately after the collection of the routine samples for the same parameter. The sample collection procedure is as follows:

- Additional bottles will be prepared the first day so the sampling teams will be ready to sample. For example, a routine sample for BNAs requires two amber glass, 950-mL bottles. An MS/MSD sample for BNAs requires six amber glass, 950-mL bottles.

- Note in the GEOLIS logbook that an MS/MSD sample was collected at that particular well. Once collected, handle samples in the same manner as routine samples.

The MS/MSD samples are identified using the standard nomenclature as outlined in SOP G-3, with the designation of MS/MSD on the chain-of-custody form and on the sample containers. Chain-of-custody procedures are presented in SOP G-10.

## 4.7 SPLIT SAMPLING

WESTON participates in several external audits sponsored by state regulatory agencies and EPA. These audits include performance and system audits. When representatives from these agencies are on-site with the sampling teams, they will be collecting samples to be analyzed in a laboratory of their choice. Keep the following guidelines in mind when oversight personnel are conducting split sampling:

- Oversight personnel must have the proper PPE to come on-site with the sampling team. WESTON may not supply them with any equipment.
- Agencies are to provide their own sample bottles, although the WESTON sampling team will collect all samples.
- Note in the GEOLIS logbook the name and agency of the oversight representative, and its split sample ID number.
- Once collected, split samples are handed back to the oversight personnel.

For sample identifier designation, follow the procedures outlined in SOP G-3.

## 4.8 PERFORMANCE EVALUATION SAMPLES

Performance evaluation (PE) samples are prepared externally to the laboratory to assess the ability of the laboratory to accurately perform the relevant analyses. The samples are fortified with known concentrations of analytes of interest and submitted to the laboratory with field sample delivery groups. PE samples are submitted blind to both the on-site and off-site laboratories as normal laboratory samples. The laboratory results for the samples are then compared to the known values and acceptance ranges to assess the laboratory's performance for a specific analytical method. If the laboratory fails to properly quantitate the target analytes, then corrective action will be implemented. PE sample submission will be initiated by USACE.

# STANDARD OPERATING PROCEDURE G-10

# SAMPLE DOCUMENTATION

# STANDARD OPERATING PROCEDURE G-10

# SAMPLE DOCUMENTATION

## 1. SCOPE AND APPLICATION

Chain-of-custody records provide documentation of the handling of each sample. Sample custody will be initiated by WESTON upon collection of samples. Chain-of-custody forms will be placed in waterproof plastic bags and taped to the inside lid of the cooler. The cooler will be sealed with chain-of-custody seals. Chain-of-custody forms will be used for recording pertinent information about the types and numbers of samples collected and shipped for analysis. Sample identification numbers will be included on the chain-of-custody form to ensure that no error in identification is made during shipment.

## 2. EQUIPMENT

Chain-of-custody forms

Waterproof plastic resealable bags

Chain-of-custody seals

Labels

Pen

Markers

Tape

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-3 | Field Documentation |
| G-6 | Field Sample Numbering |
| G-11 | Sample Packing and Shipping |

# 4. DOCUMENTATION

## 4.1 CHAIN-OF-CUSTODY RECORDS

Chain-of-custody procedures provide documentation of the handling of each sample. Chain-of-custody procedures are implemented so that a record of sample collection, transfer of samples between personnel, sample shipping, and receipt by the laboratory that will analyze the sample is maintained. The chain-of-custody (COC) record serves as a legal record of possession of the sample. The COC record is initiated with the acquisition of the sample. The COC record remains with the sample at all times and bears the name of the person (field investigator) assuming responsibility for the samples. The field investigator is tasked with ensuring secure and appropriate handling of the bottles and samples. To simplify the COC record and eliminate potential litigation problems, as few people as possible should handle the sample or physical evidence during the investigation. A sample is considered to be under custody if one or more of the following criteria are met:

- The sample is in the sampler's possession.
- The sample is in the sampler's view after being in possession.
- The sample was in the sampler's possession and then was locked up to prevent tampering.
- The sample is in a designated secure area.

### 4.1.1 Transfer of Custody and Shipment

All sample sets should be accompanied by a COC record (Figure 1). When transferring possession of samples, the individual receiving the samples should sign, date, and note the time that he/she received the samples on the COC record. This COC record documents transfer of custody of samples from the field investigator to another person, other laboratories (including any on-site laboratory), or other organizational units.

Figure 1 Example Chain-of-Custody Form

Laboratory Batch No.

WESTON
MANAGERS DESIGNERS/CONSULTANTS

# Custody Transfer Record/Lab Work Request

Page ___ of ___

**Client** ______________________

**Sampling Date** ______________________

**Work Order No.** ______________________

**Project Contact/Phone No.** ______________________

**Project Manager** ______________________

**Laboratory** ______________________

**Turnaround Time** ______________________

**Date Rec'd** __________ **Date Due** __________

**Account #** ______________________

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No./Type Container** | Liquid | | | | | | | | | | | | | | | |
| | Solid | | | | | | | | | | | | | | | |
| **Volume (Per Container)** | Liquid | | | | | | | | | | | | | | | |
| | Solid | | | | | | | | | | | | | | | |
| **Preservatives (Pre Container)** | | | | | | | | | | | | | | | | |
| **ANALYSES REQUESTED** | → | **ORGANIC** | | | | | | | | **INORG** | | | | | | |
| | | VOA | BNA | Pest/ PCB | Herb | | | | | Metal | CN | | | | | |

**MATRIX CODES:**

- **S** - Soil
- **SE** - Sediment
- **SO** - Solid
- **SL** - Sludge
- **W** - Water
- **O** - Oil
- **A** - Air
- **DS** - Drum Solids
- **DL** - Drum Liquids
- **L** - EP/TCLP Leachate
- **WI** - Wipe
- **X** - Other
- **F** - Fish

| Lab ID No. | Client ID/Description | Matrix QC MS/MSD Rep. | Matrix | Date/Time Collected | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**Special Instructions:**

**DATE/REVISIONS:**

________ 1. ______________________

________ 2. ______________________

________ 3. ______________________

________ 4. ______________________

________ 5. ______________________

________ 6. ______________________

| Relinquished by | Received by | Date | Time |
|---|---|---|---|
| | | | |
| | | | |

| Relinquished by | Received by | Date | Time |
|---|---|---|---|
| | | | |
| | | | |

Discrepancies Between Samples Labels and COC Record? ☐ Y or ☐ N
NOTES:

Samples were:

1) Shipped ☐ or Hand Delivered ☐
Airbill #_____

2) Temperature Blank Temp. _____C°

3) Received in Good Condition ☐ Y or ☐ N

4) Properly Preserved ☐ Y or ☐ N

5) Received Within Holding Times ☐ Y or ☐ N

COC Tape was:

1) Present on Outer Package ☐ Y or ☐ N

2) Unbroken on Outer Package ☐ Y or ☐ N

3) Present on Sample ☐ Y or ☐ N

4) Unbroken on Sample ☐ Y or ☐ N

COC Record Present Upon Sample Rec't ☐ Y or ☐ N

Samples sent off-site for analysis must be properly packaged for shipment, and delivered or shipped to the designated laboratory for analyses. Shipping containers must be secured by using nylon strapping tape and custody seals. The custody seals must be placed on the container so that it cannot be opened without breaking the seals. The seal must be signed and dated by the field investigator. When previously collected samples are split with a facility, state regulatory agency, or other government agency, the agency representative must sign the COC record, if present. All samples should be accompanied by the COC record. The original and copies of the record will be placed in a plastic bag taped to the inside lid of the secured shipping container. One copy of the record will be retained by the field investigator or project leader. The original record will be transmitted to the field investigator or project leader after samples are accepted by the laboratory. This copy will become a part of the project file. If sent by mail, the package should be registered with return receipt requested. If sent by common carrier, an air bill should be used. Receipts from post offices and air bills should be retained. The air bill number or registered mail serial number should be recorded in the remarks section of the COC record.

## 4.2 CHAIN-OF-CUSTODY SEALS

In addition to the COC record, there is also a COC seal. The COC seal is an adhesive seal placed in areas such that if a sealed container is opened, the seal would be broken (Figure 2). The COC seal ensures that no sample tampering occurred between the field and the laboratory analysis.

These signed and dated seals will be placed at the junction between the lid and the jar and on the cooler by the person responsible for packaging for both on-site and off-site sample analyses. If the coolers or jars are opened before receipt at the laboratory, the seals will not be intact. If the chain-of-custody seals are not intact, the Laboratory Project Manager will notify the WESTON Analytical Manager within 24 hours of receipt of the container. The WESTON Analytical Manager will then follow the corrective action procedures.

## 4.3 SAMPLE LABELS

Field personnel will be responsible for identifying, labeling, providing proper preservation, and packaging samples to preclude breakage during shipment.

Every sample will be labeled (Figure 3) and labels will include:

- Project name.
- Unique sample number.
- Sampling date and time.
- Initials of sampler.
- Method of sample preservation/conditioning.
- Requested analysis.
- Sample type.

### 4.4 POTENTIAL PROBLEMS

Although most sample labels are made with water-resistant paper and are filled out using waterproof ink, inclement weather and general field conditions can affect the legibility of sample labels. It is recommended that, after sample labels are filled out and affixed to the sample container, the container be placed in a plastic resealable bag. This will preserve the label, keep it from becoming illegible, and if the label falls off, the identity of the contained will still be known. In addition to label protection, chain-of-custody and analysis request forms should also be protected when samples are shipped in iced coolers. Typically, these forms should be placed inside a plastic resealable bag or similar waterproof protection and taped to the inside lid of the secured shipping container with the samples.

## 5. DOCUMENTATION PROCEDURES

Prior to sample collection, labels will be affixed to sample containers. Ink will be used for all logbook, chain-of-custody, and sample label entries.

### 5.1 CORRECTIONS TO DOCUMENTATION

All original data recorded in field logbooks, sample labels, chain-of-custody records, and receipt for sample forms will be written in waterproof ink. If an error is made, a single line should be drawn through the entry, and the entry initialed and dated. The erroneous information should not be obliterated. Any errors found in documentation should be corrected by the person who made the entry.

|  |  |
|---|---|
| WESTON®<br>MANAGERS DESIGNERS/CONSULTANTS<br><br>**OFFICIAL**<br>**CUSTODY SEAL**<br><br>WCS 1 | Name __________________________________<br>Date __________________________________<br>W.O. # _ _ _ _ _ – _ _ _ – _ _ _ – _ _ _ _ _ – _ _ |

**Figure 2 Chain-of-Custody Seal**

[redacted]

|  |  |
|---|---|
| **PROJECT NAME** |  |
| **SAMPLE ID** | **SAMPLE DATE** |
| **SAMPLED BY** | **SAMPLE TIME** |
| **PRESERVATIVE** | ____**GRAB**<br>____ **COMPOSITE** |
| **ANALYSIS REQUESTED** |  |

**Figure 3 Jar/Bottle Label**

## 5.2 PHOTOGRAPHIC DOCUMENTATION

Sampling points should be documented on film. A film record of a sampling event allows positive identification of the sampling point. In some cases, a photograph of the actual sample collected may be required. Photographs are the most accurate and convenient record of field personnel observations. Photographs taken to document sampling points should include two or more reference points to facilitate relocating the point at a later date. Keeping a record of photographs taken is crucial to their validity as a representation of an existing situation. Photograph documentation is invaluable if the sampling and subsequent analytical data end in litigation, enforcement, or cost recovery actions. In addition to photographs, video coverage of a sampling episode can be equally or even more valuable than photographs because it can be used to prove that samples were taken properly, as well as the location at which they were taken. Video coverage can be used as a record of site conditions, and can give those who have not been on-site an idea of the circumstances. For each photograph taken, the following items should be noted in the field logbook:

- Date.
- Time.
- Photographer (signature).
- Name of site.
- General direction faced and description of the subject taken.
- Sequential number of the photograph and the roll number.
- Site photo map.

# STANDARD OPERATING PROCEDURE G-11

# SAMPLE PACKING AND SHIPPING

# STANDARD OPERATING PROCEDURE G-11

# SAMPLE PACKING AND SHIPPING

## 1. SCOPE AND APPLICATION

This section describes procedures for properly packaging and shipping environmental and hazardous waste samples. The procedures described in this section are performed after samples have been collected and placed in the proper containers and correctly preserved. Guidelines for proper container and preservative selection can be found in the QAPP, Section 6 (WESTON, 00-0507).

The following are procedures for packaging and shipping requirements of environmental and hazardous waste samples. *The person overseeing sample shipping is required to have current certification in the Dangerous Goods Shipping Course*.

## 2. EQUIPMENT

Chain-of-custody

Custody seals

Fiber strapping tape

Ice

Picnic cooler

Plastic resealable bags

Paper towels

Vermiculite or “peanuts” or other inert packing material

Air bills

Up arrows

See Subsection 4.2 for hazardous equipment.

# 3. RELATED PROCEDURES

G-10 Sample Documentation

# 4. PROCEDURE

## 4.1 ENVIRONMENTAL SAMPLES

Environmental samples are defined as those samples collected from environmental matrices such as soil, groundwater, or sediments. Environmental samples should be packaged for shipment as follows:

1. The sample container is checked to determine if it is adequately identified, and sample labels are compared to chain-of-custody.

2. All bottles are checked that they are taped shut with custody seals.

3. Each sample bottle is placed in a separate plastic bag, the air removed as much as possible, and is then sealed. For water samples, each VOA vial is wrapped in a paper towel, and the two vials are placed in one bag. If a trip blank is submitted, it should be wrapped and placed in the bag with the two VOA vials. Bags may be sealed with evidence tape or custody seals for additional security.

4. A picnic cooler (such as a Coleman or other sturdy cooler) is typically used as a shipping container. In preparation for shipping samples, the drain plug is taped shut from the outside. Approximately 3 in. of inert packing material, such as asbestos-free vermiculite, perlite, or Styrofoam beads or "peanuts", is placed in the bottom of the container. Other commercially available shipping containers may be used; however, the use of such containers (cardboard or fiber boxes complete with separators and preservatives) should be specified in the work plan and pre-approved.

5. The bottles are placed upright in the picnic cooler in such a way that they do not touch and will not touch during shipment. Cardboard separators may be placed between the bottles at the discretion of the shipper.

6. All samples should be shipped to the laboratory on ice and chilled to 4 °C, except for the geotechnical and other samples that do not require shipment with ice. A temperature blank should be placed in the cooler so that it can be easily found by the lab when the cooler is first opened upon receipt.

7. Additional inert packing material is placed in the cooler to partially cover the sample bottles (more than halfway). If samples are required to be shipped to the laboratory with ice, ice in a bag must be placed around, among, and on top of the sample bottles. If

chemical ice is used, it should be placed in a double plastic bag. The cooler should then be filled with inert packing material and the liner taped shut.

8. The paperwork going to the laboratory is placed inside a plastic bag. The bag is sealed and taped to the inside of the cooler lid. The COC form is included in the paperwork sent to the laboratory. The air bill must be filled out before the samples are handed over to the carrier. The laboratory should be notified if another sample is being sent to another laboratory for analysis (such as dioxin), or if the shipper suspects that the sample contains any other substance that would require laboratory personnel to take additional safety precautions.

9. The cooler is closed and taped shut with strapping tape (filament-type).

10. At least two signed custody seals are placed on the cooler, one on the front and one on the side. Additional seals may be used if the sampler or shipper thinks more seals are necessary.

11. The cooler is handed over to the overnight carrier. A standard air bill is necessary for shipping environmental samples. The shipper should be aware of carrier weight or other policy limitations.

## 4.2 HAZARDOUS SAMPLES

Hazardous samples are defined as those that are typically highly contaminated, such as oils (LNAPL and DNAPL), sludges, discarded products, and other materials. Hazardous samples must be packaged as follows:

1. The sample container is checked to determine if it is adequately identified, and the sample label is checked against the COC.

2. All bottles, except the VOA vials, are taped closed with electrical tape (or other tape as appropriate). Evidence tape or custody seals may be used for additional security.

3. Each sample bottle is placed in a plastic bag, and the bag is sealed. As much air as possible is squeezed from the bags before sealing. Evidence tape or custody seals may be used to seal the bags for additional security.

4. Each bottle is placed upright in a separate paint can, the paint can is filled with vermiculite, and the lid is fixed to the can. The lid must be sealed with metal clips or with filament or evidence tape; if clips are used, the manufacturer typically recommends six clips.

5. Up arrows are placed on the can to indicate which end is up.

6. The outside of each can must contain the proper Department of Transportation (DOT) shipping name and identification number for the sample. The information may be

placed on stickers or printed legibly. A liquid sample of an uncertain nature is shipped as a flammable liquid with the shipping name "FLAMMABLE LIQUID, N.O.S." and the identification number "UN1993." A solid sample of uncertain nature is shipped as a flammable solid with the shipping name "FLAMMABLE SOLID, N.O.S." and the identification number "UN1325." If the nature of the sample is known, 40 CFR 171-177 is consulted to determine the proper labeling and packaging requirements.

7. The cans are placed upright in a cooler that has had its drain plug taped shut inside and out, and has been lined with a garbage bag. Vermiculite is placed on the bottom. Two sizes of paint cans are used: half-gallon and gallon. The half-gallon paint cans can be stored on top of each other; however, the gallon cans are too tall to stack.

8. All hazardous samples should be shipped to the laboratory on ice and chilled to 4 °C.

9. Additional inert packing material is placed in the cooler to partially cover the sample bottles. If samples are shipped to the laboratory with ice, bags of ice must be placed around the cans. The cooler must be filled with packing material, and the liner taped shut.

10. The paperwork going to the laboratory is placed inside a plastic bag and taped to the inside of the cooler lid. The COC form is included in the paperwork sent to the laboratory. The sampler keeps one copy of the COC form. The laboratory should be notified if a parallel sample is being sent to another laboratory for analysis (such as dioxin), or if the sample is suspected of containing any substance for which laboratory personnel should take safety precautions.

11. The cooler is closed and sealed with strapping tape. At least two custody seals are placed on the outside of the cooler (one on the front and one on the back). More custody seals may be used at the discretion of the sampler.

    The following markings are placed on the top of the cooler:

    - Proper shipping name (49 CFR 172.301).
    - DOT identification number (49 CFR 172.301).
    - Shipper's or consignee's name and address (49 CFR 172.306).
    - "This End Up" legibly written if shipment contains liquid hazardous materials (49 CFR 172.312).

12. The following labels are required on top of the cooler (49 CFR 172.406(e)):

    - Appropriate hazard class label (placed next to the proper shipping name).
    - "Cargo Aircraft Only" (if applicable as identified in 49 CFR 172.101).

13. An arrow symbol(s) indicating “This Way Up” should be placed on the cooler in addition to the markings and labels described above.

14. Restricted-article air bills are used for shipment. The “Shipper Certification for Restricted Articles” section is filled out as follows for a flammable solid or a flammable liquid:

    - Number of packages or number of coolers.
    - Proper shipping name; if unknown, use:
        - Flammable solid, N.O.S.
        - Flammable liquid, N.O.S.
    - Classification; if unknown, use:
        - Flammable solid, N.O.S.
        - Flammable liquid, N.O.S.
    - Identification number; if unknown, use:
        - UN1325 (for flammable solids).
        - UN1993 (for flammable liquids).
    - Net quantity per package or amount of substance in each cooler.
    - Radioactive materials section (leave blank).
    - Passenger or cargo aircraft. (Cross off the non-applicable. Up to 25 lb of flammable solid per cooler can be shipped on a passenger or cargo aircraft. Up to 1 qt of flammable liquid per cooler can be shipped on a passenger aircraft, and up to 10 gal of flammable liquid per cooler can be shipped on a cargo aircraft.)
    - Name and title of shipper (printed).
    - An emergency telephone number at which the shipper can be reached within the following 24 to 48 hours.
    - Shipper’s signature.

# 5. REFERENCES

00-0507 WESTON (Roy F. Weston, Inc.). March 2001. *Quality Assurance Project Plan.* Environmental Remediation Contract, GE/Housatonic River Project. Volumes I, II, IIA, and IV. DCN GE-021601-AAHM.

99-0166 International Air Transport Association (IOTA). 1998. *Dangerous Goods Regulations*. 39th Edition. Effective from 1 January 1998 through 31 December 1998.

# STANDARD OPERATING PROCEDURE G-12

# SURVEYING

# STANDARD OPERATING PROCEDURE G-12

# SURVEYING

## 1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide technical guidance for the surveying of environmental sampling locations. Sampling locations/stations covered in this operating practice include wells, piezometers, soil borings, test pits, surface soil and sediment stations, and staff gages.

This operating practice, however, can also be referenced for surveying other data points, as necessary. The objective of this operating practice is to identify the specific data and reporting requirements for the measuring of coordinates and elevations for environmental sampling locations.

The objective of a sample location surveying effort is to provide accurate and well documented coordinate and elevation information that is referenced to an appropriate benchmark. It is equally important that the calculated coordinate and elevation information is reported in a pre-established format to facilitate the timely uploading of this information into a project's locational database. An increasing number of environmental projects have begun to use integrated geological, hydrological, analytical, and geographical databases to effectively manage, analyze, and report the large amounts of technical information. The link between the project's technical databases and the locational database provides a system for the generation of accurate data presentations (including 2-D and 3-D maps and cross-sections). Thus, when planning for a survey effort, or preparing a survey RFP, the scope of work should include a detailed explanation of the deliverable format for the survey information.

## 2. EQUIPMENT

Surveying equipment

Calculator

Knife or small saw to notch top of casing survey point

Radio (optional)

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-13 | Trimble Pathfinder Pro XL GPS |
| GW-8 | Water Level Measurements |

## 4. PROCEDURE

All surveying activities shall be performed under the direct supervision of a certified land surveyor. Locations and elevations surveyed shall be measured as the distance in feet from a reference location(s), which is tied to the applicable state plane coordinate system or other coordinate system, as required by the project. The surveys shall be third order (cf. Urquhart [99-0173], pp 96-97). Elevations shall be surveyed to a precision of ±0.01 foot. Horizontal precision shall be to the nearest 0.1 foot. An xy-coordinate system shall be used to identify horizontal locations. The x-coordinate is the north-south axis, and the y-coordinate is the east-west axis. All x,y values shall be positive.

### 4.1 SURVEYING DRILLING/SAMPLING LOCATIONS

The surveyor will survey the location (referenced to the applicable coordinate system) and ground elevations of soil borings, test pits, and surface soil sampling points. Wells and piezometers will require the following survey measurements:

- Adjacent ground surface elevation.
- Top of inner casing elevation.
- State plane coordinate location of inner casing.

In most instances, wells and piezometers will have a locking cap, and will be opened and re-locked by the surveyor using keys supplied by WESTON. Elevations for both the natural ground surface (not the concrete well pad) and inner well casings will be surveyed from pre-established reference points. Either a notch of the casing rim or an arrow point painted on the inside well casing, just below the rim, will designate a casing reference point. If no reference point is observed, the surveyor will establish a reference point. Well locations will be surveyed from the inner casing reference point.

The surveyor shall provide only the state plane coordinates (or other specified) for surface water/ sediment sampling points; no elevation control is required. The top of each staff gage will be surveyed for state plane coordinate (or other specified) and elevation information.

## 4.2 ELECTRONIC DELIVERABLE

The survey information for each sample location shall be delivered on IBM-compatible computer diskette(s) (3.5-inch or CD) along with a hard copy. The electronic information can be in the form of either Microsoft Excel spreadsheet files or standard ASCII data files. No CAD drawing (DXF-type) files will be accepted.

Each electronic file MUST contain the following fields or entries for each drilling/sampling location surveyed:

- Client name.
- Site name.
- Site number (NA if not applicable).
- Location ID number.
- Location type (e.g., piezometer, soil boring, test pit, etc.).
- Northing (state plane [or other specified] coordinate in feet).
- Easting (state plane [or other specified] coordinate in feet).
- Ground surface elevation (excluding surface water/sediment sampling locations).
- Top of inner casing elevation (for wells and piezometers only).
- Reference elevation (see below for definitions).

All fields must be filled out. If a particular field is not applicable, such as top of inner casing elevation for a soil boring location, then “NA” should be placed in that particular field.

Reference elevations vary with location type; the following definitions shall be used for determining reference elevations:

- Wells and piezometers - The reference elevation equals the top of inner casing elevation, which is the reference point for water level measurements.

- Boring and test pits - The reference elevation equals the ground surface elevation.

- Staff gages - The reference elevation equals the elevation measured from the top of the staff gage.

- Surface water/sediment sampling locations - Reference elevation is not applicable for these sampling locations.

## 4.3 SURVEYOR NOTES

One copy of all field notes collected during the performance of the survey effort plus any survey data reduction notes shall be delivered to WESTON, along with the survey electronic deliverable, and shall be maintained in the project file.

All topographic survey efforts conducted under contract will be certified by a surveyor with a current surveyor's license in Massachusetts.

Each boring and/or well installation will be topographically surveyed to determine its map coordinates referenced to either a Universal Transverse Mercator (UTM) grid or the State Plane Coordinate System (SPCS). These surveys will be connected to the UTM or SPCS by third-order, Class II control surveys in accordance with the Standards and Specifications for Geodetic Control Networks (Federal Geodetic Control Committee, 1984). All borings, wells, temporary, and/or permanent markers will have an accuracy of 1 ft within the chosen system.

Elevations for the natural ground surface (not the top of the coarse gravel blanket or concrete well pad) and a designated point on the rim of the uncapped well casing (not protective casing) for each bore/well site will be surveyed to within 0.01 ft and referenced to the National Geodetic Vertical Datum of 1929 (NGVD of 1929). These surveys will be connected by third-order leveling to the NGVD of 1929 in accordance with the Standards and Specifications for Geodetic Control Networks.

The topographic survey will be completed as near to the time of last well completion as possible. Survey field data (as corrected), including loop closures and other statistical data in accordance with the Standards and Specifications referenced above, will be provided. Closure will be within the horizontal and vertical limits given above. These data will clearly be listed in tabular form: the coordinates (and system) and elevation (ground surface and top of well), as appropriate, for all borings, wells, and reference marks. All permanent and semipermanent reference marks used for horizontal and vertical control (benchmarks, caps, plates, chiseled cuts, rail spikes, etc.) will be described in terms of their name, character, physical location, and reference value. These field data will become part of the project records.

# 5. REFERENCES

99-0173 Urquhart, L.C. 1962. *Civil Engineering Handbook.* 4th edition. McGraw Hill, New York.

# STANDARD OPERATING PROCEDURE G-13

# TRIMBLE PATHFINDER PRO XL GPS UNIT

# STANDARD OPERATING PROCEDURE G-13

# TRIMBLE PATHFINDER PRO XL GPS UNIT

## 1. SCOPE AND APPLICATION

The backpack Pro XL unit is equipped with a white dome-like sensor, an 8-channel receiver (capable of monitoring 8 satellites simultaneously), and a handheld datalogger, which can be programmed to enter positional and attribute data into one or more rover files. It may be used at distances of up to 300 km from the base station.

## 2. EQUIPMENT

Trimble Pathfinder Pro XL GPS

Datalogger

Computer

## 3. RELATED PROCEDURES

G-12 Surveying

## 4. PROCEDURE

1. First set up the various components to each field unit, then turn on the data logger.
   - Be sure to attach the antenna cable and the battery cables before initializing the system.
   - Connect the cable from the backpack to the datalogger.
2. One of the first things that will happen is that the satellites will beam down an "almanac" indicating the approximate positions of all satellites, and each satellite will also send down an "ephemeris" giving its own precise location.
3. You will see a Main Menu. First check some of the configuration settings by pressing *Func,* then *Config*, then *GPS*, and specifying Rover Options (enter):

- Point features should be recorded at 1s intervals and line/area features at 3s intervals.

- The minimum number of positions should be set at 150.

- The elevation mask is set at 15° (higher than for the Base Station; the Base Station must be able to “see” all satellites seen by the rover).

- The SNR and PDOP masks should be set to 6.0.

- You may then exit this feature using the *Clear* button.

4. Now choose *Data Capture* from the main menu list.

   - Create the file RMMDDHHa (type in the appropriate filename, then press Enter). You should now see a screen with the file name you just created. You may now collect the first point.

   - Select the *Point-Generic Option*.

   - Now stand immobile with the antenna close to the sign. Record at least 150 points for this file. After the beep (minimum number of readings has been achieved), press OK to complete the data collection, then *Clear* and *F2* (Yes) to exit the file, then press *Function*, then *Clear* to turn off the datalogger.

Note: If you hear a continuous beep while collecting, this indicates too few satellites visible; pause a moment before continuing.

## 4.1 DATA ANALYSIS

Once the fieldwork is complete, you need to return to the office, where you will differentially correct the rover files.

To transfer a data file from one of the rovers:

1. Connect the yellow cable from the data logger to the serial port on your PC.
2. Turn the rover on and highlight *File Transfer* (press *Enter)*.
3. Then enter the PFINDER package on the PC (this is done at the DOS prompt by entering pfinder).
4. Under *Comm* pull down to *Data Files to PC*, select the file(s) to transfer, and click on *Okay*.
5. A series of .SSF will be created for each of the data logger files.

6. The newly created .SSF files may then be transferred to the WESTON office for differential correction.

## 4.2 USING A REMOTE COMMUNITY BASE STATION

Field crews will collect GPS data on a daily basis.

At the end of each sampling day, each field crew will download the .SSF files collected that day.

All downloaded files will be sent electronically via e-mail or FTP to the WESTON office.

The WESTON office will download the base station files on a daily basis (from base stations listed below), and correct files received from Pittsfield.

NH Dept. of Transportation
Concord, NH 03302
PH: (603) 271-1600
BBS: (603) 271-6889
Contact: Kerrie Hartshorn
Password: gpsbase.

Maine Technical Source
Woburn, MA 01801
PH: (718) 932-8888
BBS: (718) 932-7981
Contact: Spencer Drake
Password:

The corrected GPS files will then be put into a GIS environment for QC/QA checks.

Any stray points would then be revisited by the sampling teams in Pittsfield and sent back for post-processing.

The GPS positions will then be posted on maps for client access.

Note: This procedure will be able to run under the following alternative plans if necessary:

1. Files can be collected by field teams and stored by the GPS unit if a computer is not immediately available.
2. The corresponding base station files can be acquired and stored until the GPS files are obtained (by disk, e-mail, or FTP).

## 4.3 USING THE WESTON BASE STATION

1. At the beginning of each field collection day, the base station will be put into operation.
2. Field crews will collect GPS data on a daily basis.

3. At the end of each sampling day, each field crew would download the .SSF files collected that day.
4. Each field crew will then proceed to perform the differential corrections for their data.
5. The corrected data will then be checked for accuracy in a GIS environment by the field crews, at which time non-valid points will be retaken the following day.
6. The corrected and uncorrected files will then be sent (via e-mail or FTP) to the WESTON office.

## 5. REFERENCES

Trimble Pathfinder Pro Operating Manual.

# STANDARD OPERATING PROCEDURE SS-1

# DETERMINATION OF PRESENCE OF FREE PRODUCT

# STANDARD OPERATING PROCEDURE SS-1

# DETERMINATION OF THE PRESENCE OF FREE PRODUCT

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the field procedures to be used for the determination of free product in soil where free product is suspected. Areas that are suspected to contain free product or nonaqueous phase liquid (NAPL) include:

- Areas adjacent to those where NAPL has been observed.
- Areas where groundwater contains contaminants exceeding 1% of their solubility.
- Areas where very high field screening readings were obtained and/or contain strong product odors.
- Areas where samples are collected at the top of a confining unit.

## 2. EQUIPMENT

Aluminum foil

Portable ultraviolet (UV) light

SUDAN IV dye

Eight-ounce sample jar

PID

Bailer

## 3. RELATED PROCEDURES

G-1 Calibration of Field Screening Instruments

G-2 Decontamination

G-3 Field Documentation

# 4. PROCEDURE

## 4.1 LNAPL SCREENING OF SOIL SAMPLES

Soil samples from areas of suspected light NAPL (LNAPL) will be visually examined for the presence of LNAPL. If the sample is from the saturated zone, groundwater associated with the sample will be examined for the presence of a sheen. Unsaturated samples (approximately 20 cubic centimeters) will be placed in a sample jar with 20 ml of water, capped, and shaken vigorously for 10 seconds to see if a sheen is observed on the surface of the water or the walls of the jar. Hydrophobic dye will be added if a sheen is not observed in the shake test, but LNAPL is still suspected. Approximately 2 mg SUDAN IV (an amount that would fit on the edge of a toothpick) will be added to the existing soil-water suspension in the sample jar and shaken vigorously for 10 to 30 seconds. The fluid surface and jar walls will then be visually examined for a pinkish red color that indicates NAPL.

## 4.2 DNAPL SCREENING OF SOIL SAMPLES

Each soil sample that is collected in the areas where dense NAPL (DNAPL) is suspected will be subjected to headspace screening. Headspace screening will be performed by placing a portion of a soil sample into an eight-ounce sample jar, covering the jar with aluminum foil, and replacing the lid. The jar will then be allowed to warm to about 60 °F, either by leaving it outside in warm weather or placing it in a warm vehicle during colder weather. Once warmed, the sample will be screened by removing the screw cap and inserting a field instrument probe through the aluminum foil and recording the result. Experience at other DNAPL sites in New England suggest that an instrument response greater than 10 units (expressed as parts per million of a standard gas) above background may be indicative of DNAPL.

Further DNAPL screening may include one of the following:

- Visual examination.
- Fluorescence test.
- Dye test.

### 4.2.1 Visual Examination

Each sample will be visually examined for the presence of DNAPL. Samples subject to the DNAPL screening procedure will be prepared in an open area. Under no circumstances should the jar be opened in an enclosed area. The sample will be examined for areas of strong black coloration.

### 4.2.2 UV Screening

Once the results of the visual examination have been recorded in the field notebook, the sample can be exposed to a portable multi-wavelength ultraviolet (UV) light in a darkened location if DNAPL is still suspected. A wooded box with the interior painted flat black and equipped with a viewing port may be used. Approximately 20 ml of water will be added to 20 cubic centimeters of soil in a Ziploc-type bag. The fluid will be squeezed against the side of the bag and scanned with the UV light. Any fluorescent areas within a sample will be noted in the logbook. A soil and water blank sample without NAPL should be used as a check for natural mineral, shell, and/or other fluorescence.

### 4.2.3 Dye Test

A dye test can be performed using SUDAN IV dye. SUDAN IV dye is added to the sample jar and the jar is shaken as described for LNAPL detection. SUDAN IV is known to turn DNAPL pinkish red. The sample will then be examined for signs of a pinkish red color and then noted in the logbook.

## 4.3 NAPL DETECTION WITH DIRECT PUSH TECHNOLOGIES

Geoprobe and Cone Penetrometer Testing (CPT) are viable methods for use in obtaining information for screening of NAPLs while generating minimal IDW. If soil samples are collected during direct push (Geoprobe) drilling and NAPL is suspected but not observable by the methods listed above, then an additional method can be employed before the rods are extracted as described below.

### 4.3.1 Geoprobe

Flexible Liner Underground Technologies (FLUTe) liners can be installed using Geoprobe to provide continuous depth discrete sampling. The essential components of the system are: a central tube, a surrounding liner, and an outer compressive wrap. The carrier liner is a strong impermeable coated fabric. For NAPL detection, the system also includes a reactive covering on the liner.

A water injector is attached to the top end of the central tube. A compressive wrap compresses the carrier liner onto the central tube for a final outside diameter of the assembly of less than 1 inch. This “rope” of compressed material is then lowered into the central hole of a push rod assembly after the rod has been pushed to its full depth. The tip of the rod is “disposable” and will be left in place as the rod is withdrawn.

After the liner assembly is lowered to the bottom of the rod, the rod interior is filled with water, which then surrounds the “rope.” The central tube of the liner assembly is connected to an injector that provides a measured amount of water at a controlled pressure.

Next, the rod is lifted in the hole to expose one rod section of hole wall. The liner assembly is held in place against the bottom of the hole as the rod is raised. Water is added via the central tube under pressure to burst the compressive wrap and to dilate the liner in the exposed hole. The liner dilates in the rod somewhat, but the water in the annulus between the liner and the rod wall (the annular water) resists the dilation of the liner in the rod. Since the geologic formation is usually somewhat permeable, the liner dilates freely against the hole wall to anchor the liner in the hole with very high friction against the hole wall.

The top rod section lifted out of the ground is removed by sliding it off the central tube. The tube is reconnected to the injector. Water is again added to the annulus between the liner and the rod wall at the surface. This water at relatively high head compresses the liner and the water inside the liner. The high pressure in the liner allows the liner to support and seal the hole wall where the liner is against the hole wall. The water added inside the liner is more than that needed to fill the hole exposed. Hence, there is some water stored in the liner interior inside the rod.

A measured amount of water is injected again into the liner interior via the central tube. This is sufficient water to fill the next section of hole to be exposed by withdrawal of another section of rod. This water addition typically forces some of the annular water out the top of the rod.

The next section of the rod assembly is then lifted and removed. Since the liner is anchored in the exposed hole and the friction in the rod is low because of the annular water, the liner stays in place and dilates out of the bottom of the rod to fill the hole as the rod is raised. Water is again added to the interior of the liner and also to the annulus, if needed, to fill it to the top of the rod. The next section is withdrawn. The procedure is repeated until the rod sections have been entirely removed. The liner assembly can be removed by simply pulling upward on the central tube. The liner inverts and is peeled, inside out, from the hole. The unsupported hole is now free to collapse.

To detect NAPLs, a color reactive absorbent ribbon is located on the exterior of the liner. The absorbent ribbon is manufactured from a material that will repel water and absorb liquid solvents and petroleum products (NAPLs). Once the liner is in place, it presses the outer ribbon against the hole wall for contact with solvents or other materials in the soil pore space. The ribbon wicks NAPL compounds from the adjacent borehole sediments. Originally, SUDAN IV was used as the dye for DNAPL detection; however, a less toxic dye in a stripped pattern can now be used, which is mobilized by the solvents wicked into the cover to produce an obvious stain pattern on the cover. This dye is also much less expensive to produce than the original SUDAN IV loaded covering.

The cover is removed for identification of the location of the reactants by simply inverting the liner and the cover with it. In this way, the cover does not contact any other part of the hole. The carrier liner is removed from the cover, a tape measure is placed next to the cover, and the location of the contaminants in the subsurface is deduced from the stains on the cover. The inversion of the liner during extraction brings the liner up on the inside away from the sediments, preventing smearing of NAPL on the membrane. The method has been shown to locate both free product phase and dispersed globules of NAPL (Riha, et al., 2000 [99-0461]).

### 4.3.2 Cone Penetrometer Testing (CPT)

Cone Penetrometer Testing (CPT) is based on the resistance to penetration of a cone with embedded sensors while it is continuously advanced into the subsurface. Standard CPT sensors measure cone tip pressure and sleeve friction. The ratio of tip resistance to sleeve friction provides information that can be used to classify soil type (ASTM standard D5778-95).

Laser-induced fluorescence is a site characterization technique that can be coupled with CPT for screening soils for LNAPL, DNAPL, and commingled NAPLs (ITRC, 2000 [99-0460]).

A laser mounted in the CPT rig is connected to a sensor flush mounted on the cone penetrometer probe, and the laser transmits pulses of light to the sensor through a fiber optic cable. Fluorescence emitted by down-hole compounds is returned to a detection system on the CPT rig via a second fiber optic cable.

Although there are several devices that utilize this technology, the Rapid Optical Screening Tool (ROST) marketed by Fugro Geosciences, Inc. has been accepted by the U.S. EPA Environmental Technology Verification Program as a screening tool where hydrocarbons such as petroleum, oils, lubricants, and coal tars are suspected (U.S. EPA, 1997 [99-0459]). With the ROST, the emitted fluorescence may be measured simultaneously at multiple wavelengths. Wavelengths between 266 and 490 nm cover the range of light produced by light fuels through heavy contaminants such as coal tar and creosote. Fluorescence intensity is recorded relative to a standard reference solution, considered to have a fluorescence intensity of 100 percent. A sample of free product should be tested to identify the representative response for the product.

## 5. REFERENCES

99-0171 U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response. 1991. *Dense Nonaqueous Phase Liquids*. EPA Ground Water Issue, EPA/540/4-91-002.

99-0172 U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response. 1995. *Light Nonaqueous Phase Liquids*. EPA Ground Water Issue, EPA/540/S-95/500.

99-0459 U.S. Environmental Protection Agency (EPA). 1997. *Rapid Optical Screening Tool (ROST-TM) Laser-Induced Fluorescence (LIF) System for Screening of Petroleum Hydrocarbons in Subsurface Soils.* EPA600R97020 and EPAVSSCM01.

99-0460 Interstate Technology and Regulatory Cooperation (ITRC) Work Group. 2000. *Dense Non-Aqueous Phase Liquids (DNAPLs): Review of Emerging Characterization and Remediation Technologies.* June 2000.

99-0461 Riha, B., J. Rassabi, C. Eddy-Dilek, D. Jackson, and C. Keller. 2000. *DNAPL Characterization Using the Ribbon NAPL Sampler: Methods and Results.* In Treating Dense Nonaqueous-Phase Liquids (DNAPLs): Remediation of Chlorinated and Recalcitrant Compounds. The Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 22-25, 2000.

# STANDARD OPERATING PROCEDURE SS-2

# SOIL SAMPLING USING A GEOPROBE®

# STANDARD OPERATING PROCEDURE SS-2

# SOIL SAMPLING USING A GEOPROBEâ

## 1. SCOPE AND APPLICATION

The objective of this standard operating procedure (SOP) is to provide guidance and general reference information on soil sampling using a Geoprobe® drilling rig and collecting representative soil samples at depth and recovering them for visual inspection and/or chemical analysis.

A Geoprobe® is a hydraulically-powered drilling machine that utilizes both pressure and percussion to advance sampling and logging tools into the subsurface. Geoprobe® rigs can be used to perform soil core and soil gas sampling, groundwater sampling, soil conductivity and contaminant logging, grouting, and materials injection.

## 2. EQUIPMENT

See Soil Sampling SOP (SS-6)

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| G-3 | Field Documentation |
| G-6 | Field Sample Numbering |
| G-7 | Management of IDW |
| G-9 | Quality Assurance/Quality Control Sampling |
| G-10 | Sample Documentation |

SS-1 Determination of Presence of Free Product

GW-1 Borehole/Well Abandonment

# 4. PROCEDURE

## 4.1 GENERAL PROCEDURE

When used to collect soil samples, the assembled soil sampler is attached to the leading end of a probe rod and driven into the subsurface using a Geoprobe® soil probing machine. Additional probe rods are connected in succession to advance the sampler to depth. Depending on the type of sampler used, the sampler may be used as an open-tube or closed-piston sampler.

The simplest and most common use of the sampler is as an open-tube sampler. In this method, coring starts at the ground surface with an open-ended sampler. From the ground surface, the sampler is advanced one sampling interval and then retrieved from the hole with the first soil core. In stable soil, the open-tube sampler is inserted back down the same hole to obtain the next core. Operators have reported coring to depths well exceeding 30 feet (9 m) with this method.

In unstable soil, which tends to collapse into the core hole, the sampler can be equipped with a piston assembly. This assembly locks into the cutting shoe and prevents soil from entering the sampler as it is advanced to the bottom of an existing hole.

The closed-piston sampler is not designed to be driven through undisturbed soil containing gravel, asphalt, coarse sand, or rubble. In this case, the soil should be removed down to the sampling depth using an open-tube sampler, or a pilot hole may be drilled. The closed-piston sampler is then installed and the sampler is inserted or driven back down the same hole. When the leading end of the sampler reaches the top of the next sampling interval, the piston is unlocked using extension rods inserted down the inside of the probe rods.

Soil samples are collected within a liner. A liner is a removable/replaceable, thin-walled tube inserted inside the sample tube for the purpose of containing and storing soil samples. Liner materials include stainless steel, brass, polytetrafluoroethylene or Teflon® (PTFE), polyvinyl chloride (PVC), cellulose acetate butyrate (CAB), and polyethylene terephtalate glycol (PETG).

## 4.2 GENERAL CONSIDERATIONS

1. Make sure that the driller has at least three or four samplers. This allows the collection of several samples before stopping to clean and decontaminate the equipment.
2. A collapsible table or stand is handy to hold decontaminated sampler tubes and liners. Equipment must be protected from contamination by placing it on a sheet of plastic on the ground.
3. Ensure that all soil is removed from inside the sample tube. Sand particles can bind liners in the sampler. Full liners are difficult to remove under such conditions. In extreme cases the soil sample must be removed from the liner before it can be freed from the sample tube.
4. Information about the subsurface and depth to bedrock should be known before driving the sampler. Damage may occur if the sampler is driven into rock or other impenetrable material. The pilot hole should be made only to a depth above the sampling interval.

## 4.3 OPEN-TUBE SAMPLING

A representative soil sample is obtained by driving the sampler one sampling interval from ground surface into undisturbed soil. Upon retrieving the sampler, the liner and soil core are removed. The sampler is then properly decontaminated, reassembled with a new liner, and inserted back down the same hole until the top of the next sampling interval is reached. The tool string is then driven to the depth of the subsequent continuous sampling interval.

Non-cohesive soils will often collapse to the bottom of the hole. This slough material then enters the sampler as the next soil core is collected, resulting in a non-representative sample. A closed-piston sampler should be used under such conditions.

## 4.4 CLOSED-PISTON SAMPLING

It is often difficult to collect representative soil cores from significant depths with an open-tube sampler due to soil slough. Because of this, the sampler can be equipped with a piston that locks into the cutting shoe. This allows the sealed sampler to pass through the slough material and be opened at the appropriate sampling interval.

The assembled sampler is connected to the leading end of a probe rod and driven into the subsurface. Additional probe rods are connected in succession to advance the sampler to depth.

The sampler remains sealed (closed) by a piston tip as it is being driven. The piston is held in place by a stop-pin at the trailing end of the sampler. When the sampler tip has reached the top of the desired sampling interval, a series of extension rods, sufficient to reach depth, are coupled together and lowered down the inside diameter of the probe rods. After the extension rods and stop-pin have been removed, the tool string is advanced the depth of the sampling interval. The piston is displaced inside the sampler body by the soil as the sample is collected. To recover the sample, the sampler is retrieved from the hole and the liner containing the soil sample is removed. Do not allow the driller to over-drive the sampler.

## 4.5 SOIL CORE RECOVERY

The soil sample is removed from the sampler by unscrewing the cutting shoe and pulling out the liner. Depending upon the sampling protocols, the soil sample may either be preserved within the liner or removed from the liner and placed in sample jars.

If soil samples are to be collected from the liner, undisturbed samples can be obtained from Teflon®, PVC, and PETG liners by splitting the liner. Clear plastic liners and Teflon® liners can be slit open with a hooked-blade utility knife or other device and the samples to be analyzed placed in appropriate containers. A manual extruder may be used to push the soil cores out of metal liner sections for transfer to other containers.

If the samples are to be preserved in the liner, the soil sample should be secured by placing a vinyl (or other appropriate material) end cap on each end of the liner. If the sample is to be segmented, the liner should be cut around the outside circumference. Metal liners come with plastic cladding on the outside of the liner to keep four 6-inch sections aligned. Remove the cladding and cut the sections apart with a knife. When using brass, stainless steel, and Teflon® liners, cover the end of the sample tube with Teflon® tape before placing the end caps on the liner. The tape should be smoothed out and pressed over the end of the soil core to minimize headspace. However, care should be taken not to stretch and therefore thin the tape. Develop a system such as always placing a black end cap at the bottom (down end) of the sample core and a red end cap at the top (up end) of the core. Color-coding the ends of the liner will help to quickly identify the top and bottom of the sample during later analysis.

## 4.6 DECONTAMINATION

Before and after each use, thoroughly clean all parts of the soil sampling system according to project requirements (see SOP G-2). A new, clean liner is required for each use if using PETG, PVC, or Teflon liners.

Thoroughly clean the sampler before assembly, not only to remove contaminants but also to ensure correct operation. Dirty threads complicate assembly and may lead to sampler failure. Sand is particularly troublesome because it can bind liners in the sample tube resulting in wasted time and lost samples.

## 4.7 FIELD BLANK

A field blank may be required to be taken on a representative sample liner prior to starting a project and at regular intervals. Because liners can become contaminated in storage, a field blank will prove that the liners do not carry contaminates which can be transferred to soil samples. However, a field blank will probably not be required when sampling for only PCBs.

If a field blank is required, it may be taken as follows:

1. Place an end cap or other appropriate device on one end of the liner.
2. Pour distilled water (or other suitable extracting fluid) into the liner.
3. Place an end cap on the open end of the liner.
4. From the vertical position, repeatedly invert the liner so that the distilled water contacts the entire inner surface. Repeat this step for one minute.
5. Remove one end cap from the liner, empty contents into an appropriate sample container, and cap the container.
6. Perform analysis on the extract water for the analytes of interest to the investigation.

# STANDARD OPERATING PROCEDURE SS-3

# PORE WATER SAMPLING

# STANDARD OPERATING PROCEDURE SS-3

# PORE WATER SAMPLING

## 1. SCOPE AND APPLICATION

The objective of this standard operating procedure (SOP) is to provide guidance and general reference information on sampling of sediment pore water. Pore water, or "interstitial water," is defined as the water held within the interstitial spaces between sediment particles. These procedures are designed to be used in conjunction with analyses for the most common types of pore water contaminants (e.g., volatile and semivolatile organic compounds, pesticides/PCBs, or metals) and/or toxicity bioassay studies, specifically toxicity identification evaluation (TIE).

Several pore water sampling techniques exist. Because the pore water sampling technique used will vary with site-specific characteristics and ultimate project analytical objectives, two pore water sampling procedures are provided. Subsections 4 and 5 are intended as a general guideline; Subsection 6 provides a specific protocol for collection of pore water samples for TIE and analytical chemistry. In all instances, any deviation from this SOP will be documented in the final report.

## 2. EQUIPMENT (See Respective Method)

Polycarbonate corer

Polyethylene caps

Polyethylene tape

Cooler

Ice

Seepage meters

Thermometer

Conductivity meter

pH meter

Dissolved oxygen (DO) water

Eh meter

Labels

“Peepers” (dialysis-type sampler)

Deionized water

Flagging

# 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| G-6 | Field Sample Numbering |
| G-10 | Sample Documentation |
| SS-4 | Sediment Sampling |

# 4. PROCEDURE

## 4.1 METHOD SUMMARY

To obtain a representative sample of pore water, it is important that the water collected have minimal mixing with the overlying surface water. There are two general pore water sampling approaches for ensuring that mixing does not occur. The first approach is ex situ and consists of collecting a sediment sample and exacting pore water via centrifugation or other pressurization device. The second approach consists of collecting pore water in situ via placement of “peepers” or similar containers in the sediment, allowing pore water to diffuse into the sampling container over time, or else suctioning pore water directly into a container.

A variety of pore water methods exist, each with its own advantages and disadvantages (see Table 1). Of these methods, squeezing and suction filtration are not recommended (especially for metals) because they may underestimate the concentrations of contaminants present in the interstitial water (Bufflap and Allen, 1995 [99-0194]). Because both of these methods require a specialized sampling apparatus, they may also be expensive. The remaining recommended methods consist of centrifugation, seepage meters, and dialysis ("peeper") methods.

The following variables should be considered before choosing a pore water method:

1. Water body characteristics (lake, pond, river, stream).
2. Sediment particle size (gravel, sand, silt, clay).
3. Analytical objectives (parameters, detection limits, data quality objectives).
4. Analytical volume required (e.g., toxicity testing, chemistry).
5. Project duration and time available.
6. Groundwater/surface water inter-relationships (gaining/losing stream).
7. Cost.

Sample processing methods vary with the technique used, but generally samples should be sealed and labeled, then placed immediately in coolers with ice to maintain a temperature of 4 degrees Celsius (°C). Samples are subsequently shipped to a subcontracted analytical or toxicity testing laboratory.

Procedures to be followed are summarized below for each of the three recommended sampling procedures.

## 4.2 CENTRIFUGATION

1. Collect sediment core using a standard sediment coring device such as the K-B corer (Wildco, Inc.) or polycarbonate coring device. There should be no head space within the core.

2. Seal the core with polyethlyene (or equivalent) caps and tape, then label the top end of each core as "top." Subsequently label the top end of the core with the sample location number. Cut the core into sections if it is necessary to sample at multiple depths. Cap and label each section with the sampling location, depth, and date.

3. Place the cores in a cooler at 4 °C and ship to the laboratory or processing area.

# Table 1

## Comparison of Sediment Pore Water Sampling Methods

| Method | Description of Approach | In Situ | Sufficient Volume For Tox Testing | Advantages | Disadvantages |
|---|---|---|---|---|---|
| Centrifugation | Collect sediment core in airtight container, extract sample under inert conditions, centrifuge sample, and analyze. | No | Yes | Simple to collect; sufficient volume for chemistry and toxicity analyses; most widespread method. | Collection tube must be airtight; centrifuge oxidizes sample unless done in a nitrogen chamber; must spin sample twice or filter it to avoid suspending fine particles. |
| Squeezing | Collect sediment core in sampling apparatus that forces pore water out by applying pressure. | No | Yes | Simple to collect; sufficient volume for chemistry and analysis. | Samplers are expensive and difficult to make; oxidation or temperature artifacts may occur through sample handling; pore water concentrations may be altered by forcing water through sediment. |
| Seepage Meters | Install vented cylinder into sediment and collect water that flows through it. | Yes | Yes | Simple to install/collect samples; sufficient volume for all analyses; also provides flux data. | Can use only in areas of groundwater discharge and water depth <2 ft; must wait to equilibrate before sampling. |
| Suction Filtration | Insert device into sediment that sucks pore water into holding vessel. | Yes | No | Avoids sample handling artifacts associated with ex situ handling. | Complex and expensive to produce. |
| Dialysis | Allow deionized, distilled water to come into equilibrium with the pore water in order to determine concentrations. | Yes | No | "Peepers" may be quickly and cheaply constructed, and are easy to install; most ex situ artifacts are avoided. | Some oxidation of sediments may still occur via water supplied. |

4. If metals are to be analyzed, sample handling and centrifugation should be undertaken within a nitrogen chamber. Otherwise, certain metals may oxidize, affecting analytical results of the metals as well as phosphates.

5. Samples should be processed immediately upon receipt by the laboratory because coagulation and precipitation of humic material in interstitial water was observed in samples stored for more than 1 week at 4 °C (Burton and Landrum, 1989 [99-0196]; Landrum et al., 1987 [99-0200]).

6. The laboratory should centrifuge each sample at 3,000 revolutions per minute (rpm) for 20 minutes; this should be done in a nitrogen chamber if necessary. The supernatant should be filtered through a 0.45 micrometer (µm) paper filter before analysis. Filtration with glass or plastic filters is inappropriate because nonionic organics may be removed (Burton and Landrum, 1989 [99-0196]; Word et al., 1987 [99-0201]).

7. The resultant filtered supernatant may be analyzed for chemistry and/or used for toxicity bioassays.

## 4.3 SEEPAGE METERS

1. At least 1 day prior to the sampling event, install seepage meters into the sediment until its top is about 2 centimeters above the sediment surface. The vent hole on top of the seepage meter is fitted with a rubber stopper and tube. A deflated plastic bag is connected to the tube and left overnight to collect the sediment pore water sample.

2. On the day of sample collection, estimate the depth of water to the nearest 0.1 foot. Record these measurements in the logbook.

3. Measure/observe the physical characteristics of the water body, such as odor, color, temperature, pH, conductivity, oxidation-reduction potential (ORP), dissolved oxygen (DO), presence of dead vegetation, and surface sheens. Use the polyethylene cups for collection of a sample for field monitoring. Record the measurements/observations in the logbook.

4. Collect the pore water sample by removing the plastic sample collection bag from the vent hole tube. The sample can be directly transferred into the laboratory sample bottles. Record a description of the sampling location.

5. Samples for volatile organic analysis (VOA) will be collected first. Following the collection of a sample in a VOA vial, ensure that there are no air bubbles in the vial by turning the vial upside down and tapping it lightly. All other sample containers should be filled to at least ¾ full.

6. Immediately label, preserve (if necessary; see Subsection 4.5), refrigerate/ice, and log the samples in the field logbook.

7. Collect a final sample aliquot in a disposable container and immediately measure and record the pH, temperature, conductivity, ORP, and DO of the sample.

## 4.4 DIALYSIS

1. Construct "peepers" from a 6-mL polyethylene snap vial by boring out the center of the cap.
2. Fill each vial with deionized water, then place a 1-µm filter screen over the opening and tighten the cap. The screen acts as a membrane across which the pore water diffuses over time and enters the bottle.
3. Once in the field, mark the sampling location with a stake, flagging, or other means.
4. Submerge the vial in the sediment and leave it for 1 to 10 days to allow it to equilibrate with the pore water. In gravel or coarse sand environments, it will equilibrate faster than in fine-grained silt.
5. Retrieve the sample and label it according to sample location.
6. Place the samples in a cooler at 4 °C and ship to the laboratory.
7. In the laboratory, immediately extract the sample by inserting a pipette or syringe through the membrane.
8. Analyze the sample.

## 4.5 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The type of analysis for which a sample is being collected determines the type of bottle, preservative, holding time, and filtering requirements. When dedicated sampling containers (e.g., peepers) are used, the sample will be retained within the container, sealed, and shipped. Otherwise, samples should be collected directly from the sampling device into appropriate laboratory-cleaned containers.

After the sample is collected, complete a field data sheet, a chain-of-custody form, and record all pertinent data in the site logbook. Samples shall be appropriately preserved, labeled, logged, and placed in a cooler to be maintained at 4 °C. Samples must be shipped well before the holding time expires, and ideally should be shipped within 24 hours of sample collection. It is imperative that samples be shipped or delivered daily to the analytical laboratory to maximize the time available for the laboratory to perform the analyses. The samples should be shipped with adequate packing and cooling to ensure that they arrive intact and at the appropriate temperature.

# 5. INTERFERENCES AND POTENTIAL PROBLEMS

## 5.1 GENERAL

The primary goal in performing sediment pore water sampling is to obtain a representative sample of the water present within the interstitial spaces between sediment particles. To characterize sediment quality, pore water analyses should be conducted concurrently with analyses of water quality, sediment bulk chemistry, and/or toxicity, if desired. This approach facilitates data interpretation.

## 5.2 ADVANTAGES/DISADVANTAGES OF DIFFERENT SAMPLING METHODOLOGIES

No sampling method guarantees true interstitial water concentrations (Schults et al., 1992 [99-0197]), and different sampling methods have been shown to differ in their accuracy (Bufflap and Allen, 1995 [99-0194]), at least with respect to metals' chemistry.

### 5.2.1 Centrifugation

Centrifugation is the most commonly used means of extracting sediment pore water. This method involves collection of a sediment core using a polycarbonate tube or equivalent apparatus and subsequently spinning the sediment in a high-speed centrifuge. This method is appropriate for most studies, especially when a relatively large volume of pore water is necessary for analysis, such as for toxicity testing studies, studies where multiple analyses are conducted, or studies for which low detection limits are required.

The principal disadvantage of centrifugation is that it is an ex situ method; hence, artifacts in the data may be introduced from sample handling. For example, oxidation of certain metals may occur, affecting analytical chemistry. It has also been suggested that, in cases where solid and liquid phases are not in equilibrium, centrifugation may not be suitable for analysis of hydrophobic chemicals because they may partition back into the sediment (Baudo et al., 1990 [99-0195]).

### 5.2.2 Seepage Meters

Sediment pore water can be collected by capturing groundwater seeping into standing surface waters by covering an area of the streambed with a bottomless cylinder vented to a deflated plastic bag (Lee, 1977 [99-0190]). One-half of a 55-gallon drum is used to construct the seepage meter. A vent hole is fitted with a rubber stopper and tubing on the top-side of the seepage meter. A deflated plastic bag is then attached to the vent hole in order to collect sediment pore water seeping into the riverbed.

The advantage of using a seepage meter to collect sediment pore water samples is that the rate of groundwater/surface water flux can also be determined using this method, which is often useful in determining groundwater/surface water dilution ratios. In addition, large sample volumes can be collected by repeatedly filling the deflated plastic bag to facilitate toxicity testing or for multiple laboratory analyses. Another advantage is the relatively low cost to construct, install, and sample the seepage meters. The limitation of seepage meters is that they are restricted to use in areas where groundwater is discharging into the surface water and in areas where the depth of the surface water is less than approximately 2 feet.

### 5.2.3 Dialysis

“Peepers” are another commonly used means of assessing sediment pore water quality. Since they are an in situ method, most potential sampling artifacts may be avoided; however, some oxidation of sediment contaminants may still occur via the water supplied in the peepers. Peepers generally do not provide sufficient volume for toxicity testing and may not provide sufficient volume to achieve desired detection limits for analytical parameters. Moreover, it may take several days for the peepers to come into equilibrium with the surrounding pore water; however, they are inexpensive and can be used in a variety of situations.

# 6. REFERENCES

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# STANDARD OPERATING PROCEDURE SS-4

# SEDIMENT SAMPLING

# STANDARD OPERATING PROCEDURE SS-4

# SEDIMENT SAMPLING

## 1. SCOPE AND APPLICATION

Instructions presented in this Standard Operating Procedure (SOP) are for collecting representative sediment samples from surface water bodies. Sediment can be considered as any material that is submerged/saturated (at least temporarily) or suspended in any surface water body. This includes sludges, lake bottom sediments, perennial and intermittent stream sediments, and marine sediments. Sampling devices to be used are based on the following categories according to applicability: (1) surface sediments (scoop), (2) subsurface sediments/shallow water (corer/tube sampler), and (3) surface sediments/deep water (Ponar sampler).

## 2. EQUIPMENT

Personal protective (see Health and Safety Plan)

FID/PID

Decontamination items

Visqueen

Rinse bottles

Trash bags

Paper towels

Funnel

Health and Safety Plan

Field logbook and black ball point pens

Work plan

Folding ruler marked in tenths of an inch

Tape measure

Grain size chart

Munsell color chart

Appropriate sampling device

Stainless steel trowels

Stainless steel bowls

Shipping supplies

Plastic resealable bags (1 quart + 1 gallon size)

Sharpies or other permanent marker

Camera and film

Stakes

Flagging

Caution tape

Identification tags for staked locations

Mean Streak or other paint markers

Drum liners

Bung wrench/crescent wrench

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| G-3 | Field Documentation |
| G-6 | Field Sample Numbering |
| G-9 | Quality Assurance/Quality Control Sampling |

G-10 Sample Documentation

G-11 Sampling Packing and Shipping

# 4. PROCEDURE

## 4.1 SAMPLE LOCATIONS

Depositional patterns should be considered in regard to the sample objectives when deciding the sediment sample locations. These patterns differ between standing and flowing bodies of water. Generally, for flowing water (e.g., stream or river beds), the depositional areas are normally found inside bends and downstream of islands or obstructions. Areas directly downstream from the joining of two streams should be avoided because the flows may not immediately mix. For standing water bodies, the center of the mass or a discharge point should be sampled for sediments. Selection of sample locations should be made based on the investigation objectives.

## 4.2 SAMPLE TYPES

The type of sample should be designated when selecting a sampling method. Sediment samples can either be discrete (grab) or composite samplers.

## 4.3 SAMPLER SELECTION

The choice of samplers is dictated by sampling objectives (surficial versus subsurface samples) and site constraints based on water depth. Each sampling technique presents various advantages and disadvantages for its application. For example, sample disturbance, sample volume, chemical/physical reactivity between potential contaminants and sampling tool materials, and ease of decontamination vary from technique to technique.

## 4.4 SAMPLING OVERVIEW

Presented below are sampling instructions for the most common techniques for collecting sediment and sludge samples. For additional information, see Plumb, 1981 (00-0231), and Spigolon, 1993 (00-0232). Prior to sample collection, water body characteristics (size, depth, flow) should be recorded in the field logbook. Sampling should proceed from downstream locations to upstream locations so that disturbance from sampling does not affect sampling quality. Additionally, if surface water samples will be collected at the same locations as sediment samples, the water samples must be collected first. In collecting sediment samples from any source, care must be taken to minimize disturbance and sample washing as it is retrieved through the liquid column. Sediment fines may be carried out of the sample during collection if the liquid above is flowing or deep. This may result in collection of a non-representative sample due to the loss of contaminants associated with these fines.

While a sediment sample is usually expected to be a solid matrix, the sampler should not place the sample in the bottle and decant the excess liquid. If the sample is collected properly, any liquid in the bottle is representative of sediment conditions. If liquid flow and depth are minimal and sediment is easy to reach, a trowel or scoop may be used to collect the sediment sample; however, when the liquid above the sediment collection point is either flowing or greater than 6 inches in depth, a corer or other device that eliminates sample washing must be used to collect the sample to minimize washing the sediment as it is retrieved. It may be necessary to decant standing water from the top of the core. This should be done carefully and prior to transfer to the sample bottle. A decontaminated trowel should be utilized to transfer the sample from the corer directly into the bottle. After collection, the sampling device should be decontaminated before collecting the next sample.

In some instances, the dimensions of the surface water dictate that a barge or boat must be used. Generally, trowels or scoops cannot be used in an offshore situation. Instead, corers or dredges are a more efficient means for sample collection. The barge or boat should be positioned upstream (if there is flowing water) of the desired sample location. As the corer or dredge is lowered, it may be carried slightly downstream, depending upon the force of the flow. Upon retrieval, the contents of the corer or dredge should be transferred directly into the sample bottle using a decontaminated trowel. Both the corer or dredge and the trowel should be decontaminated before collecting the next sample.

## 4.5 SCOOP OR TROWEL

### 4.5.1 Applicability

The scoop or trowel method is a very accurate procedure for collecting representative surface sediment samples. This method can be used in many sampling situations, but is limited to sampling exposed sediments or sediments in surface waters less than 6 inches deep. The scoop or trowel sampler is not effective for sampling in waters more than 6 inches deep.

### 4.5.2 Method Summary and Equipment

The simplest, most direct method of collecting sediment samples is with the use of a stainless steel scoop or trowel. A stainless steel scoop or trowel is used to collect the sample, and a stainless steel bowl is used to homogenize the sample when applicable to the subsequent analysis.

### 4.5.3 Sampling Procedure

- Place plastic sheeting on the ground around the sampling location to prevent cross-contamination.
- Sketch the sample area or note recognizable features for future reference.
- Insert scoop or trowel into material and remove sample.
- Begin sampling with the acquisition of any grab VOC samples, conducting the sampling with as little disturbance as possible to the media.
- If homogenization of the sample location is appropriate for the remaining analytical parameters, or if compositing of different locations is desired, the sample is transferred to the stainless steel bowl for mixing.
- Transfer sample into an appropriate sample bottle with a stainless steel spoon or equivalent.
- Check that a PTFE liner is present in the cap. Wipe away any particles clinging to the bottle threads and rim to ensure a tight seal. Secure the cap tightly.
- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.

- Place filled sample containers on ice immediately.
- Complete all chain-of-custody documents and field sheets and record in the field logbook.
- Decontaminate sampling equipment after use and between sample locations.

## 4.6 TUBE SAMPLER

### 4.6.1 Applicability

Discrete sediment samples from shallow to moderately deep water can be collected efficiently. Equipment for the Polycarbonate tubing sampler is portable and easy to use.

### 4.6.2 Method Summary and Equipment

Polycarbonate tubing samplers are a simple and direct method for obtaining sediment samples. The corer is forced into the sediment. The corer is then withdrawn using a vacuum/suction technique and the sample is collected.

### 4.6.3 Sampling Procedure

- Probe sample location with rebar to determine approximate sediment thickness.
- Lower the polycarbonate tubing sampler until the tube contacts the top of the sediment.
- Gradually force corer into sediment (use a hammer or slambar if necessary to obtain desired sediment depth). Maintain tension on the plunger rope as sampling apparatus and tubing is advanced into the sediment. Tension will create a vacuum between the top of the sediment and the tubing, generally increasing sediment recovery.
- Remove the sampling apparatus and tubing from the sediment. Place cap on bottom of tubing and secure with tape. Remove the tubing from the sampling apparatus and place a top on the TOP of the tubing and secure with tape. Record the date, time, and location of the sample in the logbook and on the top cap with a permanent marker. Properly decontaminate the sampling equipment after use and between sampling locations.
- Remove sediment core from corer and place core on a clean working surface.
- Discard top of core if any organic material (e.g., leaves) is present.

- Begin sampling with the acquisition of any grab VOC samples, conducting the sampling with as little disturbance as possible to the media. If homogenization of the sample location is appropriate for the remaining analytical parameters, or if compositing of different locations is desired, the proper sample interval is sectioned from the tube and transferred to the stainless steel bowl for mixing.

- Repeat as necessary to obtain sufficient sample volume.

- Transfer sample into an appropriate sample bottle with a stainless steel spoon or equivalent.

- Remove any soil clinging to the bottle threads or rim, and secure the cap tightly.

- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.

- Place filled sample containers on ice immediately.

- Complete all chain-of-custody documents and field sheets and record in the field logbook.

- Decontaminate sampling equipment after use and between sample locations.

## 4.7 PONAR SAMPLER

### 4.7.1 Scope and Applicability

Ponar samplers are capable of sampling most types of sludges and sediments from silts to granular materials in deep water. They are available in sizes from hand-operated to winch-operated. Ponars are relatively safe, easy to use, prevent escape of material with end plates, reduce shock waves, and have a combination of the advantages of other sampling devices. Ponar grab samplers are more applicable for a wide range of sediments and sludges because they penetrate more deeply and seal better than spring-activated types (e.g., Ekman samplers). Penetration depths will usually not exceed 6 inches. Ponar samplers are not capable of collecting undisturbed samples. For example, material in the first centimeter of sediment cannot be separated from the rest of the sample. Ponars can become buried in soft sediment. The Ponar sampler is not recommended for the acquisition of VOA samples.

### 4.7.2 Method Summary and Equipment

The Ponar grab sampler is a clamshell-type scoop activated by a counter-lever system. The shell is opened, latched in place, and slowly lowered to the bottom. When tension is released on the lowering cable, the latch releases and the lifting action of the cable on the lever system closes the clamshell.

### 4.7.3 Sampling Procedure

- Place plastic sheeting around the sampling location to prevent cross-contamination.
- Attach the necessary length of sample line to a decontaminated Ponar. Solid braided 5-mm (3/16-inch) nylon line is usually of sufficient strength; however, 20-mm (3/4 -inch) or greater nylon line allows for easier hand hoisting.
- Measure the depth to the top of the sediment with a weighted object or pole.
- Mark the distance to the top of the sediment on the sample line with a proximity mark 1 m above the sediment. Record depth to top of sediment and depth of sediment penetration.
- Open sampler jaws until latched. From this point, support the sampler by its lift line, or the sampler will be tripped and the jaws will close.
- Tie free end of sample line to fixed support to prevent accidental loss of sampler.
- Begin lowering the sampler until the proximity mark is reached.
- Lower the sampler rapidly through last meter until contact is felt.
- Allow sample line to slack several centimeters. In strong currents, more slack may be necessary to release mechanism.
- Slowly raise dredge to clear surface.
- Drain free liquids through the screen of the sampler, being careful not to lose fine sediments.
- Place Ponar into a stainless steel or PTFE tray and open.
- Repeat until sufficient sample volume has been collected.
- Begin sampling with the acquisition of any grab VOC samples, conducting the sampling with as little disturbance as possible to the media.

- If homogenization of the sample location is appropriate for the remaining analytical parameters, or if compositing of different locations is desired, the sample is transferred to the stainless steel bowl for mixing.

- Collect a suitable aliquot with a stainless steel laboratory spoon or equivalent and place sample into appropriate sample bottle. Remove any soil clinging to the bottle threads or rim, and secure the cap tightly.

- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.

- Place filled sample containers on ice immediately.

- Complete all chain-of-custody documents and field sheets and record information in the field logbook.

- Decontaminate sampling equipment after use and between sample locations.

## 4.8 SEDIMENT SAMPLING PROCEDURE IN A COBBLE SUBSTRATE

The following method will be used when the presence of a large proportion of cobbles and/or boulders precludes the use of other sediment sampling techniques:

1. Place 55-gallon drum (lid and bottom removed) onto sampling location. Push, pound, and wiggle the drum into the sediment. Remove cobbles around rim of drum as needed.

2. Remove large rocks (e.g., cobbles) from inside of drum as a 5-gallon bottomless bucket is placed inside of the drum. Push, pound, and wiggle the bucket into the sediment to partition this area from the drum.

3. Remove sediment from 0 inches to 6 inches from the entire inside of the bucket with a trowel or scoop and place into sample jars.

4. Place rubber seal in bottom of the bucket. Pump or bail water from the bucket into a 10 µm filter bag. Pump/bail until water level reaches bottom of bucket, or until 5 gallons of water are passed through the filter bag. Remove rubber seal from bottom of the bucket.

5. Use a power auger to loosen the next 6-inch interval of sediment/cobbles.

6. Collect the 6-inch to 12-inch interval of sediment with trowel or scoop, and place into sample jars.

7. Repeat step 4.

8. Decontaminate the 5-gallon bucket, rubber seal, and trowel/scoop.
9. Submit all 4 samples (2 sediment, 2 filter bags) for (field) laboratory analysis.

## 4.9 SAMPLE CONTAINERS AND PRESERVATION TECHNIQUES

### 4.9.1 Sample Containers

Refer to the QAPP, Section 6 (WESTON, 00-0507), or the specific analytical method to designate an acceptable container. Containers should be cleaned based on the analyte of interest. Refer to the QAPP, Section 6, for information on the required size and type of sample containers. Samples should be collected and containerized in the order of the volatilization sensitivity of the parameters. A preferred collection order for some common parameters follows:

1. Volatile organics (VOA).
2. Total organic carbon (TOC).
3. Extractable organics (BNAs or SVOCs).
4. Total metals.
5. Phenols.
6. Cyanide.
7. Total solids.

### 4.9.2 Sample Preservation and Handling

Many of the chemical constituents and physiochemical parameters that are to be measured or evaluated in investigation programs are not chemically stable; therefore, sample preservation is required. Appropriate preservation techniques and sample containers that the sampler should use for each constituent or common set of parameters are specified in QAPP Section 6. The samples collected for volatile analysis should *never* be homogenized or composited. They should be carefully transferred directly from the sample collection device to the sample container in order to minimize contaminant loss through agitation/volatilization or adherences to another container.

### 4.9.3 Field Quality Control Sampling Procedures

Field control samples are collected by the sampling team to determine whether data are of suitable quality. They include blanks, duplicates, and/or background samples. A detailed discussion of field control samples is present in SOP G-9.

### 4.9.4 Decontamination Procedures

All equipment that will enter the sediment must be decontaminated. Sampling equipment should be decontaminated as described in SOP G-2. Sampling equipment should be placed in plastic bags until immediately prior to use. Additional sampling devices may be needed on-site to ensure an adequate drying time.

### 4.9.5 Documentation

Bound field logbooks should be used for the maintenance of field records. All aspects of sample collection and handling as well as visual observations shall be documented in the field logbooks as outlined in SOP G-3.

All entries in field logbooks should be legibly recorded and contain accurate and inclusive documentation of an individual's project activities.

## 5. REFERENCES

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# STANDARD OPERATING PROCEDURE SS-5

# SOIL SAMPLING

# STANDARD OPERATING PROCEDURE SS-5

# SOIL SAMPLING

## 1. SCOPE AND APPLICABILITY

Instructions presented in this Standard Operating Procedure (SOP) are for collecting representative soil samples. Soil sampling can be classified into two primary types: surficial and subsurface. Instructions for sampling surficial soil included in this section utilize the spade and scoop. Instructions for sampling subsurface soil included in this section utilize the following techniques: split spoon sampler, ring-lined (California) barrel sampler, and thin-walled (Shelby) tube. There are also specific sampling protocols presented for riverbank and/or floodplain sampling using hand augering.

## 2. EQUIPMENT

GEOLIS logbook or individual logging forms

Muncell color chart

GEOLIS reference book

Grain size card

Hand lens

Clip board

Folding rule (in feet and tenths)

Pocket penetrometer (if required)

Pocket knife

Indelible ink markers

Squirt bottle (with deionized water)

Plastic sheeting

Paper towels

Pens (blue or black)

Eye protection

Work gloves

Surgical gloves

Sample jars

Sample jar labels

Chain-of-custody forms

PID

Depth to water meter

Decontamination materials

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| G-3 | Field Documentation |
| G-6 | Field Sample Numbering |
| G-7 | Management of IDW |
| G-9 | Quality Assurance/Quality Control Sampling |
| SS-1 | Determination of the Presence of Free Product |
| GW-1 | Borehole/Well Abandonment |

# 4. PROCEDURE

## 4.1 SAMPLING LOCATIONS

Sampling at sites is usually conducted in an attempt to discover contamination and to define its extent and variability. With such an objective, it is most logical to choose sample locations that will yield the most information about site conditions. Because of the nature of the media, soil samples can vary considerably across a site. Physical properties of the soil, including grain size and cohesiveness, may limit the depth from which samples can be collected and the method required to collect them. In most soil, hand-powered equipment can only be used to a depth of approximately 4 to 5 ft. At greater depths, soil sampling is normally performed with a drill rig or other mechanically driven device.

## 4.2 SAMPLE TYPES

The type of sample should be designated when selecting a sampling method. Application techniques for sample methods include discrete (grab) or composite samples. A discrete (grab) sample is defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected immediately and at one particular point in the sample matrix. The representativeness of such samples is defined by the nature of the materials being sampled. In general, as sources vary over time and distance, the representativeness of grab samples will decrease. Composites are samples composed of two or more specific aliquots (discrete samples) collected at various sampling locations and/or different points in time. Analysis of this type of sample produces an average value and can, in certain instances, be used as an alternative to analyzing a number of individual grab samples and calculating an average value. It should be noted, however, that compositing can mask the presence of contaminants by diluting isolated concentrations of analytes that may be present in the environmental matrix.

## 4.3 SAMPLE COLLECTION AND FIELD AND LABORATORY ANALYSIS

Each sampling technique presents various advantages and disadvantages for its application. For example, sample disturbance, sample volume, chemical/physical reactivity between potential contaminants and sampling tool materials, and ease of decontamination vary from technique to technique. Subsurface soil conditions themselves will restrict the application of certain samples. For example, the thin-walled tube sampler is not applicable for sampling sands.

Presented below are sampling instructions for the most common techniques of collecting soil samples. Prior to sample collection, the soil sampling location and characteristics (soil type, depth) should be recorded in the field logbook. Selection of soil sampling equipment is usually based on the depth of the samples. Manual techniques are usually selected for surface or shallow subsurface soil sampling. At greater depths, mechanically driven equipment is usually required to overcome torque induced by soil resistance and depth.

### 4.3.1 Surficial Sampling

#### *4.3.1.1 Spade and Scoop*

The spade and scoop method is a very accurate, representative method for collecting surface and shallow subsurface soil samples. This method is usually limited to soil depths less than 1 ft.

**Method Summary and Equipment**

The simplest, most direct method of collecting surface soil samples is to use a spade and stainless steel scoop. A typical garden spade can be used to remove the top cover of soil to the required depth, and the smaller stainless steel scoop can be used to collect the sample.

**Sampling Procedure**

- Place plastic sheeting on the ground around the sampling location to prevent cross-contamination.
- Carefully remove the top layer of soil to the desired sample depth with a pre-cleaned or decontaminated spade.
- Using a pre-cleaned or decontaminated stainless steel scoop or trowel, collect the sample aliquot for VOC analysis first (if applicable), then homogenize enough soil in a stainless steel bowl for the remaining sample containers.
- Transfer sample into the appropriate sample bottle with a stainless steel lab spoon or equivalent.
- Remove any soil clinging to the bottle threads or rim, and secure the cap tightly.

- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.
- Place filled sample containers on ice immediately.
- Complete all chain-of-custody documents and record in the field.
- Prepare samples for shipping.
- Decontaminate sampling equipment after use, and maximum sampling depth for the hand auger is typically between sample locations.

### 4.3.2 Subsurface Sampling

#### *4.3.2.1 Split-Spoon Sampler*

The split spoon sampler is used for sampling subsurface soil in cohesive and non-cohesive type soils. It is used extensively for collecting subsurface soil samples for chemical analysis. The split spoon sampler will require a drill rig and crew for collecting samples at a depth greater than 5 ft. The split-spoon sampler will be the primary subsurface sampling device used.

**Method Summary and Equipment**

The split spoon sampler is typically a 2- or 3-in. diameter, thick-walled, steel tube that is split lengthwise. If a 2-in. diameter split spoon sampler is used, then standard penetration tests can be taken to determine the density of the soil (ASTM D-1586). A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to the drill rods. When a boring is advanced to the point that a sample is to be taken, drill tools are removed, and the sampler is lowered into the hole on the bottom of the drill rods. The sampler is driven into the ground in accordance with the standard penetration test.

**Sampling Procedure**

- Place plastic sheeting on the ground around the sampling location to prevent cross-contamination.
- Assemble the sampler by aligning both sides of the barrel and then screwing the drive shoe on the bottom and the heavier headpiece on top.
- Place the sampler in a perpendicular position on the material to be sampled.

- Drive the tube utilizing a sledge hammer or drill rig if available. Do not drive past the bottom of the headpiece because this will result in compression of the sample.

- Record the length of the tube that penetrated the material being sampled and the number of blows required to obtain this depth. Typically, the number of blows per 6 in. of depth is recorded.

- Withdraw the sampler and open it by unscrewing the drive shoe and head, and splitting the barrel. If split samples are desired, a decontaminated stain-less steel knife should be utilized to split the tube contents in half longitudinally.

- Begin sampling with the acquisition of any grab VOC samples, conducting the sampling with as little disturbance as is possible to the media.

- If homogenization of the sample location is appropriate for the remaining analytical parameters or if compositing of different locations is desired, the sample is transferred to the stainless steel bowl for mixing.

- Transfer sample into an appropriate sample bottle with a stainless steel lab spoon or equivalent.

- Remove any soil clinging to the bottle threads or rim, and secure the cap tightly.

- Label the sample bottle with the appropriate sample label. Be sure to label the bottle carefully and clearly, addressing all the categories or parameters.

- Place filled sample containers on ice immediately.

- Complete all chain-of-custody documents and record in the field.

- Prepare samples for shipping.

- Decontaminate sampling equipment after use and between sampling locations.

#### *4.3.2.2 Ring-Lined (California) Barrel Sampler*

**Applicability**

The ring-lined barrel sampler provides the ability to collect samples without loosing volatiles or moisture. Soil is contained in the rings and it can be easily and quickly capped after it is removed. The relatively small size of the rings allows easy sample shipping and handling; however, the opportunity for describing the soil is diminished because most of the soil is conceded in the ring apparatus. Because rings are not always accepted by the laboratory, prior arrangements should be made with the laboratory. <u>The California sampler will only be used to</u>

collected VOC samples when the EnCore sampler is not being used, and the field team has specifically been instructed to use it.

## Method Summary and Equipment

Ring-lined barrel samplers are typically 3 in. in diameter and are used to obtain representative subsurface soil samples with a split sampling barrel that has removable rings. The rings are typically constructed of plastic, stainless steel, or brass and fit inside the barrel assembly. Rings are commonly used within the California modified sampler and are typically 3 in. long.

## Sampling Procedure

- Place plastic sheeting on the ground around the sampling location to prevent cross-contamination.
- Assemble the sampler by placing eight 3-in.-long rings in the 2-ft-long sampler. Align both sides of the barrel and screw the drive shoe on the bottom and the heavier headpiece on top.
- Place the sampler in a perpendicular position on the material to be sampled.
- Drive the tube utilizing a sledge hammer or drill rig if available. Do not drive past the bottom of the headpiece because this will result in compression of the sample.
- Record the length of the tube that penetrated the material being sampled and the number of blows during each 6-in. increment.
- Withdraw the sampler and open it by unscrewing the drive shoe and head and the splitting barrel. Remove the sampling rings. Trim the soil at the end of the rings so that it is flush with the endings. For chemical samples, cap the end of the rings with a teflon-lined plastic cap or teflon sheet followed by a plastic cap. For geotechnical samples, a plastic cap is suitable. Seal each end cap with plastic electrical tape.
- Label the sample ring with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.
- Place sealed sample rings on ice immediately.
- Complete all chain-of-custody documents and record in the field.
- Prepare samples for shipping.
- Decontaminate sampling equipment after use and between sampling locations.

### *4.3.2.3 Thin-Walled (Shelby) Tube Sampler*

#### Applicability

Thin-walled tube samplers allow collection of undisturbed samples in cohesive type soil (i.e., clays). They are primarily used for collecting soil samples for certain geotechnical tests. Thin-walled tube samplers are not the ideal container for transporting samples to the laboratory for chemical analysis. The opportunity for describing the soil is diminished because most of the soil is concealed in the tube. The Shelby Tube will only be used in clayey material where an undisturbed sample is required, and the field crew has specifically been instructed to use a Shelby Tube sampler.

#### Method Summary and Equipment

The thin-walled tube sampler is designed to take undisturbed samples in cohesive type soils. The thin-walled tube sampler is available in either brass, galvanized steel, plain steel, or stainless steel, and is manufactured in either 30- or 36-in. lengths. It is available in 2-, 3-, and 5-in. diameters; however, the 3-in. diameter is the most commonly used. Thin-walled tube samplers are usually used for sampling cohesive soils for geotechnical evaluation, rather than chemical analysis.

#### Sampling Procedure

- Place plastic sheeting on the ground around the sampling location to prevent cross-contamination.
- Place the sampler in a perpendicular position on the material to be sampled.
- Push the tube into the soil by a continuous and rapid motion, without impact or twisting. In no instance should the tube be pushed further than the length provided for the soil sample.
- When the soil is so hard that a pushing motion will not penetrate the sample sufficiently for recovery, it may be necessary to collect a disturbed sample with the split-spoon sampler. Extremely dense and hard soil may result in damage to the thin-walled tube sampler.
- Before pulling out the tube, rotate the tube at least two revolutions to shear off the sample at the bottom. For geotechnical analysis, seal the ends of the tube with wax or

rubber packers to preserve the moisture content. In such instances, the procedures and preparation for shipment should be in accordance with ASTM Method D1587-94. For chemical samples, seal the ends of the tube with teflon-lined plastic caps or equivalent. Seal each end cap with plastic electrical tape.

- Label the sample tube with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.
- Complete all chain-of-custody documents and record in the field.
- Prepare samples for shipping.
- Decontaminate sampling equipment after use and between sampling locations.

#### *4.3.2.4 Hand Augering—Riverbank and Flood Plain Sampling*

Instructions presented in this Standard Operating Procedure (SOP) are for collecting representative soil samples at riverbank and/or flood plain locations.

**Applicability**

Hand augering is an accurate and efficient method for sampling soil. Soil samples are removed at discrete depths. Hand augering proves inefficient where the subsurface contains large gravel, or when the surface and subsurface are frozen.

**Method Summary and Equipment**

The auger is attached to an auger handle. There are three size augers used (with internal diameters (I.D.) of 4, 2, and 1 inch, respectively). The augers are used in succession (from highest to lowest I.D.) to take three discrete samples at different depths (0 to 6 inches, 12 to 18 inches, and 24 to 30 inches below ground surface) at the same location.

**Sampling Procedure**

- Place plastic sheeting on the ground around the sampling location to prevent cross-contamination.
- Attach the 4-inch I.D. auger on the auger handle.
- Clear the area of any vegetation, if necessary.
- Begin augering at the sample location. Auger to a depth of 6 inches.

- Remove all soil from the auger and place in a clean stainless steel bowl for homogenizing. This is the first sample with a depth of 0 to 6 inches below ground surface (bgs).

- If it is too difficult to auger to a depth of 6 inches, remove soil sequentially until reaching the 6 inch depth.

- After collecting the first sample, use the same auger (4-inch I.D.) to auger the soil from 6 to 12 inches bgs. Remove the auger from the auger handle and set aside. Be careful to let the soil from the 6- to 12-inch depth remain in the auger.

- Replace surgical gloves (to prevent cross-contamination) and attach a clean 2-inch I.D. auger to the auger handle.

- Auger from 12 to 18 inches bgs. This is the second sample. Carefully place this soil in a second clean stainless steel bowl for homogenizing.

- Using the same auger, auger to a depth of 24 inches. Remove the auger from the auger handle, again keeping the soil in the auger.

- After replacing your gloves, attach a 1-inch I.D. auger on the auger handle and collect the third sample. The third sample is the soil at a depth of 24 to 30 inches. Place this soil in a third clean stainless steel bowl for homogenizing.

- Once the three samples are collected, place the soil in the first two augers back in the sample location.

- Homogenize the soil in the third bowl. Use a new pair of gloves to avoid cross-contamination. Write up a GEOLIS description, and place soil in desired jars as necessary. Label the jars with the correct sample ID number and other necessary information (see SOP G-6).

- Place the sample jars in a cooler filled with ice as soon as possible.

- Repeat this procedure for the other two soil samples. If any soil is left over, place in the same sampling hole to avoid spreading possible contamination.

- Prepare samples for shipping.

- Decontaminate all sampling equipment after use and between sampling locations.

## 4.4 FIELD MEASUREMENT PROCEDURES

The purpose of this section is to identify field methods for field screening soil. Visual assessment and instrument readings will be used to screen field samples and residual samples. Residual materials may include excess samples, cuttings, and other materials.

### 4.4.1 Preparation

- Review screening procedures and equipment operation manuals.
- Calibrate field screening instruments in accordance with the manufacturer's instructions and operating procedures (see SOP G-1).
- Document calibrations in the field logbook.
- Determine the ambient air temperature. If the ambient air temperature is below 15 $^{o}$ C, select an area where soil samples can be kept warm for head space readings.

### 4.4.2 Field Screening

Prior to and during collection of a soil or sediment sample, visually observe the sampling area, and sample for signs of releases that include the following:

- Surface discoloration or staining.
- Stressed or discolored vegetation.
- Physical evidence of hydrocarbons or other contamination.

Record visual observations of the sampling area in the field logbook. Include a sketch and dimensions of any area where visual signs of a release are observed.

### 4.4.3 Instrument Readings

Take instrument readings prior to sampling to monitor ambient air for health and safety purposes. Record this information in the field logbook.

Soil and/or sediment headspace readings are taken in the following manner:

- Place soil/sediment sample in a clean, dry, glass jar so that the jar is not more than half full. Cover the jar with aluminum foil and replace the lid.
- If the ambient temperature is low, bring the jarred samples to an area where then can be warmed.
- Gently shake the jar to aid sample volatilization.
- Remove the lid and insert the probe through the aluminum foil, but not into the sample, since this will clog the instrument. Record the instrument reading of the area on the log reserved for headspace readings.

- Do not submit the jarred sample for laboratory analysis.
- Dispose of the jarred sample in accordance with residual management protocols.

## 4.5 SAMPLING FOR CHEMICAL ANALYSIS

### 4.5.1 VOC Soil Sample Collection

The EPA has established a new extraction method for volatile organic compounds. This new method resulted from EPA research indicating that analytical results for volatile compounds are inaccurate and biased low using Method 5030 extraction. Loss of volatile compounds such as BTEX results from volatilization and decomposition or biodegradation caused by light, moisture, age, biological organisms, and air; therefore, Method 5035 was promulgated.

### 4.5.2 EnCore$_{TM}$ Sampler

The EnCore Sampler has been approved for collection of samples, and this method is the preferred sampling method for use at the site. The EnCore Sampler (or equivalent) selects a small volume (about five grams) of soil that is stored in a chamber that is submitted to the analytical lab. *The sample must be received, prepped, and analyzed within two days of collection; therefore, all samples must be shipped the day they are collected.*

Two or three EnCore samplers will be required per analytical sample:

- One EnCore sampler for low-concentration analysis.
- One EnCore sampler for high-concentration analysis or low-concentration duplication.
- One EnCore sampler for repreparation.
- One VOA jar with Teflon cap for moisture determination.

The EnCore Sampler is a single use device. It can not be cleaned and/or reused. The following is the procedure for using the EnCore Sampler:

- Hold the coring body and push the plunger rod down until the small o-ring rests against the tabs. This will ensure that the plunger moves freely.

- Depress the locking lever on the EnCore T-Handle. Place the coring body, plunger end first, into the open end of the T-Handle, aligning the two slots on the coring body with the two locking pins in the T-Handle.

- Twist the coring body clockwise to lock the pins in the slots. Check to ensure the sampler is locked in place. The sampler is now ready for use.

- Turn the T-Handle with the T up and the coring body down. This positions the plunger bottom flush with the bottom of the coring body (ensure that the plunger bottom is in position).

- Using the T-Handle, push the sampler into the soil until the coring body is completely filled. When full, the small o-ring will be centered in the T-Handle viewing hole.

- Remove the sampler from the soil and wipe any excess soil from the exterior of the coring body.

- Place a cap on the coring body while it is still in the T-Handle. Push and twist the cap over the bottom until the grooves on the locking arms seat over the ridge on the coring body. The cap must be seated to seal the sampler.

- Remove the capped sampler by depressing the locking lever on the T-Handle while twisting and pulling the sampler from the T-Handle.

- Lock the plunger by rotating the extended plunger rod fully counter-clockwise until the wings rest firmly against the tabs.

- Attach a completed circular label from the EnCore Sampler bag to the cap on the coring body.

- Label outside label on EnCore Sampler bag and add a custody seal.

Return the full EnCore Sampler to a zip-lock bag. Seal the bag and place on ice.

It should be noted that EnCore Samplers can be used for all soil sampling activities, i.e., surface soil, sediment, etc., by sub-sampling the sampling device (shovel, coring device, split spoon, etc.). In a soil matrix that is noncohesive, the EnCore Sampler's plunger can be retracted, filled with the required sample volume, and then capped.

## 5. REFERENCES

99-0169 American Society for Testing and Materials. 1991. ASTM Standard D4700-91, "Guide for Soil Sampling from the Vadose Zone." In: American Society for

Testing and Materials (ASTM). 1997. *ASTM Standards on Environmental Sampling,* Second Edition. ASTM Publication 03-418097-37, p. 121-137.

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# STANDARD OPERATING PROCEDURE SS-6

# TEST PIT EXCAVATION

# STANDARD OPERATING PROCEDURE SS-6

# TEST PIT EXCAVATION

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) defines the safe methods to be followed during the excavation, logging, and sampling of test pits. Included in this discussion are procedures for obtaining representative samples and proper documentation of sampling activities.

### 1.1 DISCUSSION

The scope of this document is limited to project activities relating to test pit construction, soil and waste description, and sample collection. The objectives of test pit excavation are to:

- Describe the physical nature of consolidated or unconsolidated subsurface earthen materials.
- Characterize disposal areas.
- Describe waste materials.
- Determine subsurface soil characteristics.
- Collect representative samples of materials encountered.

## 2. EQUIPMENT

### 2.1 HEALTH AND SAFETY ITEMS

Gloves (surgical, viton, and nitrile)

Duct tape

Hard hat

Steel-toed boots

Rain gear

Ear plugs

Field first-aid kit

Eye wash

FID/PID

## 2.2 DECONTAMINATION ITEMS

Visqueen

Rinse bottle

Trash bags

Paper towels

Deionized water

Methanol, hexane, and stainless steel pressurized tanks, if necessary

Carboy for potable water

Decontamination tubs

Long-handle brushes

Alconox

Funnel

## 2.3 PAPER WORK

Health and Safety Plan

Field logbook and black ballpoint pens

Work Plan

Site map

Borehole logs/test pit logs

Chain-of-custody forms

## 2.4 MEASURING EQUIPMENT

Folding ruler marked in 0.10 of an inch

100-foot fiberglass tape measure

Grain size chart

Color chart

## 2.5 SAMPLING EQUIPMENT

Stainless steel trowels

Stainless steel scoopulas

Stainless steel buckets

## 2.6 SHIPPING SUPPLIES

Sample containers, including bottles for QC samples

Airbills (e.g., Federal Express)

Mailing labels

Bottle labels

Plastic resealable bags (1 quart and 1 gallon sizes)

Packing tape

Vermiculite

Coolers

## 2.7 MISCELLANEOUS

Camera and film

Stakes

Flagging

"Caution" tape

Identification tags for staked locations

Mean Streak or other paint markers

Drum liners

Bung wrench/crescent wrench

Straw and grass seed

# 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| G-3 | Field Documentation |
| G-6 | Field Sample Numbering |
| G-7 | Management of IDW |

# 4. PROCEDURE

## 4.1 PREPARATION

Field Team Leaders and other key project members must meet with the Project Manager to discuss requirements for test pit activities. At a minimum, this discussion needs to address the following items:

- The extent of the test pit field effort. Determine the number, location, and type of samples to be collected including Q/A and Q/C samples. Review available background information (i.e., topographic maps, soil survey maps, geologic survey maps, other site reports, etc.). If appropriate, prepare a work and sampling plan with appropriate site maps.
- Review associated operating practices for information on the performance of all relevant field activities that will be required to complete near surface or shallow soil sampling activities.
- Determine necessary sampling and monitoring equipment. Decontaminate or pre-clean equipment. Inspect and test, if possible, all equipment to determine the

operating condition of equipment to be utilized prior to performance of field activities.

- Verify that the client representatives have been notified of test pit activities, including dates, times, equipment, subcontractors, number of personnel, duration, operations clearances, utility clearances, and other information affecting site operations and client personnel or safety. All test pit locations are required to be utility-cleared by the client or utility companies in writing prior to any intrusive activities. Verify utility clearances have been completed prior to sampling. In no instance shall WESTON personnel perform utility clearances or act on behalf of a client to obtain utility clearances.

- Obtain the appropriate GEOLIS Forms, which, at a minimum, will include the Location Identification Form, the Test Pit Logging Form, and optional Notes and Sketch Forms. See Appendix B for samples of GEOLIS Forms. If project requirements specify another form for recording test pit information, obtain those form(s).

- Obtain a logbook for documentation of equipment checks and all other miscellaneous activities not documented in GEOLIS Forms.

- Contact delivery service to confirm ability to ship all equipment and samples to and from the site. Determine if shipping restrictions exist, and confirm regulations and specifications.

- Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate.

- Notify analytical laboratory of sample types, the number of samples, and approximate arrival date.

- Confirm that all equipment has arrived, has been decontaminated or pre-cleaned before sampling, and is operational.

- Conduct a site survey prior to site entry in accordance with the Health and Safety Plan.

- Identify and locate all test pit areas. Stake anticipated limits of excavation as indicated on the site map, and mark stakes with the test pit number. Complete appropriate GEOLIS Location Identification Forms.

- Ensure that site access to excavation areas has been obtained and cleared with appropriate personnel. Confirm utility clearances from the client representative and other utility representatives. Obtain signatures of client representative and other utility representatives in the field logbook and on the site map documenting that utility clearances have been completed. If test pits are in a high-traffic area, set up an exclusion zone using yellow marking tape strung from stakes or other semi-permanent objects.

## 4.2 TEST PIT EXCAVATION

Excavate test pits with a backhoe that uses a 2- to 3-foot wide bucket capable of efficient excavation to the appropriate depth.

- At those sites requiring restoration or containing contaminated materials, remove and stockpile the topsoil or contaminated material. Make shallow cuts of 1- to 2-foot depths, and stockpile the material on the downwind or downslope side of the trench. Maintain ample space (a minimum of 2 feet) between the stockpiled material and test pit to maneuver excavation equipment.

- Depending on the strength of the surficial deposits being trenched, mapping may occur concurrently with the advancement of the trench. The site geologist and an assistant should conduct the mapping of the trench wall at a safe distance behind the backhoe, lessening the risk of exposure to caving induced by backhoe vibrations.

- When appropriate, restrict access to the trench area(s). Use barricades with flashing lights to preclude vehicle and pedestrian traffic, and delineate a perimeter that contains the trench, windbreak, and topsoil/contaminated material stockpiles.

- Do not stand near the edge of the pit because of the danger of collapse.

- Sketch the development of the test pit in map view in the field logbook or in the GEOLIS Notes and Sketch Forms. Complete vertical profiles at several locations along the length of the test pit. Sketch a longitudinal section of the test pit. Indicate the lateral changes in soil or fill conditions.

- Record physical attributes of units that are distinct because of lithology, texture, or color. Utilize the ground surface adjacent to the test pit as the reference elevation. In addition to bedding planes and lithologic interfaces, geologic features (like cobble strings) may aid in following stratum continuity, particularly if individual units are difficult to discern.

- Describe samples using the soil field classification system designated for the project. Photographs are useful. Reference photographs in the field logbook.

- Excavated material will be placed on plastic and isolated from contact with surface soil to the extent practical. Arrange the excavated material in such a way that it can be placed in the test pit in the approximate reverse order from which it was removed.

- Samples will be collected as described in SOPs G-3 and G-6.

- Backfill the test pit with the material excavated. Replace the material in the reverse order from which it was removed. Compact the material after replacement of each foot of backfilled material. Mound the surface slightly to allow for subsidence of the backfill.

- Stabilize the surface soil of the test pit by seeding and covering with hay or straw to minimize erosion, if required by the project scope of work.
- The pits are not to remain as open excavations overnight. Plan test pits to be completed within one work day. Test pits are required to be backfilled the same day as excavated.
- Decontaminate backhoe equipment between test pits as specified in SOP G-2.

## 4.3 TEST PIT SAMPLING

- When required, collect samples from material excavated by the equipment during excavation of the test pit. Do not enter the test pit. Collect samples at locations and frequencies specified in the Work Plan or as determined during office preparation activities.
- Select parts of excavated material not contacting the bucket of the excavation equipment by scraping the surface layer away with a clean sampling implement. Use a second clean implement to collect the sample.
- If sampling for volatile organic analytes (VOAs), collect this sample first from a fresh surface to minimize effects of aeration. Place the soil in the sample container, remove any soil clinging to the bottle threads or rim, and seal without delay.
- When composite samples are specified, collect an equal volume of each discrete homogeneous sample. Place discrete samples in a stainless steel or tempered container, and mix thoroughly to obtain a composite sample representative of the sampling interval. Using a decontaminated or disposable sampling tool, place the sample in appropriately marked laboratory-provided containers.
- When discrete sampling is specified, direct the backhoe operator to excavate a bucket from the specified depth or use a shovel if depth is easily accessible. Using the appropriate sampling tools, collect the soil from the backhoe bucket and place into the appropriate jars.
- Samples may also be sieved through a 0.25- or 0.375-inch sieve. Sieving serves to remove non-soil debris, reduce sample size, and promote sample homogeneity.
- Record pertinent information about each sample in a field logbook or on a GEOLIS Test Pit Logging Form.

## 4.4 POST OPERATION

- Ensure that all equipment is accounted for and ready for shipment.

- Ensure that a chain-of-custody is completed and included as part of shipping documents.

- Make sure all test pit locations are properly identified and location markers are readily visible.

- Deliver the original GEOLIS Forms and field notebook to the Project Manager (or his designee). The original forms should be copied and filed.

- Follow the QA/QC regimen established for the data. At a minimum, this should include documentation of all corrections or changes to the field forms whenever they are made. Field personnel should review these changes for accuracy at appropriate times during the QA/QC process.

## 4.5 SAMPLE CONTAINERS AND PRESERVATION TECHNIQUES

### 4.5.1 Sample Containers

Refer to QAPP Section 6 (WESTON, 00-0507) or the specific analytical method for information on the required size and type of sample containers. Samples should be collected and containerized in the order of the volatilization sensitivity of the parameters. A preferred collection order for some common parameters follows:

1. Volatile organics (VOA).
2. Total organic carbon (TOC).
3. Extractable organics (BNAs or SVOCs).
4. Total metals
5. Phenols.
6. Cyanide.
7. Total solids.

### 4.5.2 Sample Preservation and Handling

Many of the chemical constituents and physiochemical parameters that are to be measured or evaluated in soil investigation programs are not chemically stable; therefore, sample preservation is required. Appropriate preservation techniques and sample containers that the sampler should use for each constituent or common set of parameters for various parameters are specified in QAPP Section 6.

The following general precautions should be taken when sampling:

1. A clean pair of new, disposable gloves should be worn each time a different location is sampled, and gloves should be donned immediately prior to sampling.
2. Sample containers for source samples or samples suspected of containing high concentrations of contaminants should be placed in separate plastic bags immediately after collecting, preserving, tagging, etc.
3. Samples of waste or highly contaminated samples should never be placed in the same ice chest as environmental samples.
4. If possible, one member of the field team should take all the notes, fill out sample tags, field sheets, etc., while the other members collect all of the samples.
5. Sample collection activities should proceed progressively from the suspected least contaminated area to the suspected most contaminated area.
6. Field personnel should use equipment constructed of teflon, stainless steel, or glass that has been properly pre-cleaned. Teflon or glass is preferred for collecting samples where trace metals are of concern.
7. Collection of adequate field control samples.

### 4.5.3 Field Quality Control Sample Procedures

Field control samples are collected by the sampling team to determine whether the data are of suitable quality. They include blanks, replicates, and/or background samples. A detailed discussion of field control samples is contained in SOP G-9.

### 4.5.4 Decontamination Procedures

All sampling equipment must be decontaminated prior to its use. Sampling equipment should be decontaminated as described in SOP G-2. The sampling equipment should be placed in plastic bags until immediately prior to use. Additional sampling devices may be needed on-site to ensure an adequate drying time.

### 4.5.5 Documentation

Bound field logbooks should be used for the maintenance of field records. All aspects of sample collection and handling, as well as visual observations, shall be documented in the field logbooks as outlined in SOP G-3.

All entries in field logbooks should be legibly recorded, and contain accurate and inclusive documentation of an individual's project activities.

## 5. REFERENCES

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# STANDARD OPERATING PROCEDURE SS-7

# SUPPLEMENTAL MODELING STUDY

# STANDARD OPERATING PROCEDURE SS-7

# SUPPLEMENTAL MODELING STUDY

## 1. BACKGROUND AND OBJECTIVE

During evaluation of existing data and development of the Conceptual Model for the modeling study (in collaboration with General Electric's consultant, QEA), the need for a supplemental modeling study was identified. A smaller, representative section of the EFDC model domain known as the "Test Reach" was identified to test the EFDC model and determine the optimal model grid configuration. The optimal configuration will represent a balance between model representativeness and computational feasibility. The use of the smaller, computationally more efficient, yet representative domain will allow the testing of a larger number of possible configurations.

The primary objective of the Supplemental Modeling Study is to determine the selected characteristics of the bed and suspended sediment loads in the Housatonic River during high-flow events. Representative samples of total suspended solids (TSS) and bedload sediments will be collected. Additional field tasks, including installation and surveying of toe pins, resurveying of channel cross-sections, collection of velocity measurements, staff gage monitoring, and the installation of pressure transducers, will be conducted as part of the Supplemental Modeling Study. These data will be used to parameterize the Housatonic River hydrodynamic and sediment transport computer model.

The TSS and bedload data collected during the Supplemental Modeling Study will be used to develop the final model grid by testing a series of cases with progressively coarsening model grids. The results from the simulations will be evaluated to determine the loss of information resulting from the associated reduction in spatial resolution.

# 2. METHODOLOGY

## 2.1 SCOPE OF STUDY

Surface water sampling, bedload sediment sampling, velocity measurements, staff gage measurements, and rain gage measurements will be performed at three locations.

1. Pomeroy Avenue Bridge – West of Appleton Avenue.
2. Electric Power Research Institute (EPRI) – Upstream end of the "Test Reach." This station is located approximately one-half mile upstream of the New Lenox Road Bridge.
3. New Lenox Road Bridge – This station is approximately in the middle of the Primary Study Area (PSA) and is located just upstream of the Decker canoe launch.

Sampling at the Pomeroy and New Lenox locations will be conducted from the bridges. Due to the lack of a bridge at EPRI, sampling activities will be conducted from the riverbank via suspended cables over the Housatonic River.

At each location, the deepest point of the channel, or thalweg, has been previously established through cross-sectional surveys. Surface water samples will be collected as grab samples at 6/10 water depth above the thalweg. Four additional points have been pre-established across the channel based on stream bed conditions. For bedload sediment sampling, the bedload samplers will be lowered to the sediment surface at these five points for a fixed period of time. The samplers will be moved from one point to the next until all five points are sampled, effectively creating a 5-point composite sample.

At the Pomeroy and New Lenox locations, velocities will be measured using USGS protocols at 2-foot intervals across the channel. The 2-foot interval will correspond to the 2-foot intervals previously established by cross-sectional surveys at each location. At the EPRI location, velocities will be measured at the five sampling points used for the bedload sampling.

The following table identifies the types of samples and velocity measurements at the three sampling locations.

| | Bedload Samples | Surface Water Samples | Velocity Measurements | |
|---|---|---|---|---|
| | 5-Point Composite | Grab at 6/10 Depth at Thalweg | 2-Foot Intervals | 5 Points Only |
| Pomeroy | X | X | X | |
| EPRI | X | X | | X |
| New Lenox | X | X | X | |

To assist in characterizing channel and bank stability and potential channel migration over time, toe-pins will be installed in five to nine riverbanks located in areas with high erosion/sloughing potential. The extent of the toe-pins exposed will be measured on installation and re-measured after up to five storms (or on a monthly basis for five months). Nine channel cross-sections at locations also selected for their high erosion potential will be resurveyed over time as part of the Study to evaluate changes in the sediment bed.

Pressure transducers will be installed at the three sampling locations to measure water levels and water temperatures during the sampling events. Data from these transducers and two additional transducers (to be installed as part of other studies) will be used to evaluate the changing river water levels related to storms occurring during the sampling.

## 2.2 NUMBER OF EVENTS AND MOBILIZATION CRITERIA

Surface water sampling, bedload sampling, velocity measurements, and staff/rain gage measurements will be performed for up to four higher-flow storm events. One of these events will be implemented under the Major Storm Sampling Study. Initiation of a sampling event will be considered only if the existing stage of the river and precipitation forecasts indicate that the flow rate at the Coltsville USGS gaging station will likely exceed 200 cfs. Meteorological monitoring will be conducted by a WESTON meteorologist or subcontracted forecasting service. Twice weekly, 5- and 10-day forecasts will be forwarded to the following decision-making team:

Susan Svirsky (EPA)
Earl Hayter (EPA)
Dick McGrath (WESTON)
Rick Beach (WESTON)
Tom Czelusniak (WESTON)
Rich Zoppel (WESTON)
Paul Paquin (HydroQual)
Rich DiNitto (Sleeman, Hanley & DiNitto)

The forecasts will include a percent probability for precipitation totals in excess of 0.5, 1, and 2 inches. An initial evaluation of the river stage and forecast will be conducted by Tom Czelusniak (Field Coordinator for this study). If conditions appear favorable for sampling, Tom Czelusniak will alert the Level I group consisting of Rick Beach, Paul Paquin, and Earl Hayter for closer evaluation of the information. If conditions warrant further consideration, the Level I group will initiate a conference call with the entire decision-making team to discuss the predictions. Based on the forecast and existing stage of the river, the decision to begin mobilization will be made by Susan Svirsky (EPA) or her designee. Phone numbers for the decision-making team and potential storm samplers are included in Attachment 1.

Toe-pins and channel cross-sections will be measured/resurveyed up to five times.

Pressure transducers will collect readings once every 15 minutes for the duration of the study.

## 2.3 STAFFING AND DURATION OF SAMPLING/MONITORING

Two sampling teams will be deployed during the Study, with each working a 12-hour shift for the duration of the event. Events are planned to run approximately 24 hours, but may run longer or shorter, depending upon the conditions presented by the storm. Susan Svirsky (EPA), in conjunction with Paul Paquin, will decide when to stop sampling. Decisions to stop work for safety reasons will be made with the concurrence of the Field Team, Field Coordinator, and Site Safety Officer. The Program Safety Manager will be notified of any safety-related stop work event.

Each shift team will consist of one Manager/Health and Safety Officer, seven Samplers, one Sample Manager/Runner. This results in nine people for each 12-hour shift. When the mobilization decision is made, Pittsfield staff will initiate setup of equipment and supplies and additional personnel will be scheduled to mobilize to provide two shift teams. Also at that time, extra rental vehicles will be arranged if necessary. At 12 to 24 hours before the storm, the second shift team will be mobilized to Pittsfield, and the first shift team will make final preparations. When the teams are ready to go, they will be dismissed for the day, if necessary, to rest before the event. Because predictions are not always accurate, and do change, this timeline may be amended. It is probable that there may be a need to respond in a much shorter timeframe. Under no circumstance will any response timeframe be such that safety requirements and/or motor vehicle laws are broken.

One two-person team will staff the EPRI and New Lenox sampling stations. A three-person team will staff the Pomeroy location (at least for the rising limb of the storm), due to the rapid water level response during storms at this location. Samplers will cycle continuously between surface water sampling, bedload sampling, and velocity measurements. Based on the proposed staffing level, it is anticipated that a complete cycle of the activities will be completed approximately once every 2 to 3 hours. The runner will periodically meet the sampling teams to retrieve samples, deliver sample bottles and other equipment needs, and assist the sampling teams if necessary. Sampling teams should be prepared with extra sample containers in the event that the runner is delayed or off schedule. Samples will be brought back to the office and stored on ice until samples are selected for analysis and shipped to the laboratory.

## 2.4 ANALYTICAL PARAMETERS

### 2.4.1 Surface Water Samples

The following parameters will be analyzed in selected surface water samples:

1. Total organic carbon (TOC).
2. Total suspended solids (TSS).
3. Polychlorinated biphenyls (PCBs) (total and Aroclors).

For each location, samples collected from three sample periods during rising stream conditions, the one sample period closest to peak stream conditions, and one sample period during falling stream conditions will be selected at a minimum for PCB, TSS, and TOC analysis. Sample selection criteria may be altered based on current storm and river conditions (and apparent sediment transport quantities). Susan Svirsky (EPA) and Paul Paquin will select the samples to be submitted for analysis based on the evaluation of the hydrograph developed from the staff gage readings for each location and event. All QA/QC samples will be collected on the falling limb of the storm at Pomeroy Avenue and/or New Lenox Road, but not at EPRI due to the difficult logistics of sampling from the cable system.

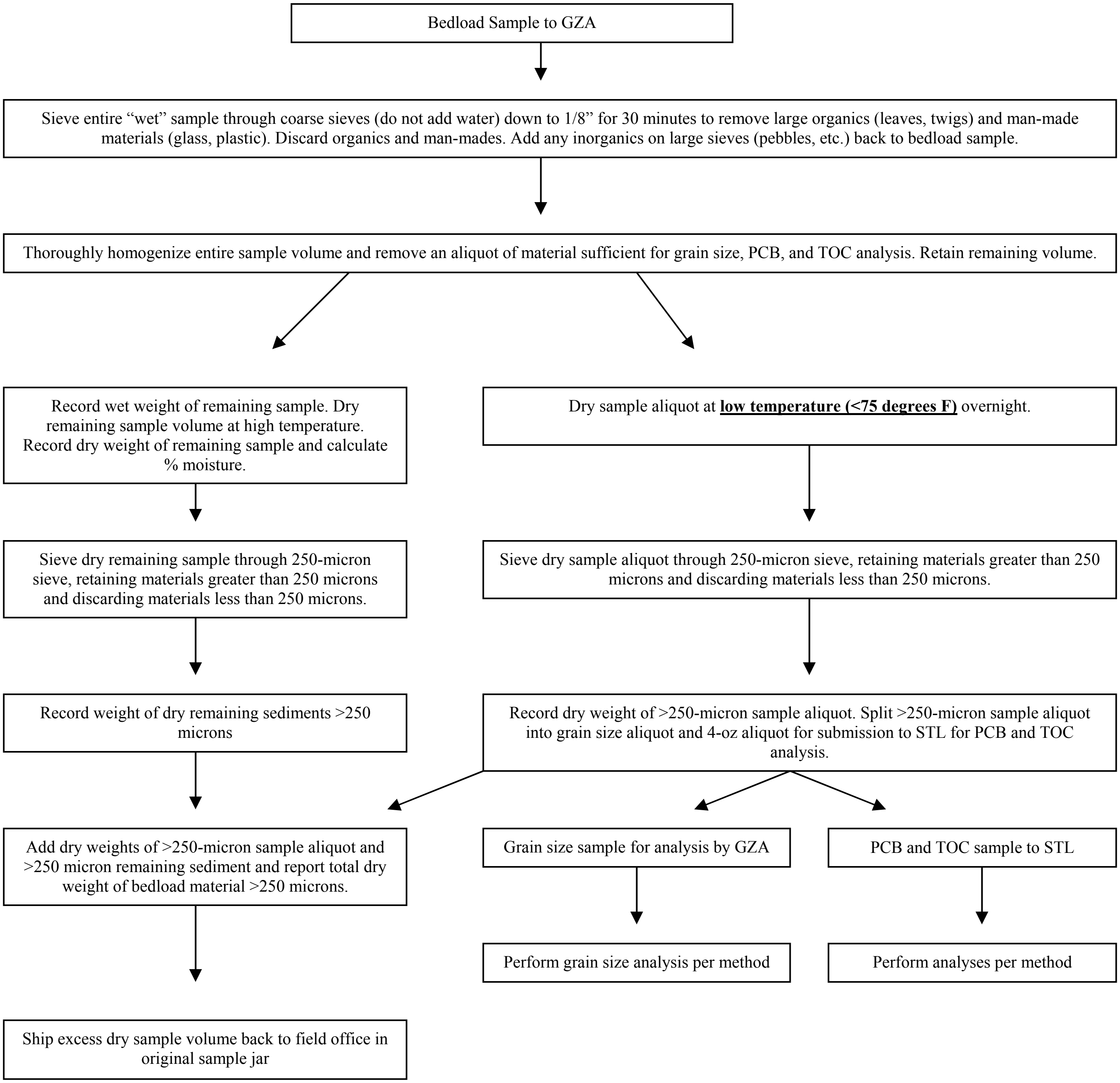
### 2.4.2 Bedload Sediment Samples

The following parameters will be analyzed in selected bedload sediment samples:

1. Total organic carbon (TOC).
2. Polychlorinated biphenyls (PCBs) (total and Aroclors.)
3. Grain size distribution greater than 250 microns.
4. Total dry sample mass.

For each location, three bedload sediment samples will be submitted for PCB and TOC analysis, grain size distribution >250 microns, and total dry sample mass. One of the samples will be selected to best measure the peak sediment transport, which usually occurs slightly prior to the peak water discharge. Two additional bedload samples will be selected from the total samples to bracket the peak sediment transport sample or to evaluate other sediment transport features dependent on the specific storm conditions. Susan Svirsky (EPA) and Paul Paquin will select the samples to be submitted for analysis based on the evaluation of the hydrograph developed from the staff gage readings for each location and event. Figure 1 presents a flow chart for the laboratory processing and analysis of the bedload samples. QA/QC samples will be collected from those samples selected for analysis that contain sufficient sample mass for additional QA/QC volumes.

# Figure 1 - Laboratory Bedload Sample Processing and Analysis



Bedload Sample to GZA

Sieve entire "wet" sample through coarse sieves (do not add water) down to 1/8" for 30 minutes to remove large organics (leaves, twigs) and man-made materials (glass, plastic). Discard organics and man-mades. Add any inorganics on large sieves (pebbles, etc.) back to bedload sample.

Thoroughly homogenize entire sample volume and remove an aliquot of material sufficient for grain size, PCB, and TOC analysis. Retain remaining volume.

Record wet weight of remaining sample. Dry remaining sample volume at high temperature. Record dry weight of remaining sample and calculate % moisture.

Sieve dry remaining sample through 250-micron sieve, retaining materials greater than 250 microns and discarding materials less than 250 microns.

Record weight of dry remaining sediments >250 microns

Add dry weights of >250-micron sample aliquot and >250 micron remaining sediment and report total dry weight of bedload material >250 microns.

Ship excess dry sample volume back to field office in original sample jar

Dry sample aliquot at **<u>low temperature (<75 degrees F)</u>** overnight.

Sieve dry sample aliquot through 250-micron sieve, retaining materials greater than 250 microns and discarding materials less than 250 microns.

Record dry weight of >250-micron sample aliquot. Split >250-micron sample aliquot into grain size aliquot and 4-oz aliquot for submission to STL for PCB and TOC analysis.

Grain size sample for analysis by GZA

Perform grain size analysis per method

PCB and TOC sample to STL

Perform analyses per method

GZA to report % moisture of bedload minus organics and man-mades, total dry weight of bedload >250 microns, and grain size analysis.

STL to report PCB and TOC analysis.

Analytical methods, required containers, preservation techniques, and holding times for the above samples are contained in the *Quality Assurance Project Plan* (QAPP) (WESTON, 2001, 00-0507) and summarized below.

| Parameter | No. of bottles | Bottle | Preservative | Holding Time |
|---|---|---|---|---|
| **Surface Water Samples** | | | | |
| TOC (EPA Method 415.1) | 2 | 40-mL glass vials | $H_2SO_4$,<br>Cool 4°C | 28 days |
| TSS (EPA Method 160.2) | 1 | 1-L amber glass | Cool 4°C | 7 days |
| Total PCB (SW846 8082) | 2 | 1-L amber glass | Cool 4°C | Extract within 7 days, analyze within 40 days following extraction |
| **Bedload Sediment Samples** | | | | |
| TOC (EPA Method 415.1) | 1 | 4-oz glass | Cool 4°C | 28 days |
| Total PCB (SW846 8082) | 1 | 4-oz glass | Cool 4°C | Extract within 14 days, analyze within 40 days following extraction |
| Grain Size Distribution (ASTM D422) | 1 | 2,000-mL glass* | Cool 4°C | N/A |

*Oversized sample container selected to allow homogenization of sample. Minimum sample volume required for analysis is approximately 250 mL (8 oz).

The number of samples per event to be submitted for analysis along with the relevant QA/QC samples are summarized below.

| | Number of Samples | | | | | |
|---|---|---|---|---|---|---|
| | PCBs - Sediment | PCBs - Aqueous | TOC - Sediment | TOC - Aqueous | Grain Size | TSS - Aqueous |
| Bedload Composites | 9 | | 9 | | 9 | |
| Surface Water Grabs | | 15 | | 15 | | 15 |
| Field Blanks* | | 1 | | 1 | | 1 |
| Field Duplicates | 1 | 1 | 1 | 1 | 1 | 1 |
| MS/MSD | 1 | 1 | 1 | 1 | | |
| Totals | 11 | 18 | 11 | 18 | 10 | 17 |

* Field blank for depth-integrated surface water samples will consist of D.I. water poured into and out of sample collection bottle following post-sampling decon (D.I. water rinse).

Surface water samples will be collected as grab samples from 6/10 depth with a model USDH-76 sampler, as described in Subsection 2.5. Bedload samples will be collected with a Model 8035 Helley-Smith design bedload sampler as described in Subsection 2.6. This model is a 65-lb, cable-suspended bedload sampler with a 3-inch x 3-inch opening, 3.22 expansion ratio, and 250-micron mesh bag. Velocity measurements will be taken with a Marsh-McBirney FloMate 2000 at each monitoring station as described in Subsection 2.7.

## 2.5 SURFACE WATER SAMPLE COLLECTION METHODS

The samples will be collected with a model USDH-76 sampler deployed from a manual winch system and cable. The model USDH-76 sampler samples water isokinetically (i.e., at the same velocity as the stream); therefore, the sample volumes are proportional to the velocity. This sampler is typically used as a depth-integrated sampler; however, for this study the sampler will be used to collect a grab sample from a specified depth. The sample procedure involves inserting a 1-liter collection bottle to the device, which will be quickly lowered to the specified depth and allowed to fill completely at that depth.

The following sampling protocol will be used for the collection of the surface water samples:

- The location and river bottom elevation of the thalweg at each location are included on the cross-sectional survey tables presented in Attachment 2 of this SOP. The zero elevation of the staff gages are also included on these sheets. The staff gage reading and calculated surface water elevation will be recorded on the field data sheet included in Attachment 3. Using the surface water elevation and river bottom elevation, the total water depth and 6/10 water depth at the thalweg will be calculated and recorded on the field data sheet.
- A 1-liter collection bottle will be loaded into the sampler and the sampler connected to the sampling cable of the winch or cable system. A clip or flagging will be placed on the sample cable at the calculated 6/10 depth above the sampler intake port. The sampler will be lowered to the water surface, then quickly lowered into the water until the clip or flagging reaches the water surface. The sampler will be allowed to hang at the 6/10 water depth to fill completely.
- After the retrieval of each collection bottle, the bottle will be closed and shaken to mix the sample. The sample will then be split equally into the one TSS and two PCB 1-liter sample bottles. The sampler will continue to be deployed and the sample split until the three 1-liter sample bottles are filled. The two 40-mL TOC sample vials will then be filled from one of the 1-liter sample jars after capping and shaking. The

sample containers will be labeled and placed in a cooler on ice for transport back to the office by the runner. Following sample collection, the collection bottle will be rinsed with deionized water and retained for reuse at that sample location.

Susan Svirsky (EPA) and Paul Paquin will select the samples to be submitted for analysis based on the evaluation of the hydrograph developed from the staff gage readings for each location and event.

## 2.6 BEDLOAD SAMPLE COLLECTION METHODS

Following completion of the surface water sampling, a composite bedload sample will be collected from the following five pre-established sample points:

| Station No. | Pomeroy | EPRI | New Lenox |
|---|---|---|---|
| 1 | L8 (8 ft left of center) | 38 ft from winch post | L34 (34 ft left of center) |
| 2 | Center of span | 51 ft from winch post | L17 (17 ft left of center) |
| 3 | R8 (8 ft right of center) | 64 ft from winch post* | Center at plaque* |
| 4 | R16 (16 ft right of center)* | 76 ft from winch post | R17 (17 ft right of center) |
| 5 | R20 (20 ft right of center) | 88 ft from winch post | R34 (34 ft right of center) |

* - Thalweg

The nylon mesh sample bag will be attached to the bedload sampler, and bedload collection will begin at the sampling point closest to the right bank (facing upstream - Station 5). The sample start time and the staff gage reading will be recorded on the field data sheet included in Attachment 3. Using the bridge winch or cable system, the sampler will be lowered into the water and allowed to orient to the flow, then lowered slowly until it rests on the bottom. The sampler will be allowed to rest on the bottom and collect bedload sediment for 2 minutes. The sampler will then be raised out of the water and moved to the next sampling point. Sampling will be continued across the channel, allowing the sampler to rest on the bottom for 2 minutes at each of the five sampling points.

The next step is dependent on the amount of sediment collected in the initial pass (e.g., 2-minute collection at each of the five sampling points):

1. Adequate amount of bedload sediment is collected. If an amount of bedload sediment adequate to fill the analytical sample bottles (e.g., total volume of approximately 750

mL) is obtained in the initial pass, the sample may be processed as noted below in Subsection 2.6.1.

2. Too much bedload sediment is collected. **If the 2-minute grab at each sampling point results in the bag filling with sediment before all of the points are sampled, or the bag is so full that it likely prevented sediments from entering the bag, the sample is void and must be discarded.** The collection protocol will be repeated with a shorter period of time for the sampler collecting at each sampling point. The shorter period of time will be determined by the field team and will be based on current river conditions and estimated bedload transport. For example, if the sediment collected just slightly overfilled the bag by the fifth (and last) sampling point, the sample would be discarded and the sampling time at each point could be reduced to 1 minute.

3. An inadequate amount of bedload sediment is collected. If the amount of bedload sediment collected in the initial pass is not adequate to fill the analytical sample bottles (e.g., total volume of approximately 750 mL), additional sediment must be collected. With the collected sediment remaining in the mesh bag, return to the first sampling point and repeat the collection protocol for a second pass.

**Note: Once a sampling pass is initiated, the collection time at each of the five sample points within that pass may not be adjusted (e.g., the collection time for each of the five points must be the same); however, the collection time on subsequent passes may be different (e.g., you can combine the bedload sediment from a 2-minute per point pass with the bedload sediment from a 5-minute per point pass). On subsequent bedload samples, the field team may adjust the collection time of the first pass (increase or decrease from 2 minutes per location) based on earlier experience in an attempt to collect sufficient volume on the first pass. The maximum cumulative sample time spent at each point will be 10 minutes. If after a total of 10 minutes collection time at each point insufficient volume has been collected, whatever sample volume has been collected will be processed as described below and retained for potential total dry mass determination.**

### 2.6.1 Processing

Once an adequate amount of bedload sediment is obtained in the composite sample, the time spent at each sampling point, the number of passes, and the sample completion time will be recorded on the field log included in Attachment 3. Following sample collection, the sampler will be retrieved and the nylon mesh sample bag removed. The sample bag with sediment will be allowed to drain until no water drips from the bag for a 5-second period. The entire bedload sediment composite (five sample collection points per pass and multiple passes if performed) will be emptied into a 1-gallon wide-mouth sample jar.

The sample jars will be labeled and placed in a cooler with ice for transport back to the office by a runner. Following sample collection, the nylon bag will be washed in an Alconox/water solution, rinsed with deionized water, and retained for re-use at that sample location.

Three bedload samples will be analyzed for TOC, PCB, grain size distribution, and total dry sample mass. Susan Svirsky (EPA) and Paul Paquin will select the samples to be submitted for analysis based on the evaluation of the hydrograph developed from the staff gage readings for each location and event. The lithology of all bedload samples will be recorded and the selected samples submitted to the laboratory for processing and analysis as outlined in Figure 1.

## 2.7 VELOCITY MEASUREMENTS

Velocity measurements will also be taken at the three sampling locations following bedload sample collection. Velocity measurements, along with staff gage measurements, will be used to track the progress of the river responses to the storm. Due to safety requirements that prohibit personnel from entering the river during storms, velocity measurements will be taken from the bridges or through the use of the overhead suspended cables at the EPRI location. Rain gage readings will be recorded prior to each set of velocity measurements and recorded on a field data sheet included in Attachment 3. The field team will also note the time if the river rises out of its banks.

Velocity measurements will be made using a Marsh-McBirney FloMate 2000 portable electronic current meter. The meter uses an electromagnetic sensor to measure the velocity in a conductive fluid such as water using Faraday’s law of electromagnetic induction to measure fluid flow. As a conducting fluid, such as non-ionically pure water, moves through a magnetic field produced by the meter, a voltage will be induced (Gordon et al., 1992, 99-0199). Velocity meters will be set to a 20-second averaging interval.

At Pomeroy and New Lenox, velocity measurements will be recorded in accordance with USGS protocols (Buchanan et al., 1969, 99-0198) at pre-established 2-foot intervals across the river channel, starting at the left-most interval, using the following protocol:

The staff gage will be read to determine the elevation of the water surface. Using the surface water elevation and cross-sectional elevation data of the riverbed, the depth of the water at each pre-established 2-foot interval across the river will be calculated. At velocity measurement positions with a water depth of 2.5 ft or less, the velocity will be measured at 6/10 of the water depth from the surface. At depths greater than 2.5 ft, the velocity will be measured at 2/10 of the water depth and 8/10 water depth from the surface. The weighted bomb and Marsh McBirney sensor will be clipped onto the winch system and lowered to the prescribed depth. The velocity probe will be allowed to remain at each sampling depth for approximately 20 seconds to allow the meter to stabilize. Once the meter has stabilized, the second reading will be recorded. The velocity and stage data will be entered on the field data sheet (included in Attachment 3).

At EPRI, velocity measurements will be recorded at the five previously established bedload sampling points instead of the 2-foot intervals across the Housatonic River. Also, the velocity measurements will be obtained at 1-foot depth intervals from the water surface to the river bottom instead of the fractional water depths (therefore no calculations are necessary). The 1-foot depth intervals will be estimated from the cable length used to lower the instrument.

The field data sheet will document the following general information:

1. Flow monitoring location and point across the river
2. Date
3. Time
4. Water elevation from staff gage
5. Water depth at monitoring point
6. Velocity at depth monitored

## 2.8 INSTALLATION OF PRESSURE TRANSDUCERS

Pressure transducers will be installed as part of the supplemental modeling study to allow accurate measurement of propagation/timing of flood waves resulting from the various storm events. The pressure transducers will have a range of 10 ft maximum and an accuracy of 0.05% (accuracy equates to ±0.03 ft over the expected range). Pressure transducers with temperature probes will be installed at the three previously identified locations and at Woods Ponds Footbridge. Pressure transducers will collect readings once every 15 minutes. Data will be downloaded at the end of each sampling event or at the request of the modeling team for other objectives. A staff gage will be installed at the upstream end of the test reach for calibration reference. Staff gages currently exist at the other sampling locations.

## 2.9 INSTALLATION OF TOE PINS/CHANNEL CROSS-SECTION RESURVEY

Two pairs of toe pins will be installed on opposing river banks at five major bends in the "Test Reach" to monitor changes in channel morphology over time. At each of the bends, a toe pin will be positioned horizontally and one will be positioned vertically on each bank. Toe pins will be monitored monthly or after major storm events and the exposed portion of the pins will be measured and recorded to track erosion and deposition.

Nine channel cross-sections upstream of New Lenox Bridge will be resurveyed over time to monitor changes in channel morphology over time. The cross-sections that will be resurveyed included the following locations: XS049, XS061, XS089, XS133, XS153, XS182, XS192, XS194, and XS198.

# 3. REPORTING

The results of each sampling event will be summarized and presented as a report memo. At a minimum, the report will include the following:

1. Documentation of conditions and activities likely impacting the amounts of PCBs and suspended material in the surface water of the river for 7 days prior to and during the sampling event. This will include a daily summary of the remedial activities and storm events during this period. The flow and velocity information from the USGS Coltsville Station will be presented in graphical format for the same time period prior to and during the sampling event.

2. Sample collection information on the sampling date and time, river temperature, and river and sampling observational notes. Any deviations from the decontamination or collection protocols will be noted.

3. River elevations at the time of the sampling for each station will be determined from the staff gage readings. A hydrograph for the event at each location will be presented. If a rating curve for a station is available at the time of the report draft, the curve will be presented with the estimation of the flow during the sampling at each station.

4. Sample processing information regarding the submission and transport of the samples to the laboratory for analysis.

5. Summary tables of the sample results for each event, organized by location:

    - Dry mass (in grams) of the bedload sediment composite samples per unit collection time.
    - Total PCBs and Aroclors in bedload samples (reported as mg/kg).
    - Total PCBs and Aroclors in the surface water samples (reported as ug/L).
    - TOC in bedload samples (reported as mg/kg).
    - TOC in the surface water samples (reported as mg/L).
    - TSS in the surface water samples (reported as mg/L).
    - Grain size distribution (>250 microns) of the bedload samples.

## REFERENCES

Buchanan, T.J. and Somers, W.P. 1969. “Discharge Measurement at Gauging Stations.” *Techniques of Water-Resource Investigations*, Book 3, Chapter A8, U.S. Geological Survey Washington, DC. (99-0198)

Gordon, N.D., McMahon, T.A. and Finlayson, B.L. 1992. *Stream Hydrology.* John Wiley & Sons. New York, NY. (99-0199)

WESTON (Roy F. Weston, Inc.). 2001. “Laboratory Standard Operating Procedures” In: *Final Quality Assurance Project Plan,* Volumes II and IIA. General Electric (GE) Housatonic River Project, Pittsfield, Massachusetts. DCN GE-021601-AAHM. (00-0507)

# ATTACHMENT 1

# CONTACT LIST

# BEDLOAD STORM SAMPLER CONTACT LIST

| | |
|---|---|
| Ahsan, Quamrul (HydroQual) | 845-753-6844 (h) |
| | 210-529-5151x7135 (w) |
| | 914-441-0364 (cell) |
| Beach, Rick | 610-518-3380 (h) |
| | 610-701-3473 (w) |
| | 413-237-5432 (cell) |
| Campbell, Scott | 603-648-2903 (h) |
| | 603-656-5566 (w) |
| Cermak, Noah | 603-763-7323 (h) |
| | 413-442-4224 (w) |
| | 603-237-6113 (cell) |
| Combs, Sean | 603-529-6536 (h) |
| | 603-656-5453 (w) |
| | 603-801-0380 (cell) |
| Czelusniak, Tom | 413-637-1342 (h) |
| | 413-442-4224 (w) |
| | 413-237-3112 (cell) |
| DiNitto, Rich (Sleeman, Hanley & DiNitto) | 617-424-9757 (h) |
| | 617-330-2800 (w) |
| | 617-285-9757 (cell) |
| Ditsch, Brian | 301-752-1415 (cell) |
| Eid, Ibrahim | 610-430-6911 (h) |
| | 610-701-3430 (w) |
| Hayter, Earl (EPA) | 864-882-2763 (h) |
| | 706-355-8303 (w) |
| | 706-714-1631 (cell) |
| Jendrasiak, Ryan | 413-442-4224 (w) |
| | 413-329-0205 (cell) |
| McGrath, Dick | 978-779-5253 (h) |
| | 978-779-6578 (home office) |
| | 508-561-0980 (cell) |
| Paquin, Paul (HydroQual) | 201-529-5151, ext. 7144 (w) |
| | 201-317-0804 (cell) |
| Phillips, Rob | 860-741-3641 (h) |
| | 860-922-7982 (cell) |
| Prevost, Shana | 860-292-6222 (h) |
| | 860-983-1859 (cell) |
| Soukup, Jim | 603-424-8088 (h) |
| | 603-656-5480 (w) |
| Steele, Amy | 413-458-3488 (h) |
| | 413-442-4224 (w) |
| | 413-822-7261 (cell) |
| Svirsky, Susan (EPA) | 978-546-9143 (h) |
| | 617-918-1435 (w) |
| | 617-413-4906 (cell) |
| Taylor, Kathleen | 603-424-8088 (h) |
| | 603-656-5574 (w) |
| | 603-315-4563 (cell) |
| Totino, Rich (WESTON/ATS) | 518-884-9464 (h) |
| | 413-442-4224 (w) |
| | 518-421-3526 (cell) |
| Zapisek, Izabela | 413-442-4224 (w) |
| | 508-414-1762 (cell) |
| Zoppel, Rich | 802-375-9270 (h) |
| | 413-442-4224 (w) |
| | 413-237-3032 (cell) |

# ATTACHMENT 2

# CROSS-SECTIONAL SURVEYS

**POMEROY AVENUE BRIDGE** SK SURVEY ON 10/15/2001

TBM:
RIVET ON N.E. BRIDGE ABUTMENT = 975.92

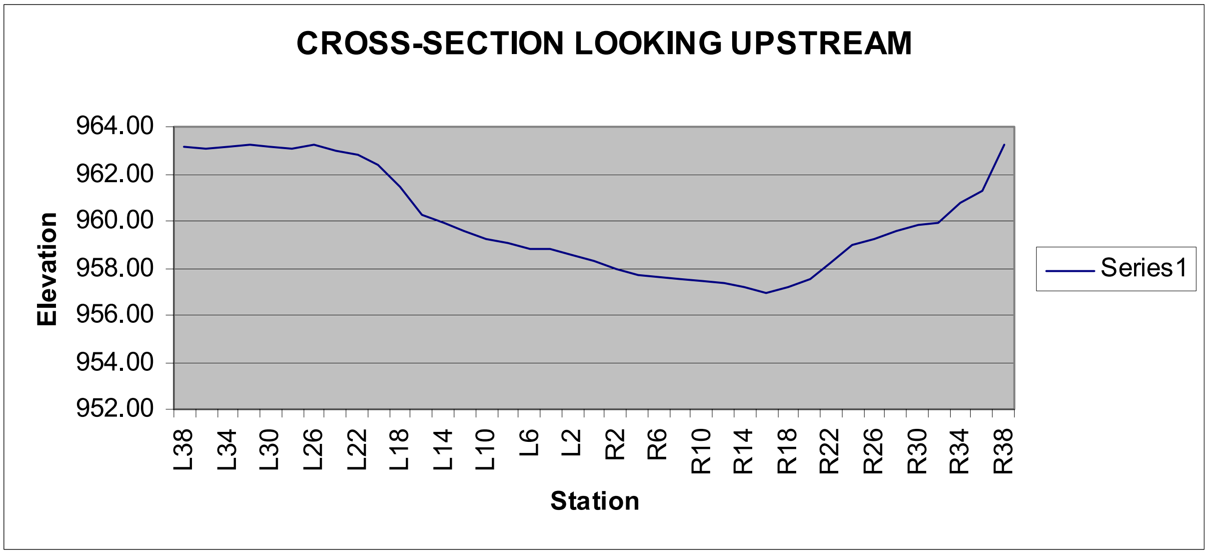
| OFFSET DISTANCE | ELEVATION | | |
|---|---|---|---|
| | LEFT | CENTER | RIGHT |
| | | | |
| 0 | | 958.30 | |
| 2 | 958.54 | | 957.95 |
| 4 | 958.84 | | 957.67 |
| 6 | 958.82 | | 957.59 |
| 8 | 959.10 | | 957.55 |
| 10 | 959.26 | | 957.47 |
| 12 | 959.56 | | 957.35 |
| 14 | 959.94 | | 957.15 |
| 16 | 960.27 | | 956.97 |
| 18 | 961.47 | | 957.17 |
| 20 | 962.37 | | 957.52 |
| 22 | 962.77 | | 958.25 |
| 24 | 962.95 | | 958.96 |
| 26 | 963.23 | | 959.27 |
| 28 | 963.09 | | 959.61 |
| 30 | 963.18 | | 959.79 |
| 32 | 963.27 | | 959.93 |
| 34 | 963.11 | | 960.77 |
| 36 | 963.06 | | 961.27 |
| 38 | 963.12 | | 963.24 |
| | | | |

Thalweg located at R16

Streambed elevation = 956.97

LEFT AND RIGHT BASED ON LOOKING UPSTREAM
CENTER POINT SPACED EQUALLY BETWEEN LEFT AND RIGHT BRIDGE ABUTMENT
BENCHMARK FROM ACOE SURVEY 10/31/01. ELEVATION PULLED TO TBM FROM ACOE TBM E - (NGVD 1929 ELEVATION 0F 977.59) - DOUBLED HEADED NAIL ON UTILITY POLE (WMECO 36) - 42' EAST OF BRIDGE.

**ZERO ELEVATION OF STAFF GAGE = 957.15**



**EPRI CROSS SECTION** SK SURVEY ON 10/22/2001

Thalweg located 64' from sampling post. Streambed elevation = 944.24

TBM:
NAIL IN POST ON WEST SIDE OF RIVER = 960.26

NOTE: STATIONING RUNS FROM POST ON WEST SIDE OF RIVER TO
POST ON EAST SIDE OF RIVER

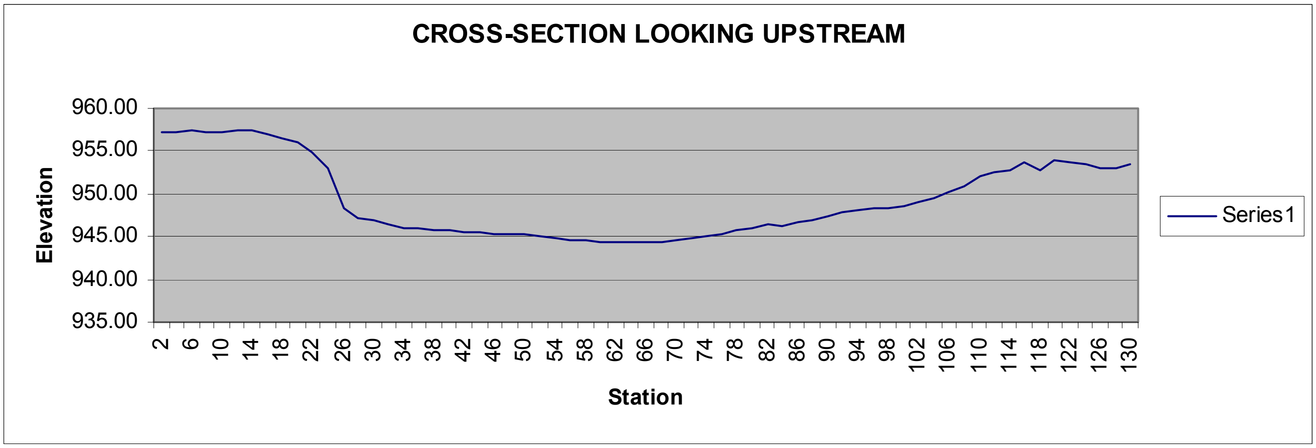
| STATION | ELEVATION | REMARK |
|---|---|---|
| 2 | 957.24 | BANK |
| 4 | 957.29 | BANK |
| 6 | 957.34 | BANK |
| 8 | 957.29 | BANK |
| 10 | 957.29 | BANK |
| 12 | 957.34 | BANK |
| 14 | 957.44 | BANK |
| 16 | 957.04 | BANK |
| 18 | 956.44 | BANK |
| 20 | 955.94 | BANK |
| 22 | 954.79 | BANK |
| 24 | 952.94 | BANK |
| 26 | 948.34 | EDGE WATER |
| 28 | 947.24 | WATER |
| 30 | 946.94 | WATER |
| 32 | 946.44 | WATER |
| 34 | 946.04 | WATER |
| 36 | 945.94 | WATER |
| 38 | 945.84 | WATER |
| 40 | 945.74 | WATER |
| 42 | 945.54 | WATER |
| 44 | 945.44 | WATER |
| 46 | 945.29 | WATER |
| 48 | 945.24 | WATER |
| 50 | 945.24 | WATER |
| 52 | 945.04 | WATER |
| 54 | 944.74 | WATER |
| 56 | 944.69 | WATER |
| 58 | 944.49 | WATER |
| 60 | 944.44 | WATER |
| 62 | 944.44 | WATER |
| 64 | 944.24 | WATER |
| 66 | 944.29 | APPROX CENTER |
| 68 | 944.29 | WATER |
| 70 | 944.59 | WATER |

| STATION | ELEVATION | REMARK |
|---|---|---|
| 72 | 944.84 | WATER |
| 74 | 945.14 | WATER |
| 76 | 945.39 | WATER |
| 78 | 945.64 | WATER |
| 80 | 946.04 | WATER |
| 82 | 946.39 | WATER |
| 84 | 946.14 | WATER |
| 86 | 946.69 | WATER |
| 88 | 946.94 | WATER |
| 90 | 947.44 | WATER |
| 92 | 947.84 | WATER |
| 94 | 948.04 | WATER |
| 96 | 948.24 | WATER |
| 98 | 948.39 | WATER |
| 100 | 948.64 | WATER |
| 102 | 948.94 | WATER |
| 104 | 949.59 | EDGE WATER |
| 106 | 950.09 | BANK |
| 108 | 950.99 | BANK |
| 110 | 952.04 | BANK |
| 112 | 952.64 | BANK |
| 114 | 952.84 | BANK |
| 116 | 953.59 | BANK |
| 118 | 952.84 | BANK |
| 120 | 953.89 | BANK |
| 122 | 953.74 | BANK |
| 124 | 953.44 | BANK |
| 126 | 952.99 | BANK |
| 128 | 952.94 | BANK |
| 130 | 953.44 | BANK |

BENCHMARK FROM SK SURVEY. ELEVATION PULLED TO TBM FROM CHISELED SQUARE CUT IN NORTHWEST WINGWALL OF NEW LENOX ROAD BRIDGE (NGVD 1929 ELEVATION OF 966.73') (SEE NEW LENOX FILE)

**ZERO ELEVATION OF STAFF GAGE = 947.97**

(BASED ON RFW SURVEY ON 12/12/01 SINCE GAGE WAS RELOCATED AFTER SK SURVEY ON 10/22/01)



**NEW LENOX BRIDGE** SK SURVEY ON 10/22/2001

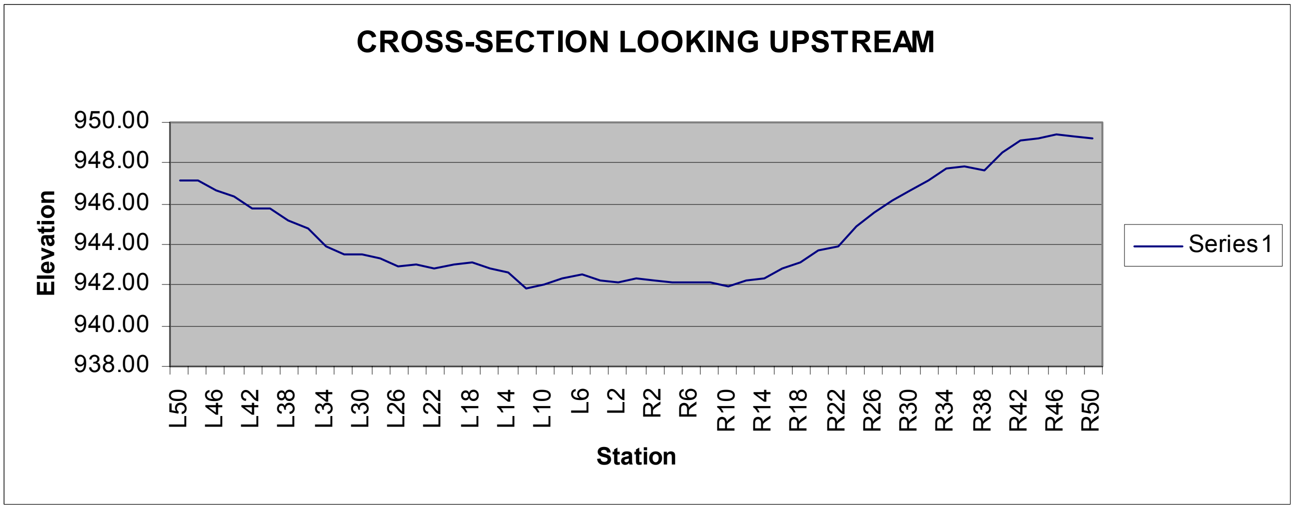
TBM:
CHISELED SQUARE CUT IN NORTHWEST WINGWALL OF
NEW LENOX ROAD BRIDGE. ELEVATION : 966.73

Thalweg set at Center of bridge at plaque for sampling purposes – elevation = 942.31.

| OFFSET DISTANCE | ELEVATION | | |
|---|---|---|---|
| | LEFT | CENTER | RIGHT |
| 0 | | 942.31 | |
| 2 | 942.16 | | 942.21 |
| 4 | 942.21 | | 942.11 |
| 6 | 942.51 | | 942.11 |
| 8 | 942.31 | | 942.11 |
| 10 | 942.06 | | 941.96 |
| 12 | 941.86 | | 942.21 |
| 14 | 942.61 | | 942.31 |
| 16 | 942.81 | | 942.81 |
| 18 | 943.11 | | 943.16 |
| 20 | 943.01 | | 943.71 |
| 22 | 942.81 | | 943.91 |
| 24 | 943.01 | | 944.91 |
| 26 | 942.96 | | 945.61 |
| 28 | 943.31 | | 946.16 |
| 30 | 943.46 | | 946.66 |
| 32 | 943.51 | | 947.19 |
| 34 | 943.91 | | 947.77 |
| 36 | 944.81 | | 947.86 |
| 38 | 945.16 | | 947.60 |
| 40 | 945.81 | | 948.51 |
| 42 | 945.81 | | 949.16 |
| 44 | 946.36 | | 949.26 |
| 46 | 946.66 | | 949.37 |
| 48 | 947.11 | | 949.31 |
| 50 | 947.16 | | 949.26 |

LEFT AND RIGHT BASED ON LOOKING UPSTREAM
CENTER POINT SPACED EQUALLY BETWEEN LEFT AND RIGHT ABUTMENT
BENCHMARK FROM ACOE SURVEY 10/31/01. ELEVATION PULLED TO TBM FROM NGS BENCHMARK T10 -
(NGVD 1929 ELEVATION OF 972.26') LOCATED 28' WEST OF WEST RAIL OF RAILROAD TRACKS, NEAR FENCE POST ADJACENT TO FORMER TRAIN STATION BUILDING (DEWEY'S CROSSING) NORTH OF NEW LENOX ROAD.

**ZERO ELEVATION OF STAFF GAGE = 948.02**



# ATTACHMENT 3

# FIELD DATA SHEETS

# Surface Water Sampling Field Data Sheet

| | | | |
|---|---|---|---|
| Location: | Pomeroy | EPRI | New Lenox |
| Staff Gage Zero Elevation: | 957.15 | 947.34 | 948.02 |

| Date | Time | Staff Gage Reading | Staff Gage Zero Elevation | Surface Water Elevation | River Bottom Elevation | Total Water Depth | 6/10 Water Depth | Sample ID* |
|---|---|---|---|---|---|---|---|---|
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* Pomeroy = H2-ST000004-☐-☐☐☐☐-☐☐☐☐
West Branch = HW-ST000005-☐-☐☐☐☐-☐☐☐☐
New Lenox = H3-ST000007-☐-☐☐☐☐-☐☐☐☐
Woods Pond = H4-ST000009-☐-☐☐☐☐-☐☐☐☐
EPRI = H3-ST000010-☐-☐☐☐☐-☐☐☐☐

# Bedload Sampling Field Data Sheet

Location: Pomeroy ☐ EPRI ☐ New Lenox

| Date | Sample Start Time | Staff Gage Reading | Sample Completion Time | Traverse # | Time Deployed (min) | | | | | Sample ID* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | #5 | #4 | #3 | #2 | #1 | |
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* Pomeroy = H2-BL000004-☐-☐☐☐☐-☐☐☐☐
New Lenox = H3-BL000007-☐-☐☐☐☐-☐☐☐☐
EPRI = H3-BL000010-☐-☐☐☐☐-☐☐☐☐

# Rain Gage Field Data Sheet

Location (circle): Pomeroy EPRI New Lenox

| Date | Time | River In or Out of Banks | Rain Gage Reading | Rain Gage Emptied? |
|---|---|---|---|---|
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# Surface Water Velocities

| | | | |
|---|---|---|---|
| Location: | Pomeroy | EPRI | New Lenox |
| Staff Gage Zero Elevation: | 957.15 | 947.34 | 948.02 |

| Station Location (#) | Date | Time | Staff Gage Reading | Staff Gage Zero Elev | Surface Water Elev | River Bottom Elev | Water Depth | Depth (ft) | | | | Velocity (ft/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 6/10 | 2/10 | 8/10 | One-Ft Interval | |
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# - From cross-sectional surveys (e.g., L16) or bedload sample locations

# STANDARD OPERATING PROCEDURE SW-1

# ACOUSTIC DOPPLER CURRENT PROFILER (ADCP)

# STANDARD OPERATING PROCEDURE SW-1

# ACOUSTIC DOPPLER CURRENT PROFILER (ADCP)

## 1. SCOPE AND APPLICATION

### 1.1 BACKGROUND

Fluvial (river) hydrodynamics determine erosional and depositional areas, sediment transport, and chemical and biological distributions and interactions within a river system. The system topography, geology, and water velocities at various river discharges are the fundamental basis for river hydrodynamic characteristics and predictions.

Typically, hydrodynamic assessments are made by mathematical modeling of the system. The water velocities and other physical measurements collected within the river system are used to set boundary conditions within the hydrodynamic model as well as to set limits on the model coefficients. In addition, field measurements are also used to test the validity of the mathematical model predictions.

Mathematical modeling results may also be used to define the weaknesses or limitations of past field data collections. The modeling predictions are used to define additional field sampling to further refine the predicted system behavior. The interaction between mathematical predictions and field data collection typically result in the most accurate assessments of the system under investigation.

### 1.2 OBJECTIVES

The Acoustic Doppler Current Profiler (ADCP) provides rapid, high resolution, vertical and horizontal profiles within an aquatic system. The general objective of the ADCP fieldwork is to provide statistically valid, high resolution velocity distributions at selected river segments to assist in the development and assessment of a hydrodynamic model. The specific objectives are:

- To provide detailed vertical and horizontal water velocity distributions at selected river segments.
- To provide total river discharge measurements at selected river transects.
- To provide subsets of vertical and horizontal discharge distributions.
- To provide high resolution bathymetry of river segments.

A secondary objective of the ADCP field measurements is to provide relative estimates of the distribution of total suspended particulate material.

## 1.3 LEVELS OF DATA QUALITY AND QUANTITY

Because the ADCP rapidly and simultaneously provides bottom depth, water velocity vertical profiles, relative backscatter (particulate material), horizontal positioning (relative to boat movement over the river bottom and/or relative to GPS positioning), and subsequent discharge calculations, data in either the vertical and/or horizontal positioning lends itself to detailed statistical analysis. Replicate measurements (multiple data collection) also allow additional statistical applications.

## 1.4 SAMPLING LOCATIONS

Sampling locations are predetermined as a function of the hydrodynamic mathematical model output and riverine conditions. Typically, sampling is of two types, namely:

- A river transect (cross sectional area) perpendicular to the longitudinal axis of the river channel (two-dimensional distribution).
- A meandering throughout a river segment (three-dimensional distribution).

## 1.5 HORIZONTAL POSITIONING

ADCP measurements are taken from either a known position (starting reference point) that is tracked throughout the entire data collection transect or segment (expressed as an earth referenced vector distance from the starting point), and/or ADCP data that is simultaneously recorded with one second differential GPS (dGPS) updates.

### 1.6 DATA SAMPLED

In all cases (i.e., 2- or 3-dimensional distributions), bottom depths, bottom track (horizontal positioning relative to a known starting point), vertical profiles of water velocities, relative backscatter (estimate of suspended solids), dGPS positioning (if available), date, time, total distance traveled, and total discharge are recorded.

## 2. EQUIPMENT

ADCP - RD Instruments, 1200 kHz, Workhorse Sentinel, High Resolution Mode with Bottom Track.

GPS - Trimble GPS, differentially corrected by either shore beacon, base station, or satellite.

ADCP/GPS Mounting - Both ADCP and GPS are mounted on a small, floating platform (independent of boat movement) controlled by a telescoping pole operated from a boat.

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-15 | Trimble Pathfinder Pro XL GPS |

## 4. PROCEDURE

### 4.1 BASIC ADCP OPERATION

The ADCP uses the frequency shift (Doppler effect) of reflected, high resolution sound waves to calculate relative movement. The instrument measures the frequency shift and relative backscatter from four transducers mounted at 90° angles to each other on the instrument face. The four transducers (beams) are earth referenced from an internal flux gate compass. The relative water movement from various depths (bins) is determined by the timing (speed of sound in water) of the signal processing of the reflected sound wave back to the instrument (water ping). ADCP movement relative to the earth is determined by the same principle, except that a separate sound wave is reflected from the river bottom (bottom ping). Water velocity at depth (bin) is calculated by the difference of movement between the water ping and the bottom ping. Implicit in this calculation is that the bottom does not move independently of the ADCP (this assumption is tested by either dGPS corrected velocities or by time series data collection from a fixed position and apparent ADCP movement).

## 4.2 INITIAL TESTING

The ADCP is factory calibrated and controlled by factory installed firmware. Field calibration is not required (nor possible) if the instrument is performing according to manufacturer specifications. Therefore, an instrument diagnostic tool is provided by the manufacturer and is used to verify the instrument operation prior to and after field operations (the results are recorded).

## 4.3 INSTRUMENT CONFIGURATION AND OPERATION

The ADCP operation is controlled by software contained in an external computer. The various commands are configured and sent to the instrument by means of the software and an RS232 communications port. GPS input data are also controlled by the software. The exact instrument configuration is determined by the field conditions (e.g. water depth) and the desired vertical resolution. In every instance, the instrument configuration is a trade off between desired resolution, relative water velocity and turbulence, and the single ping error. Single ping error may be reduced by multiple pings. (The exact instrument configuration is stored as an ASCII file.)

The process of instrument deployment consists of minimizing the ADCP movement across a transect to maximize the number of pings per segment of river (increase the number of pings to reduce the error). The rate of ADCP movement is a function of the practicality of desired accuracy and time spent on location. During high velocity events, the difficulty of ADCP positioning enters into the practicality of deployment, but at high flows, the relative error (number of pings) may be higher due to higher flows. Typically, at most flows, a rope is stretched across the river and the boat (ADCP) is manually pulled across the transect to maximize the number of pings per transect distance.

### 4.4 QUALITY CONTROL

Because the binary data processed by the ADCP is collected at less than 2 second intervals between ensembles (water ping + bottom ping + GPS), the raw data are stored electronically (raw data file), the GPS data are stored as a navigation file, and the field averaged (real time) data are stored as a processed file. The ADCP software independently labels the types of files.

The real time data presentation allows the operator to determine the validity and quality of the data at the time of collection. If bad data or data with high error are noted, the data collection process is repeated. At a minimum, replicate transects are performed to provide an additional statistical assessment of the velocities and discharge measurements.

All data files, instrument configuration files, and data storage are recorded on the attached form (see Table 1). Backup copies of the associated files are maintained.

### 4.5 QUALITY ASSURANCE

All activities, from initial instrument testing to actual data collection, are recorded on the attached form (see Table 1). The computer program (version) and the unique configuration file must be used to analyze the data at a future time. All data collection documentation and data transfers are recorded on the attached form (see Table 1).

### 4.6 SAMPLE ANALYSIS

The ADCP data may be analyzed in many ways, depending upon the objectives. The raw data files (ADCP data and GPS data) are post processed using the manufacturer-supplied software and instrument configuration files. The data analysis is the responsibility of the hydrodynamic modeler.

# Table 1

GE HOUSATONIC RIVER PROJECT - DRAFT CONFIDENTIAL

## RD Instruments ADCP Data Collection - Housatonic River, MA

**Field Crew**

**Data Collection and Test Programs**

Program: ______________________________
Version: ______________________________
ADCP Serial # __________________________
BBTEST File:

**Data Transfer Documentation**

| | | Initials | Date | Time |
|---|---|---|---|---|
| ADCP files | Transferred from: | | | |
| | Transferred to: | | | |

Misc. Notes:

| **Field Data** | | | **ADCP Data** | | | | **Data Collection Documentation** | | |
|---|---|---|---|---|---|---|---|---|---|
| Transect No. | Gauge Reading | Description / Comments | Configuration File | File Number (raw, proc, nav) | Data Directory | Water Mode | Date | Time | Initials (collector) |
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# STANDARD OPERATING PROCEDURE SW-2

# PCB CONGENER SAMPLING IN SURFACE WATER

# STANDARD OPERATING PROCEDURE SW-2

# PCB CONGENER SAMPLING IN SURFACE WATER

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) covers the collection of adequate volumes of surface water and subsequent filtration for analysis of PCB congeners. Large volumes of water are needed to provide data to meet the detection limits necessary for the hydrodynamic and surface water modeling effort. This SOP is applicable to monthly grab samples for PCB congeners. It does not apply to the normal surface water collection or to stormflow activities. This SOP is based on the methods used for collection and filtration of water samples for the Hudson River (99-0174, 99-0148).

## 2. EQUIPMENT

6-inch glass fiber filter, grade GF/F (0.7 μ)

4-liter amber glass bottles

Alconox (or equivalent)

Ultra high purity nitrogen

Aluminum foil

In-line carbon filter

Deionized water

Pesticide-grade hexane

Pesticide-grade acetone

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-6 | Field Sample Numbering |
| G-10 | Sample Documentation |

G-11 Sample Packing and Shipping

# 4. PROCEDURE

This method covers the collection of approximately 10 to 12 liters of surface water for PCB congener analysis. The procedure involves the filling of 4-liter bottles with surface water at each sampling location. Samples are immediately returned to the staging area for filtration. Filtration consists of filtering 1.5-liter aliquots of water through a 6-inch 0.7 micron (µm) pre-fired glass fiber filter until 10 to 12 liters of water are filtered.

## 4.1 WATER SAMPLING

1. At each sampling location, fill three 4-liter amber glass bottles. Each bottle should be filled by immersing the bottle to the approximate mid-depth point of the stream, avoiding any surface debris when immersing and withdrawing the bottle.

2. Two 1-liter amber bottles will also be filled at the same time as the 4-liter bottles for total PCB congener analysis at each location.

3. All bottles will be labeled in accordance with SOP G-6.

4. All bottles are returned to the staging area within 1 to 2 hours for filtration.

## 4.2 SAMPLE FILTRATION

1. The 6-inch, 1.5-liter stainless steel filtration apparatus is decontaminated according to the procedure described in Subsection 4.3 and assembled. A clean, pre-fired, pre-weighed 6-inch glass fiber filter, grade GF/F (0.7 µm) or equivalent is placed in the housing. (Each filter is weighed and pre-fired by the laboratory at 450 °C overnight, and then placed in a clean petri dish labeled with the filter weight in grams.) The three bolts are tightened to secure the housing.

2. The filtration apparatus is filled with approximately 1.5 liters of water, sealed, and pressure applied to the system using ultra high purity nitrogen. An in-line carbon filter will be used between the nitrogen source and the filtration apparatus.

3. The filtrate from the first bottle is collected in a clean labeled 4-liter bottle. The empty first bottle is rinsed with 100 to 200 mL of the filtrate to remove any suspended solids, and the rinsate is refiltered. This is repeated with a second 100 to 200 mL aliquot of filtrate. Additional rinse steps will be repeated as necessary until no suspended material is visible in the bottle.

4. The now empty first bottle is used to collect the filtrate from the second bottle. The process is repeated with the third bottle.
5. If the first filter becomes clogged, a second filter will be used and combined with the first filter as the particulate sample.
6. The filter weight (prior to sample filtration), volume sampled, sample number, site location, and date will be recorded.

### 4.3 DECONTAMINATION PROCEDURES

The following procedure will be used to decontaminate the filtration apparatus prior to each use:

1. Wash with tap water and laboratory soap, followed by extensive tap water rinse.
2. Wash with deionized (DI) water.
3. Rinse twice with acetone (pesticide grade).
4. Rinse twice with hexane (pesticide grade).
5. Rinse twice with acetone (pesticide grade).
6. Stand inverted for 20 minutes to permit acetone to drain.
7. Rinse with DI water.
8. If apparatus is not used immediately, cover with aluminum foil previously rinsed with hexane.

## 5. SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

1. The last empty sample bottle will be rinsed with 15 mL of pesticide-grade hexane, and the hexane will be transferred to the third filtrate bottle.
2. The first two filtrate bottles will be charged with 15 mL of pesticide-grade hexane.
3. Each bottle will be custody sealed, packed according to SOPs G-10 and G-11, and shipped to the laboratory for analysis.

4. The filter(s) will be placed into the original petri dish, which will be sealed with tape. The petri dish will be sealed in a plastic bag and shipped to the laboratory for analysis as the particulate fraction.

## 6. INTERFERENCES AND POTENTIAL PROBLEMS

Due to the low detection limits, contamination of the samples by dust, dirt, and other contaminants must be avoided. Decontamination must be thorough using care to ensure all filtration surfaces are cleaned. The location where filtration occurs must be in a controlled clean space. Access to the controlled clean space will be limited to laboratory personnel performing the filtration.

## 7. REFERENCES

| | |
|---|---|
| 99-0148 | TAMS Consultants, Inc. and Gradient Corporation. 1993. *Phase 2B, Sampling and Analysis Plan/Quality Assurance Project Plan, Volume 1: Flow-Averaged Water-Column Sampling, Hudson River PCB Reassessment RI/FS*. Prepared for Region II Alternate Remedial Contracting Strategy (ARCS) for Hazardous Waste Remedial Services. |
| 99-0174 | TAMS Consultants, Inc. and Gradient Corporation. 1992. *Phase 2A, Sampling and Analysis Plan/Quality Assurance Project Plan, Hudson River PCB Reassessment RI/FS*. Prepared for EPA Region II Alternative Remedial Contracting Strategy (ARCS) for Remedial Waste Remedial Services. |

# STANDARD OPERATING PROCEDURE SW-3

# STORMFLOW SAMPLING

# STANDARD OPERATING PROCEDURE SW-3

# STORMFLOW SAMPLING

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) details the collection of water quality samples from the Housatonic River and selected tributaries under conditions where water quality and suspended sediment transport in the river are influenced by storm-induced flows. This will be termed “stormflow sampling” to distinguish it from stormwater sampling because samples will be collected from the river channel, not from stormwater drainage pipes or other conveyances. The term “high flow” sampling is not used because significant movement of suspended sediments and changes in water quality can occur under storm-induced flow conditions that are not necessarily “high flow” conditions.

The objective of the stormflow sampling effort is to provide data on the suspended solids and water quality to support the calibration of a hydrodynamic and water quality model. The data will be used to assist in the determination of resuspension and redistribution of PCB-laden sediment within the study area and to determine the effects of storms on the water quality and hydrodynamics of the Housatonic River. Suspended sediment samples will reflect the suspended sediment concentrations in the water column and not the bed load.

## 2. EQUIPMENT

Model USDH-75Q depth-integrated sampler

1-quart glass sample bottle

ISCO automated sampler (optional)

Turbidity meter*

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* YSI 6280 Multiparameter probe (for Turb., pH, temp, DO, Conductivity)

pH meter*

Thermometer*

DO meter*

Bag filter system (see Subsection 4.6)

Marsh-McBirney Model 201D current meter

Stakes and flagging

# 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| G-6 | Field Sample Numbering |
| G-10 | Sample Documentation |
| SS-4 | Sediment Sampling |
| SW-4 | Surface Water Sampling |

# 4. PROCEDURE

## 4.1 LOCATIONS

Stormflow sampling will be performed at three primary locations and five secondary locations.

The three primary sampling locations are:

1. Pomeroy Avenue Bridge.
2. New Lenox Road Bridge (at Decker Canoe Launch).
3. Woods Pond Dam (at the footbridge upstream of the dam).

The secondary stormflow sampling locations are:

1. Hubbard Avenue Bridge (Coltsville).
2. Unkamet Brook.
3. West Branch of the Housatonic River.

4. Sackett Brook.
5. Roaring Brook.

Water samples and suspended sediment samples will be collected from the three primary stormflow sampling locations during storm events. In addition, water samples will be collected from the five secondary stormflow sampling locations.

Activities that will be performed during each stormflow sampling event include: water quality monitoring at the primary and secondary sampling locations in the river channels, collection of depth-integrated water quality samples at primary locations, high-volume suspended sediment collection at primary locations, and measurement of stream velocity and depth. The procedures to be used for these activities are described below.

## 4.2 PARAMETERS

The following parameters will be analyzed in the water quality samples collected from the primary and secondary stormflow sampling locations.

### 4.2.1 Water Samples

**Primary Locations**

1. Ammonia-nitrogen
2. Nitrite-nitrogen
3. Nitrate-nitrogen
4. Total Kjeldahl nitrogen (TKN)
5. Organic-phosphorus
6. Ortho-phosphorus
7. Total phosphorus
8. Chlorophyll-a
9. Biochemical oxygen demand (5-day) (BOD)
10. Chemical oxygen demand (COD)
11. Total organic carbon (TOC)
12. Dissolved organic carbon (DOC)
13. Particulate organic carbon (POC)
14. Total suspended solids (TSS)
15. Total polychlorinated biphenyls (PCBs) (total, aroclor, and congeners)
16. Dissolved PCBs (total, aroclor, and congeners)
17. Alkalinity
18. Hardness

19. Turbidity (field measurement)
20. Temperature (field measurement)
21. pH (field measurement)
22. Dissolved oxygen (DO) (field measurement)
23. Specific conductivity (field measurement)

**Secondary Locations**

1. Ammonia-nitrogen
2. Nitrite-nitrogen
3. Nitrate-nitrogen
4. TKN
5. Organic-phosphorus
6. Ortho-phosphorus
7. Total phosphorus
8. Chlorophyll-a
9. BOD
10. TOC
11. DOC
12. POC
13. TSS
14. Total PCBs (Unkamet Brook only)
15. Turbidity (field measurement)
16. Temperature (field measurement)
17. pH (field measurement)
18. DO (field measurement)
19. Specific conductivity (field measurement)

### 4.2.2 Suspended Sediment Samples

Suspended sediment samples from the three primary stormflow sampling locations will be analyzed for the following parameters:

1. Grain Size fractions for the following four size categories
    - >5 - 10 µm
    - >10 - 62 µm
    - >62 - 250 µm
    - >250 µm

2. Total PCBs for each size fraction listed above except the >250 µm fraction (the >250 µm fraction may also be analyzed for PCBs after a preliminary data evaluation).

3. Total Organic Carbon (for each size fraction listed above).

Suspended sediment samples from the five secondary stormflow sampling locations will be analyzed for grain size fractions using laser analysis techniques. The results of these analyses will provide grain size fraction data similar to that obtained for the primary stormflow sampling locations.

### 4.2.3 Methods

Analytical methods, required containers, preservation techniques, and holding times for the previously mentioned parameters are contained in the Quality Assurance Project Plan (QAPP) (WESTON, 00-0507). The procedures for stream sampling and stream velocity measurements (SOPs SW-4) will be used, with the exception that manual verification samples will be collected with a depth-integrated sampler, model USDH-75Q, as described in Subsection 4.5, and velocity measurements will be taken at three representative location at each monitoring station. These techniques will follow the general guidance recommended in Buchanan and Somers, 1969 (99-0198).

## 4.3 NUMBER OF EVENTS

Sampling will be performed over at least three representative storm events. An event is defined as a minimum of 1.0 inch of rainfall; events must be separated by 48 to 72 hours from the conclusion of the previous storm event. It is estimated that it may require 2 or 2.5 times this number of storm events (i.e., six to eight events) to achieve the three representative events because some of the storms may not meet the criteria (personal communication, W. Tate, September 1998 [00-0331]).

For sudden storms capable of generating substantial amounts of rain in short time periods, the full sampling protocol outlined in this SOP may not be implemented. A reduced data collection program may be followed and may include staff gauge measurements and TSS sample collection at selected stormflow sampling locations.

## 4.4 TIMING AND DURATION OF SAMPLING/MONITORING

Storm flow sampling/monitoring will be conducted during a range of significant rainfall events starting at a minimum of ½ inch of rainfall over a 24 -hour period. Sampling will commence within 30 minutes to 1 hour of the start of the rainfall event. Based upon a review of the hydrographs generated by rainstorms meeting the event criteria, monitoring may continue for 36 to 72 hours. Sampling will continue through the rising limb of the hydrograph, and will include at least one sample near the peak of the hydrograph and one or more samples collected during the descending limb of the hydrograph.

## 4.5 WATER QUALITY SAMPLE COLLECTION METHODS

At all stormflow sampling locations, discrete samples will be collected every hour (wherever possible) throughout the stormflow sampling event from a fixed location in the river channel (mid-channel) for water quality analyses. At primary sampling locations, verification samples will be collected with a depth-integrated sampler model USDH-75Q at the same collection time. Based upon post-sampling evaluation of the stormflow hydrographs, five samples from each location, which are determined to best represent the conditions over the hydrograph, will be selected for analysis. Typically, two samples on the rising limb of the hydrograph, one sample at the peak of the hydrograph, and two samples on the descending limb of the hydrograph will be analyzed. Triple sample volumes will be collected for samples designated for matrix QC analyses. The five samples selected for analysis will be analyzed separately and will not be composited. To collect sufficient volume for all analyses, a minimum of 12 liters (L) of water will be collected for each sample interval. PCB congener analyses will be performed on the samples representing the peak of the hydrograph and on other selected samples. Additionally, all hourly TSS samples will be analyzed.

At primary sampling locations, samples will be collected manually from a sample tap located at the pumping system described in Subsection 2.6. At secondary locations, samples will be collected manually using an ISCO sampler.

The sampling locations will be approximately 50 to 100 ft upstream or downstream of each bridge location to avoid any backwater effect (i.e., sediment deposition that may occur due to the bridge). The Woods Pond location will be sampled at the footbridge.

At the three primary sample locations, manual depth-integrated samples will be collected during the storm for comparison with the samples collected from a fixed depth. The manual samples will be collected at all three locations due to the differing characteristics of the river at each location. The manual samples will be collected with a depth-integrated sampler model USDH-75Q. The model USDH-75Q sampler samples water isokinetically (i.e., at the same velocity as the stream); therefore, the sample volumes are proportional to the velocity throughout the depth profile. The sample procedure involves connecting a 1-quart sample bottle to the device. The device is lowered from the water surface at a constant/steady rate to the bottom, then brought to the surface at the same rate. The verification samples will be taken from stream locations and times closely corresponding to samples collected at the fixed depth. The results from the first round (i.e., first storm) of fixed depth samples collected from a sample tap on the pumping apparatus will be compared with the verification samples collected with the depth integrated samplers. Further manual sampling with the USDH-75Q device may not be required if a good correlation exists between the fixed withdrawal point data ($0.6\ Z_{max}$) and the depth integrated data.

The water depth at stream gages will be monitored and recorded at each location approximately every 60 minutes. Representative velocity measurements also will be taken approximately every 60 minutes. The progress of the hydrograph will be monitored through the stream gage (water depth) observations. Flow measurements will be based upon the stage-discharge curve (rating curve) developed for each stream gage wherever possible. Turbidity, pH, temperature, specific conductivity, and dissolved oxygen measurements will be taken every hour at each location. In addition, the time, gage height, and velocity measurement will be recorded when the river exceeds its banks (i.e., when bank-full stage is exceeded).

## 4.6 SUSPENDED SEDIMENT SAMPLE COLLECTION METHODS

At the three primary stormflow sampling locations, a sufficient quantity of suspended sediments will be collected to allow classification (fractionation) of the sediments by grain size. The separated grain size fractions will be analyzed for PCBs and TOC. Bulk suspended sediment samples will be collected by filtering a known volume of water through a bag filter system. Bulk sediment samples will be collected continuously for the duration of the sampling event. The bag filter will be changed when the differential pressure across the filter bag exceeds 30 pounds per square inch (psi), indicating blinding of the filter bag. The suspended sediments collected in each individual bag filter will be combined to form a composite sample for analysis. A schematic process flow diagram of the bag filter system is shown in Figure 1. The following paragraph summarizes the principal components and operation of the bag filter system. Specific components and the piping configuration may change based on field conditions.

Water will be pumped from the river through a 1.5-inch diameter influent line attached to a centrifugal pump. The influent line will be mounted in the river at a horizontal location representative of the river flow at the sampling transect, at 6/10 of the maximum river depth (0.6 $Z_{max}$) at the sample location. The centrifugal pump will pump river water through a bag filter and flow meter. The bag filter will have a nominal size rating of 5 microns (µm). The bag filter sizes can be adjusted to 10, 25, 75, or 100 µm sizes, if necessary. The pump will be driven by a 2-hp 115V, single-phase motor that will be powered by a gasoline-powered electric generator. Pump operation will initially be controlled manually; however, provision for other control strategies, such as continuous operation, manual intermittent operation, timer operation, and/or level or turbidity control could be applied. A high-pressure switch will be installed to shut down the pump if excessive pressure occurs due to blinding or overfilling of the filter bags. A totalizing flowmeter will be installed on the effluent side of the bag filter to record flow through the bag filter. Flow control valves and shutoff valves will be installed to allow flow control and flow balancing. Discharge from the flow control shall be downstream from the withdrawal location. Effluent from the bag filter system will be discharged to the river. This configuration will allow for long-term continuous sampling or discrete, storm event-driven sampling.

ISCO automated samplers will be used to collect samples from the water column at the five secondary stormflow sampling locations for laser analysis of particle size. These samples will be collected in 5-gallon carboys every 2 to 4 hours during the course of a storm event.

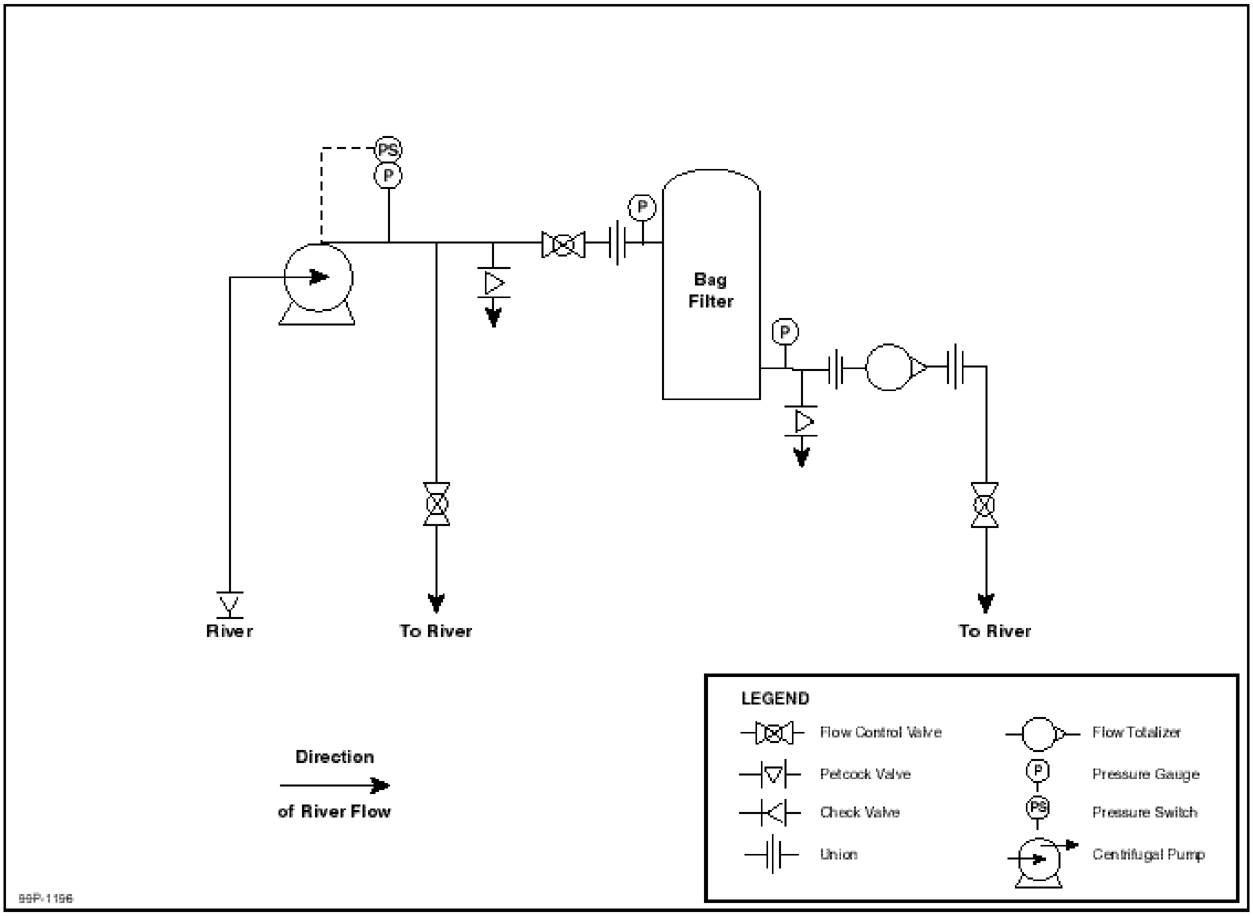

Figure 1 Sediment Collection System Schematic Process Flow Diagram

Based upon post-sampling evaluation of the stormflow hydrographs, three samples from each secondary location will be selected for analysis. The selected samples will be allowed to settle, the supernatant will be decanted, and the concentrated TSS will be submitted to an off-site laboratory for laser analysis of particle size.

## 4.7 VELOCITY MEASUREMENTS

Velocity measurements will be taken at seven sampling locations. Velocity measurements will not be taken at Hubbard Avenue because a USGS station (Coltsville, MA) is located at this sampling location. Velocity measurements, along with staff gage measurements, will be used to track the progress of the hydrograph. A representative location for velocity measurements will be chosen near and downstream from the water sample withdrawal tube in the river wherever possible. The velocity measurement location should be approximately the same distance from the river bank as the water sample withdrawal point and 10 to 20 ft downstream from the water sample withdrawal point. Due to safety requirements that prohibit personnel from entering the river, velocity measurements will be taken from bridges. Once selected, the velocity measurement location should be marked to ensure consistency and comparability between the measurements.

Velocity measurements will be made using a Marsh-McBirney Model 201D portable electronic current meter fixed to a hand-held vertical rod or a weight. The meter uses an electromagnetic sensor to measure the velocity in a conductive fluid such as water using Faraday's law of electromagnetic induction to measure fluid flow. As a conducting fluid, such as impure water, moves through a magnetic field produced by the meter, a voltage will be induced (Gordon et al., 1992 [99-0199]).

The total depth of water is measured. The position of the current meter is adjusted to the appropriate fraction of the total depth. The velocity measurement is recorded after waiting approximately 20 seconds from the start of the measurement in order to obtain a time average of the reading. When the total water depth at the velocity measurement location is 2.5 ft or less, the velocity measurement will be taken at 6/10 of the maximum depth (0.6 $Z_{max}$). When the depth is greater than 2.5 ft, velocity measurements will be taken at 2/10 maximum depth (0.2 $Z_{max}$) and 8/10 maximum depth (0.8 $Z_{max}$). The depth-averaged velocity will be taken as either the velocity at 0.6 $Z_{max}$ or the average of the velocities measured at 0.2 $Z_{max}$ and 0.8 $Z_{max}$. Velocity measurements will be taken at three locations across the river (left-channel, mid-channel, and right-channel). The velocity and stage data will be logged on a flow log sheet (Figure 2).

This flow log will document the following general information:

1. Flow monitoring location.
2. Date.
3. Time.
4. Stage elevation from staff gage.
5. Velocity at depth monitored.

## 5. REFERENCES

00-0331 Tate, William. U.S. EPA. Personal Communication. 2 September 1998.

00-0507 WESTON (Roy F. Weston, Inc.). March 2001. *Quality Assurance Project Plan.* Environmental Remediation Contract, GE/Housatonic River Project. Volumes I, II, IIA, and IV. DCN GE-021601-AAHM.

99-0198 Buchanan, T.J. and W.P. Somers. 1969. “Discharge Measurement at Gaging Stations.” Washington, DC: U.S. Geological Survey *Techniques of Water-Resource Investigations,* Book 3, Chapter A8.

99-0199 Gordon, N.D., T.A. McMahon, and B.L. Finlayson. 1992. *Stream Hydrology*. John Wiley & Sons. New York, NY.

# Figure 2 Housatonic River Storm Event Sampling
# Field Parameter Data Sheet

LOCATION: ______________________________
DATE: ______________________________

| TIME | pH (std units) | SPECIFIC COND. (µs/cm) | DO (mg/L) | TEMP (C) | TURBIDITY (NTU) | STAFF GAUGE HEIGHT (ft) | VELOCITY (ft/s) |
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# STANDARD OPERATING PROCEDURE SW-4

# SURFACE WATER SAMPLING

# STANDARD OPERATING PROCEDURE SW-4

# SURFACE WATER SAMPLING

## 1. SCOPE AND APPLICATION

Standard Operating Procedures (SOPs) presented in this section are for collecting representative surface water samples from surface water bodies. Surface water bodies can be classified into two primary types: flowing and standing. Flowing bodies include industrial effluent, municipal wastewater, rivers, sewers, leachate seeps, streams, or any other lotic water body. Standing bodies include lagoons, ponds, nonaqueous (e.g., surface) impoundments, lakes, or any other lentic water body. Surface water samples can be collected from various depths of the water bodies using one of the two techniques described in this appendix. Specific sampling techniques have been developed for PCB congener sampling of surface water (see SOP SW-2).

Due to the nature of the media, locations for surface water samples are restricted to locations within the water body under evaluation; however, variations of location within the water body may include depth, horizontal location, and time.

## 2. EQUIPMENT

### 2.1 HEALTH AND SAFETY ITEMS

Gloves

Duct tape

Rain gear

Waders and/or items for boating safety

Field first aid kit

Eye wash

FID/PID

## 2.2 DECONTAMINATION ITEMS

Visqueen

Rinse bottles

Trash bags

Paper towels

Deionized water

Methanol

Hexane

Carboy for potable water

Dilute nitric acid

Decontamination tubs

Alconox

HPLC-grade water for field blanks

Funnel

## 2.3 PAPER WORK

Health and Safety Plan

Field logbook and black ball point pens

Work plan

Site map

Chain-of-custody forms

Bottle labels, custody seals, airbills

## 2.4 MEASURING EQUIPMENT

Folding rule with tenths of inches marked

100-foot fiberglass tape measure

Thermometer

pH meter/paper

Specific conductance meter

## 2.5 SAMPLING EQUIPMENT

Grab sample glass or stainless steel container, on pole

Filtration apparatus (if required)

Sampling equipment for larger bodies of water

Preservation reagents and ice

## 2.6 SHIPPING SUPPLIES

Sample containers, including bottles for QC samples

Airbills such as Federal Express

Mailing labels

Bottle labels

Chain-of-custody tape

“THIS END UP” stickers

“Arrow Up” stickers

Resealable plastic bags (1 quart + 1 gallon size)

Packing tape

Vermiculite

Coolers

## 2.7 MISCELLANEOUS

Sharpies

Camera and film

Stakes

Flagging

Caution tape

Identification tags for staked locations

Mean Streak or other paint markers

Drum liners

Bung wrench/crescent wrench

# 3. RELATED PROCEDURES

| | |
|---|---|
| G-2 | Decontamination |
| G-3 | Field Documentation |
| G-4 | Field Filtration |
| G-6 | Field Sample Numbering |
| G-9 | Quality Assurance/Quality Control Sampling |
| G-10 | Sample Documentation |
| G-11 | Sample Packing and Shipping |

# 4. PROCEDURE

## 4.1 SAMPLE TYPES

The type of sample should be designated when selecting a sampling method. Surface water samples may be discrete or composite samples. A discrete (grab) sample is defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected at one particular point in the sample matrix. The representativeness of such samples is defined by the nature of the materials being sampled. In general, as sources vary over time and distance, the representativeness of grab samples will decrease. Composites are samples composed of two or more specific aliquots (discrete samples) collected at various sampling locations and/or different points in time. Analysis of this type of sample produces an average value and can, in certain instances, be used as an alternative to analyzing a number of individual grab samples and calculating an average value. It should be noted, however, that compositing can mask the presence of contaminants by diluting isolated concentrations of analytes that may be present in the environmental matrix.

## 4.2 SAMPLE COLLECTION

Sampling instructions for the techniques for collecting surface water samples are presented in this section. Prior to sample collection, water body characteristics (size, depth, flow) should be recorded in the field logbook. Sampling should proceed from downstream locations to upstream locations so that disturbance related to sampling does not affect sampling quality. When wading in a stream, always collect the samples on the upstream side. In addition, if sediment samples are to be collected at the same locations as water samples, the water samples must be collected first. If the project requirements make it necessary to distinguish the concentration of metals in solution from the concentration of metals associated with solids, filtration of the surface water will be required. Filtration techniques are discussed in SOP G-4.

The factors that will contribute to the selection of a sampler include the width, depth, and flow of the location being sampled, and whether the sample will be collected from the shore or a vessel. Samplers may encounter situations where rate of flow affects their ability to collect a sample. For fast-flowing rivers and streams, it may be nearly impossible to collect a mid-channel sample at a specific point. Low-flowing streams and seeps present the opposite problem. In these cases, the sampler should attempt to find a location where flow is obstructed and a pool is created. If this is not possible, the only way to obtain a sample may be to dig into the sediment with a decontaminated trowel to create a pooled area where the liquid will accumulate; however, this method is not recommended because the sample will probably be highly turbid. If the banks are not sloped, sampling personnel may be able to collect the liquid directly into the sample bottle from the edge of the water body. In some instances where the liquid to be sampled cannot be reached, a pond sampler, by virtue of its extension capabilities, may be necessary. In these cases, the pond sampler should be assembled to ensure that sampling personnel are not in danger of falling into the water body being sampled. For a stream, channel, or river, the sample should be collected at mid-depth. For standing liquid, the sample should be collected just below the surface or at mid-depth. Specific sampling strategies may be altered depending on the contaminants of concern. For instance, when sampling for hydrocarbons or other light nonaqueous phase liquids, it may be better to sample at the surface.

Once the sample is obtained, it should be transferred directly into the sample bottle. The sampling device should be decontaminated before the next sample is taken. Proper use of the sampling device chosen includes slow lowering and retrieval of the sample, immediate transfer of the liquid into the sampling container, and notation in the logbook of the depth at which the sample was collected.

## 4.3 SAMPLERS

Each sampling technique presents various advantages and disadvantages for its application. For example, desired depth, tidal influences, sample disturbance, sample volume, chemical/physical reactivity between potential contaminants and sampling tool materials, and ease of decontamination vary from technique to technique. Samplers to be used include:

- Hand held bottle.
- Dippers and pond samplers.

### 4.3.1 Hand-Held Bottle

Filling the sample containers directly is advantageous when the sample might be significantly altered during transfer from a collection vessel into another container.

Samples from shallow depths can be readily collected by merely submerging the sample containers.

The direct collection of surface water samples using pre-preserved sample containers could result in the over-dilution of the preservative. To prevent this from occurring, the direct collection of the sample will be done using an unpreserved single-use, laboratory-cleaned container. The collected sample aliquot will immediately be transferred to the pre-preserved container.

#### *4.3.1.1 Sampling Procedure*

- Spread new plastic sheeting on the ground at each sampling location to keep sampling equipment decontaminated and to prevent cross-contamination.

- Submerge the sample container with minimal surface disturbance so that the open end is pointing upstream.

- Allow the device to fill slowly and continuously.

- Retrieve the sample container from the surface water with minimal disturbance.

- Verify that a PTFE liner is present in the cap. Secure the cap tightly.

- Label the sample bottle with an appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.

- Preserve the sample as necessary, and verify that the pH is sufficient for the criteria.

- Place filled sample containers on ice immediately, along with the required trip blank, if analyzing for VOCs.

- Record the information in the field logbook, and complete the chain-of-custody form and field sheets.

### 4.3.2 Extendable Bottle Sampler

With the extended bottle sampler, samples can be obtained at distances as far as 10 ft from the edge of the source, preventing the sampler from having to physically contact the source. The tubular handle may bow when sampling very viscous liquids if sampling is not done slowly.

The extended bottle sampler consists of an adjustable clamp attached to the end of a 2- or 3-piece telescoping aluminum or fiberglass pole that serves as the handle. The clamp is used to secure the sample bottle.

#### *4.3.2.1 Sampling Procedure*

- Spread new plastic sheeting on the ground at each sampling location to keep sampling equipment decontaminated and to prevent cross-contamination.

- Assemble the extended bottle sampler. If appropriate, make sure that the sample container and the bolts and nuts that secure the clamp to the pole are tightened properly.

- Slowly submerge the extended bottle sampler with minimal surface disturbance. Make sure that the open end is pointed down.

- Submerge the bottle to the target depth, and rotate the pole 180 degrees; allow the bottle to fill.

- Retrieve the extended bottle sampler from the surface water with minimal disturbance.
- Check that a PTFE liner is present in the cap. Secure the cap tightly.
- Remove the sample bottle from the clamp. Dry the bottle with a paper towel.
- Label the sample bottle with an appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.
- Preserve the sample as necessary, and verify that the pH is sufficient for the criteria.
- Place filled sample containers on ice immediately, along with the required trip blank, if analyzing for VOCs.
- Record the information in the field logbook, and complete the chain-of-custody documents and field sheets.
- Properly clean and decontaminate the equipment prior to reuse or storage.

### *4.3.2.2 Sample Containers and Preservation Techniques*

#### Sample Containers

Refer to QAPP Section 6 to determine the required size and type of sample containers. Samples should be collected and containerized in the order of the volatilization sensitivity of the parameters. A preferred collection order for some common parameters follows:

1. Volatile organics (VOA).
2. Total organic carbon (TOC).
3. Extractable organics (BNAs or SVOCs).
4. Total metals.
5. Dissolved metals.
6. Cyanide.
7. Sulfate and chloride.
8. Turbidity.
9. Nitrate and ammonia.

#### Sample Preservation

Methods of sample preservation are relatively limited, and are generally intended to retard biological action and hydrolysis, and to reduce sorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and protection from light. The sampler should refer to QAPP Section 6 (WESTON, 00-0507) or the specific preservation method in SW-846 for the appropriate preservation technique.

### *4.3.2.3 Field Quality Control Sampling Procedures*

Field control samples are collected by the sampling team to determine whether the data are of suitable quality. They include blanks, duplicates, and/or background (upgradient) samples. A detailed discussion of field control samples is contained in SOP G-9.

### *4.3.2.4 Decontamination Procedures*

All equipment that will enter the water must be decontaminated prior to its entry. Sampling equipment should be decontaminated, as described in SOP G-2. The sampling equipment should be placed in plastic bags until immediately prior to use. Additional sampling devices may be needed on-site to ensure an adequate drying time.

### *4.3.2.5 Documentation*

Bound field logbooks should be used for the maintenance of field records. All aspects of sample collection and handling, as well as visual observations, shall be documented in the field logbooks as outlined in SOP G-3.

All entries in field logbooks should be legibly recorded, and contain accurate and inclusive documentation of an individual's project activities.

## 5. REFERENCES

00-0507 WESTON (Roy F. Weston, Inc.). March 2001. *Quality Assurance Project Plan.* Environmental Remediation Contract, GE/Housatonic River Project. Volumes I, II, IIA, and IV. DCN GE-021601-AAHM.

# STANDARD OPERATING PROCEDURE SW-5

# REMEDIATION MONITORING SAMPLE COLLECTION AND SAMPLE PROCESSING

# STANDARD OPERATING PROCEDURE SW-5

# REMEDIATION MONITORING
# SAMPLE COLLECTION AND SAMPLE PROCESSING

## 1. SCOPE AND APPLICATION

### 1.1 OBJECTIVE

The remediation monitoring program will measure the input of PCBs in surface water into the Housatonic River Primary Study Area (PSA) due to removal actions being conducted in the East Branch above the confluence. The PSA, which begins at the confluence of the East and West Branches, is also described as Rest of River.

A baseline study of the surface water PCB concentrations during non-stormwater conditions was conducted monthly at 17 stations along the Housatonic River in the PSA from August 1998 to September 1999 during a period when no removal actions were occurring. The PCB concentrations in the surface waters during the remediation program will be evaluated relative to the baseline results to determine possible impacts.

### 1.2 LOCATIONS

Samples will be collected at locations along the Housatonic River that meet specific task objectives. In general, locations will be selected upstream and downstream of the Housatonic River reaches or subreaches that are to be evaluated for PCB monitoring.

At each location selected for monitoring, the Housatonic River elevation cross-section must be determined, a semi-permanent staff gage installed, and a velocity-flow rating curve developed. Some of these requirements are already established at bridge locations used in previous studies.

## 2. EQUIPMENT

ISCO sample pump

Sample containers, glass - 12 gal.

4-liter amber glass bottles

Tubing, Sample Collection - Teflon, 3/8" ID

Tubing, Transfer - Teflon 1/4" ID

Tubing, Discharge - Teflon 1/2" ID

Battery for pumps

12" magnetic stirrers

Magnetic stir rods - large

Glass pick-up tubes - 3/8" ID x 2' length

Rod clamps

Hose clamps - various sizes

Pressure filtration unit

High-pressure tubing - 1/2"

Tube fittings - various

Molecular nitrogen gas cylinder

Gas cylinder regulator

Peristaltic pump

Graduated cylinder

Glass funnel

Forceps

Filters - 0.7-micron paper/fiber, 6-inch glass fiber filter, grade GF/F (0.7 µ)

Plastic sheeting

Alconox (or equivalent)

Ultra high purity nitrogen

Aluminum foil

In-line carbon filter

De-ionized water

Pesticide-grade hexane

Pesticide-grade acetone

# 3. RELATED PROCEDURES

| | |
|---|---|
| G-2 | Decontamination |
| G-6 | Field Sample Numbering |
| G-10 | Sample Documentation |
| G-11 | Sample Packing and Shipping |
| SW-2 | PCB Congener Sampling in Surface Water |

# 4. PROCEDURE

## 4.1 ANALYTES

Analytical procedures will follow the protocols and specifications defined in the Final Quality Assurance Project Plan (QAPP) (WESTON, 00-0507) and the related Volumes II and IIA for the Laboratory Standard Operating Procedures. The analytical methods noted below are included in more detail in these references.

- PCBs/Aroclors – Particulate (analyze directly, not as total PCBs minus dissolved PCBs) on one filter. EPA Method SW8082.
- PCBs/Aroclors – Dissolved (analyze the filtrate from the filtration used to separate the particulates). EPA Method SW8082.

- Total Suspended Solids (TSS) – Analyze the aliquot from the composite sample during mixing. EPA Method 160.2.

## 4.2 SAMPLING EVENTS

- Monthly sampling events using 24-hour composite samples.
- Additional sampling events (using 24-hour composite samples) conducted to extend the monthly sampling program and/or to assess unique conditions during the year (e.g., high flow samples, particularly active remediation tasks).

## 4.3 SAMPLING APPROACH

- The monthly sampling events should be conducted during river conditions not under the influence of storms. The Coltsville hydrograph should be reviewed prior to all sampling to ensure the river flows have been relatively constant for a period of at least 48 hours prior to the planned event. In addition, the weather forecast should be checked to judge whether storms are forecast for the sampling period.
- At each station per sampling event: Pump 1 aliquot of water per hour from the water column for 24 hours into a minimum 8-gallon glass container. Use the ISCO controller to collect approximately 1.25 L aliquots using the fastest possible pump speed. This will yield approximately 30 L in the collection container. Program the ISCO to reverse the pump and allow air to flush the water out of the intake tubing after each sample aliquot.
- Use Teflon-lined tubing for the sample intake tubing. Minimize the lengths of silicon-based tubing used for the peristaltic pump head.
- Position the intake of the collection tubing in the water column at each station at a depth equivalent to 0.6 of the total water depth from the surface at the time of the sampling. Do not allow the tubing to pick up sediment from the river bed during deployment or the actual sampling. Orient the intake opening of the collection tubing downstream.
- Use ice in the ISCO housing to cool the sample collection container during the 24-hour sampling period. Maintain the cold sample temperature with ice during transport to the field office.
- Note 1: Consistent sample aliquot size is more important than the absolute volume collected for each composite.
- Note 2: During the initial sampling setup, determine the velocity of the water in the tubing (from tables or by calculation). The sampling velocity should exceed the velocity (preferably by 150%) of the velocity in the Housatonic River. An ISCO model 37xx sampler can provide a nominal flow rate of 3.6 feet per second (= 3.25

liters per minute with 3/8” ID tubing) that should be adequate for river velocities of at least 2.4 fps.

- Note 3: Utilize PCB decontamination protocols for any equipment and tubing used in the sample collection. After normal solvent cleaning protocols (check the chemical compatibility for the materials), finish the cleaning process by flushing the tubing and rinsing all collection containers with appropriate deionized or distilled water. Store all equipment cleaned at the end of each sampling period in double plastic bags. These procedures follow the General SOP G-2 – Decontamination.

## 4.4 OTHER DATA COLLECTION

- Download the Coltsville record from the USGS web site for flows and velocities for 1 week prior to and during the 24-hour sampling event.

- Measure the staff gage readings (and convert to elevation) at each of the sampling stations during the beginning and end of each sampling event. If available for the station at the time of the draft report, use the rating curves for the location to determine the flows.

## 4.5 SAMPLE PROCESSING

1. The processing of each sample should be initiated within 4 hours of sample collection.

2. While mixing the sample thoroughly with a large Teflon stir bar (or a mixer shaft-motor unit), use a peristaltic pump to fill a 1-liter bottle for TSS analysis. The mixing activity must be adequate to suspend all particulates.

3. Add approximately a 1-liter aliquot from the mixed collection container (using the same peristaltic pump used for the TSS aliquot) to the pressure chamber of the stainless steel (SS) 150-mm filtration unit. Minimize air bubbles on the filter by minimizing turbulence in the pressure chamber and by lightly striking the filtration unit on the side with a piece of wood.

4. The filtration unit will utilize a 150-mm nominal diameter Whatman GF/F glass fiber filter (nominal filter pore size of 0.7 microns) or equivalent that was oven “cleaned” at 450 $^{o}$C for one hour and supplied in petri dishes from the analytical laboratory. The laboratory should run at least one blank on each batch of filters cleaned for each event. Once a specific filter manufacturer and pore size is selected, the same filter selection should be used for all analyses.

5. Using nitrogen gas, increase the pressure to the sample pressure chamber to filter each aliquot from the mixed sample collection container.

6. Add additional aliquots for filtering if the sample processor believes the aliquot can be filtered without changing the filter.

7. Collect all of the filtrate from each sample in a carboy. Each of the 8+ gallon glass carboys should be calibrated to units of 0.1 liter using a graduated cylinder (with a specification of ± 5% accuracy). Report the sample filtrate volume with the sampling report.

8. When all of the sample composite has been filtered, or when the processor believes another aliquot cannot be pressure filtered within an additional 2-hour period, the processor should allow the nitrogen gas from the pressure housing to gently purge the excessive water through the filter to complete the filtration step. This approach should load as much of the particulates onto one filter from a sample volume minimum of 16 L and a maximum of 20 L. (The "TAMS" technique used on the Hudson River filtered 16 L sample volumes.)

9. Disassemble the filtration unit. Carefully fold the filter with clean, flat surfaced forceps three times (along the radius into 1/8 of the diameter) and then fold in half across the radius. Place the folded filter in a pre-cleaned 4-oz wide mouth jar for submittal to the laboratory for particulate PCB analysis.

10. Request the laboratory use the first aliquot of extraction solvent to rinse the jar into the extraction vessel to capture any particulates that may have fallen off the filter in transit. The laboratory will report the PCBs based on a per filter basis.

11. Mix the filtrate by swirling gently and decant an adequate volume into the appropriate sample bottle for dissolved PCB analysis.

12. Note: Utilize PCB decontamination protocols for any equipment and tubing used in the sample collection. After normal solvent cleaning protocols (check the chemical compatibility for the materials), finish the cleaning process by flushing the tubing and rinsing all collection containers with appropriate de-ionized or distilled water. Store all equipment cleaned at the end of each sampling period in double plastic bags. These procedures follow those summarized in Subsection 4.6, Decontamination Procedures.

## 4.6 DECONTAMINATION PROCEDURES

The following procedure will be used to decontaminate the filtration apparatus prior to each use:

1. Wash with tap water and laboratory soap, followed by extensive tap water rinse.

2. Wash with de-ionized (DI) water.

3. Rinse twice with acetone (pesticide grade).

4. Rinse twice with hexane (pesticide grade).

5. Rinse twice with acetone (pesticide grade).

6. Stand inverted for 20 minutes to permit acetone to drain.

7. Rinse with DI water.

8. If apparatus is not used immediately, cover with aluminum foil previously rinsed with hexane.

## 4.7 INTERFERENCES AND POTENTIAL PROBLEMS

Due to the low detection limits, contamination of the samples by dust, dirt, and other contaminants must be avoided. Decontamination must be thorough using care to ensure all filtration surfaces are cleaned. The location where filtration occurs must be in a controlled clean space. Access to the controlled clean space will be limited to laboratory personnel performing the filtration.

## 4.8 REPORTING

The results of each sampling event will be summarized and presented as a report memo. At a minimum, the report will include the following:

1. Documentation of conditions and activities likely impacting the amounts of PCBs and suspended material in the surface water for 7 days prior to and during the sampling event. This will include a daily summary of the remedial activities and storm events during this period. The flow and velocity information from the USGS Coltsville Station will be presented in graphical format for the same time period prior to and during the sampling event.

2. Sample collection information on the sampling date and times, river temperature at the beginning and end of the sampling, aliquot size and number, and river and sample observational notes. Any deviations from the decontamination or collection protocols will be noted.

3. Housatonic River elevations at the beginning and end of the sampling period for each station will be determined from the staff gage readings. If the rating curve for a station is completed at the time of the report draft, the curve will be presented with the estimation of the flows at the initiation and completion of the sampling for each station.

4. Sample processing information on the amount of sample filtered through the single filter, the temperature of the sample during the filtration process, and information regarding the submission and transport of the samples to the laboratory for analysis.

5. A summary table of the sample results for TSS (reported as mg/L), particulate PCBs (reported as µg/L), and dissolved PCBs (reported as µg/L). The particulate PCB concentrations on a volume basis will be calculated from the µg/filter data supplied from the laboratory divided by the liters of water.

# 5. REFERENCES

00-0507 WESTON (Roy F. Weston, Inc.). March 2001. *Quality Assurance Project Plan*. Environmental Remediation Contract, GE/Housatonic River Project. Volumes I, II, IIA, and IV. DCN GE-021601-AAHM.

99-0148 TAMS Consultants, Inc. and Gradient Corporation. 1993. *Phase 2B, Sampling and Analysis Plan/Quality Assurance Project Plan, Volume 1: Flow-Averaged Water-Column Sampling, Hudson River PCB Reassessment RI/FS*. Prepared for Region II Alternate Remedial Contracting Strategy (ARCS) for Hazardous Waste Remedial Services.

99-0174 TAMS Consultants, Inc. and Gradient Corporation. 1992. *Phase 2A, Sampling and Analysis Plan/Quality Assurance Project Plan, Hudson River PCB Reassessment RI/FS*. Prepared for EPA Region II Alternative Remedial Contracting Strategy (ARCS) for Remedial Waste Remedial Services.

# STANDARD OPERATING PROCEDURE SW-6

# 1.5-MILE REMEDIATION MONITORING SAMPLE COLLECTION AND SAMPLE PROCESSING

# STANDARD OPERATING PROCEDURE SW-6

# 1.5-MILE REMEDIATION MONITORING SAMPLE COLLECTION AND SAMPLE PROCESSING

## 1. SCOPE AND APPLICATION

### 1.1 OBJECTIVE

A removal action has been scheduled for a section of the East Branch of the Housatonic River from the Lyman Street Bridge downstream to the confluence with the West Branch of the Housatonic River (also known as the 1.5-Mile Reach). As a part of this removal action, intrusive activities will be implemented to remove and replace sediments and soils in the 1.5-Mile Reach. The purpose of the 1.5-mile remediation monitoring program will be to identify and evaluate potential negative impacts to the surface water quality of the Housatonic River that may result from these remedial activities.

### 1.2 LOCATIONS

Samples will be collected at locations along the Housatonic River that meet specific task objectives. In general, locations will be selected upstream and downstream of the Housatonic River reaches or subreaches that are to be evaluated for polychlorinated biphenyls (PCBs) and total suspended solids (TSS) monitoring.

### 1.3 ANALYTES AND MEASUREMENTS

For the purpose of this remediation monitoring program, PCB and TSS concentrations in the water column will be evaluated. In addition, turbidity (in nephelometric turbidity units [NTUs]) and water temperature (in °C) will be measured as necessary.

Analytical procedures will follow the protocols and specifications defined in the Final Quality Assurance Project Plan (QAPP) (WESTON, 00-0507) and the related Volumes II and IIA for the

Laboratory Standard Operating Procedures. The analytical methods noted below are included in more detail in these references.

- PCBs/Aroclors – Total (determined on an aliquot of the sample prior to filtration). EPA Method SW8082.
- PCBs/Aroclors – Dissolved (analyze the filtrate from the filtration used to separate the particulates). EPA Method SW8082.
- Total Suspended Solids (TSS) – Analyze the aliquot from the composite sample during mixing. EPA Method 160.2.

Quality control samples will be collected.

### 1.4 RELATED PROCEDURES

Related SOPs include:

- G-2 Decontamination
- G-6 Field Sample Numbering
- G-10 Sample Documentation
- G-11 Sample Packing and Shipping

## 2. PROCEDURES

### 2.1 PCB AND TSS SAMPLING

This section outlines the equipment, sample collection and processing protocols, and any related procedures for the PCB and TSS sampling to be completed as a part of the 1.5-mile water column monitoring program.

#### 2.1.1 Equipment

- ISCO Model 3710 composite sample pump.
- 3/8-inch and ½-inch inside diameter (ID) tubing, for sample collection, and transfer respectively.
- Pump batteries.
- Plastic sheeting.

- PPE.
- Decontamination materials and supplies, including acetone and hexane.
- Sample shipping supplies.

### 2.1.2 Sample Collection Procedures

For each sampling event, an ISCO automated sample pump will be used to collect water column samples for evaluating PCB and TSS concentrations. Teflon-lined tubing dedicated to each location will be used for the sample intake tubing. Each sampling event/location should use the minimum length of intake tubing necessary to reach from the ISCO sampler to the sample intake point. In addition, the lengths of silicon-based tubing (dedicated to each location) used for the peristaltic pump head in the ISCO pump should be minimized. No solvent will be used to initially wash or clean the tubing. Prior to beginning each sampling event, the depth of water at mid channel will be measured to allow for the proper placement of the intake tubing within the water column.

PCB and TSS sample collection will proceed as follows at each sampling station per event:

- Position the intake of the collection tubing in the water column at each station at a depth equivalent to 0.6 of the total water depth from the surface at the time of the sampling (e.g., 6-ft sampling depth from the surface of the water when the total water depth is 10 ft). Do not allow the tubing to pick up sediment from the riverbed during deployment or the actual sampling. Orient the intake opening of the collection tubing downstream.
- Pump 1 aliquot of water per hour from the water column for 10 hours into a minimum 7-liter glass container. Use the ISCO controller to collect approximately 600-milliliter (mL) aliquots using the fastest possible pump speed. This will yield approximately 6 liters in the collection container (see Section 2.1.3 for variations in sample volumes for quality assurance samples). Program the ISCO to reverse the pump and allow air to flush the water out of the intake tubing after each sample aliquot.
- Use ice in the ISCO housing to cool the sample collection container during the 10-hour sampling period. Maintain the cold sample temperature with ice during transport to the field office.

The following considerations apply to the procedure outlined in the steps above:

- Consistent sample aliquot size is more important than the absolute volume collected for each composite.
- During the initial sampling setup, determine the velocity of the water in the tubing (from tables or by calculation). The sampling velocity should exceed the velocity (preferably by 150%) of water in the Housatonic River. An ISCO model 37xx sampler can provide a nominal flow rate of 3.6 feet per second (fps) [= 3.25 liters per minute with 3/8-inch ID tubing] that should be adequate for river velocities of at least 2.4 fps.
- Utilize PCB decontamination protocols for all equipment used in the sample collection and processing with the exception of the Teflon intake and silicone pump tubing. Normal decontamination protocols involve a sequence of alconox-water, acetone, hexane, acetone, and thorough distilled water rinsing. The final water rinsing should remove all organic solvent residuals and no organic odors should be evident. The Teflon and silicone pump tubing will be cleaned with a thorough flushing/rinsing with distilled water to minimize residual organic carbon on the surfaces in contact with the samples. If non-aqueous phase liquids (NAPLs) are noted inside the tubing, the tubing must be discarded and the condition noted with the associated sample. At the end of each sampling event, store all equipment cleaned in double plastic bags. These procedures are a modification of the Field Sampling Plan, General SOP G-2 – Decontamination (July 2001).

### 2.1.3 Quality Assurance Plan

To meet data quality objectives, extra sample volume will be collected for the analysis of a duplicate and a matrix spike sample. For each sampling event involving quality assurance samples, a total of 9 liters of water must be collected (5 L for the sample, 2 L for the duplicate, and 2 L for the matrix spike) over the 10-hour composite sampling period.

The following table summarizes the sample collection:

| | **Month 1** | **Month 2** |
|---|---|---|
| Sample Analysis | 5 L–dissolved and tPCBs, and TSS | 5 L–dissolved and tPCBs, and TSS |
| Duplicate Analysis | 2 L–tPCBs | 2L–dissolved PCBs |
| Matrix Spike Analysis | 2 L–tPCBs | 2L–dissolved PCBs |
| Total | 9 L | 9 L |

In addition, equipment blank samples will be collected from the sample pump apparatus. This will be accomplished by pumping 2 liters of distilled water through the pump tubing prior to sampling. The equipment blank sample will be analyzed for total PCB concentrations.

### 2.1.4 Other Data Collection

During each sampling event, the temperature of the water will be measured in degrees Celsius using a factory-calibrated, stainless-steel thermometer. The temperature will be taken at the beginning and end of the sampling event. For each event, prior to beginning sampling, a 1-liter sample of water will be pumped from the river at the proper sampling depth into an amber glass sample container. Using the pre-calibrated thermometer, the temperature will be measured directly from this sample and recorded. At the end of the 10-hour event, the temperature will be measured using the same method. However, where turbidity monitoring locations coincide with the water collection locations, temperature readings will be taken using the temperature gage built into the YSI 600 OMS sonde used for monitoring turbidity. Throughout the sampling event, temperature will be measured in degrees Celsius and recorded.

In addition, water stage will be measured using a staff gage where applicable. A reading should be taken at the beginning and end of each sampling event. Staff gage readings will be subsequently converted into water elevations. If available, the rating curves for a particular location will be used to determine the flow during the time of sampling.

### 2.1.5 Sample Processing Procedures

The following section describes the techniques to be used in processing the collected water samples. The water sample will consist of a 10-hour composite sample collected with an ISCO pump. A total of approximately 6 to 9 liters of water will be collected per sampling location. Processing of each sample should follow the procedure described below:

- Record the temperature of the composite sample before and after processing the sample. Record the ambient room temperature in the sample processing area.
- While mixing the sample thoroughly with an overhead shaft mixer system, use a peristaltic pump (with silicone tubing dedicated to each location) to pump out 2 liters

for total PCB analysis and 1 liter for TSS analysis. The mixing activity and pumping rate must be adequate to suspend and sample the particulates present in the sample.

- Add approximately a 1-liter aliquot from the mixed collection container (using the same peristaltic pump used for the initial sample aliquots) to the pressure chamber of the stainless steel (SS) filtration unit (nominal inside diameter [ID] of 142 millimeters [mm]). The units have an effective filtration ID of approximately 120 mm.

- The filtration unit will utilize a 142-mm diameter Whatman GF/F glass fiber filter (nominal filter pore size of 0.7 microns) or equivalent that is oven "cleaned" at 450 °C (minimum, 525 °C maximum) for one hour.

- Using nitrogen gas, increase the pressure (as little as possible, but no higher than 15 pounds per square inch (psi), a pressure that may result in the filter "blowing out" the sides of the filtration unit) to the sample pressure chamber to filter each aliquot from the mixed sample collection container.

- Filter enough of the remaining sample to collect approximately 2 liters of filtrate for dissolved PCB analysis.

### 2.1.6 Decontamination Procedures

The following procedure will be used to decontaminate the filtration apparatus prior to each use:

- Wash with tap water and laboratory soap, followed by extensive tap water rinse.
- Wash with deionized (DI) water.
- Rinse twice with acetone (pesticide grade).
- Rinse twice with hexane (pesticide grade).
- Rinse twice with acetone (pesticide grade).
- Let the apparatus stand inverted for 20 minutes to permit the acetone to drain.
- Rinse with DI water.

If the apparatus is not used immediately, cover it with aluminum foil previously rinsed with hexane.

### 2.1.7 Interferences and Potential Problems

Because of the low detection limits, contamination of the samples by dust, dirt, and other contaminants must be avoided. Decontamination must be thorough, and care must be used to ensure that all filtration surfaces are cleaned. The location where filtration occurs must be a controlled clean space. Access to the controlled clean space will be limited to laboratory personnel performing the filtration.

### 2.2 TURBIDITY MEASUREMENT

Turbidity of the water column will be measured automatically via an in-stream YSI Model 6200 Data Acquisition System with 600 OMS sonde and 6136 turbidity probe to record hourly turbidity measurements. The turbidimeter employs the SIO 7027 nephelometric method for turbidity and can be left in place over long time periods without fouling. In addition, the system has the following specifications:

- Range – 0 to 1,000 NTUs
- Resolution – 0.1 NTU
- Accuracy - +/- 5% of reading or 2 NTU, whichever is greater

Field personnel will record the measurements at the end of each 10-hour day via modem connection to the data acquisition system. An average turbidity for each 10-hour day will be calculated based on the turbidities recorded each hour.

## 3. REFERENCES

TAMS Consultants, Inc. and Gradient Corporation. 1992*. Phase 2A, Sampling and Analysis Plan/Quality Assurance Project Plan, Hudson River PCB Reassessment RI/F*S. Prepared for EPA Region II Alternative Remedial Contracting Strategy (ARCS) for Remedial Waste Remedial Services. (99-0174)

TAMS Consultants, Inc. and Gradient Corporation. 1993. *Phase 2B, Sampling and Analysis Plan/Quality Assurance Project Plan, Volume 1: Flow-Averaged Water-Column Sampling, Hudson River PCB Reassessment RI/F*S. Prepared for Region II Alternate Remedial Contracting Strategy (ARCS) for Hazardous Waste Remedial Services. (99-0148)

WESTON (Roy F. Weston, Inc.). March 2001. *Quality Assurance Project Plan.* Environmental Remediation Contract, GE/Housatonic River Project. Volumes I, II, IIA, and IV. DCN GE-021601-AAHM. (00-0507)

# STANDARD OPERATING PROCEDURE SW-7

# MAJOR STORM EVENT SAMPLING

# STANDARD OPERATING PROCEDURE SW-7
# MAJOR STORM EVENT SAMPLING

## 1. BACKGROUND AND OBJECTIVE

The objective of the major storm event sampling effort is to provide data on bedload sediment, suspended solids, and water quality to support the calibration of a hydrodynamic and water quality model. The data will be used to assist in determining the resuspension and redistribution of PCB-laden sediment within the study area and to determine the effects of storms on water quality and hydrodynamics of the Housatonic River. Surface water samples and bedload sediment samples will be collected from the Housatonic River under conditions where water quality and sediment transport are influenced by major storm-induced flows. This protocol will be enacted only for a storm event that will likely result in a significant out of bank flow condition. It is anticipated that this condition will result only from a hurricane or significant nor'easter.

## 2. METHODOLOGY

### 2.1 SCOPE OF STUDY

Surface water sampling, velocity measurements, and staff gage measurements will be performed at six locations:

1. West Branch of Housatonic River—Routes 7 & 20 Bridge.
2. Pomeroy Avenue Bridge—West of Appleton Avenue.
3. Holmes Road Bridge – North of intersection with Pomeroy.
4. New Lenox Road Bridge—Just upstream of Decker Canoe Launch.
5. Woods Pond Headwaters—Off October Mountain Road.
6. Woods Pond Footbridge—Access is to be from the Lee (east) side.

Bedload sediment sampling will be performed at three locations:

1. Pomeroy Avenue Bridge
2. Holmes Road Bridge
3. New Lenox Road Bridge

At West Branch, Pomeroy, Holmes Road, New Lenox, and Woods Pond Footbridge, activities will be conducted from the bridges. Because of the lack of a bridge at Woods Pond Headwaters, activities will be conducted from the riverbank via an over-water suspended cable. At Pomeroy, samplers will cycle between bedload and surface water sample collection and conduct velocity measurements at 0.5-foot stage increments beginning when the river stage exceeds 6.8 feet on the in-river staff gage. At Holmes Road, samplers will cycle between bedload and surface water sample collection and conduct velocity measurements at 0.5-foot stage increments when the river stage is below 8.3 feet on the staff gage and at 0.2-foot stage increments when the river stage is above 8.3 feet on the staff gage. At New Lenox, samplers will cycle between bedload and surface water sample collection and conduct velocity measurements at 0.5-foot stage increments throughout the event. At West Branch, Woods Pond Headwaters, and Woods Pond Footbridge, surface water sampling and velocity measurements will be initiated at approximately 3-hour intervals. This will allow two samplers to rotate between Woods Pond Headwaters and the Woods Pond Footbridge.

At each location, the deepest point of the channel, or thalweg, has been previously established through cross-sectional surveys. Surface water samples will be collected at 6/10 depth at the thalweg at each location. Bedload composite samples will be collected from five pre-established points (including the thalweg of the river channel) across the river channel. At West Branch, Pomeroy, Holmes Road, New Lenox, and Woods Pond Footbridge, velocities will be measured at 2-foot intervals across the river channel. At Woods Pond Headwaters, velocities will be measured at five equally spaced sample points.

The following matrix summarizes the sampling activities:

| | **Bedload** | **Surface Water** | **Velocities** | |
|---|---|---|---|---|
| | **5-Point Composite** | **6/10 Depth Grab at Thalweg** | **2-Foot Intervals** | **5 Points** |
| West Branch | | X | X | |
| Pomeroy Avenue Bridge | X | X | X | |
| Holmes Road Bridge | X | X | X | |
| New Lenox Road Bridge | X | X | X | |
| Woods Pond Headwaters | | X | | X |
| Woods Pond Footbridge | | X | X | |

The procedures to be used for these activities are described in Subsections 2.5 through 2.7.

## 2.2 NUMBER OF EVENTS AND MOBILIZATION CRITERIA

Sampling will be performed for a single major storm event. Meteorological monitoring will be conducted by a WESTON meteorologist or subcontracted forecasting service. Twice weekly, 5- and 10-day forecasts will be forwarded to the following decision-making team:

- Susan Svirsky (EPA)
- Earl Hayter (EPA)
- Dick McGrath (WESTON)
- Tom Czelusniak (WESTON)
- Ed Garland (HydroQual)
- Rich DiNitto (Sleeman, Hanley & DiNitto)

An initial evaluation of the river stage and forecast will be conducted by Tom Czelusniak (Field Coordinator for this study). If conditions appear favorable for an out-of-bank flood event, Tom Czelusniak will alert the Level I group consisting of Dick McGrath and Ed Garland for closer evaluation of the information. If conditions warrant further consideration, the Level I group will initiate a conference call with the entire decision-making team to discuss the predictions. Based on the forecast and existing stage of the river, the decision to begin mobilization will be made by Susan Svirsky (EPA) or her designee. Phone numbers for the decision-making team and potential storm samplers are included in Attachment 1. Events are planned to run approximately 96 hours, but may run longer or shorter depending upon the conditions presented by the storm.

Susan Svirsky (EPA), in conjunction with Ed Garland, will make the decision when to stop sampling.

## 2.3 STAFFING

Two sampling teams will be employed during the storm event, with each working a 12-hour shift for as long as the event runs. Each team will consist of 1 Shift Manager, 10 Samplers, 1 Health and Safety Officer/Runner, and 1 Sample Manager/Runner. This results in a team comprising 13 people for each 12-hour shift. When the mobilization decision is made, Pittsfield staff will initiate setup of equipment and supplies and additional personnel will be scheduled to mobilize to provide two shift teams. Also at that time, extra rental vehicles will be arranged if necessary. At 12-24 hours before the storm, the second shift team will be mobilized to Pittsfield, and the first shift team will make final preparations. When the teams are ready to go, they will be dismissed for the day, if necessary, to rest before the event. Because predictions are not always accurate, and do change, this timeline may be amended. It is probable that there may be a need to respond in a much shorter timeframe. Under no circumstance will any response timeframe be such that safety requirements and/or motor vehicle laws are broken.

Pomeroy, West Branch, Holmes Road, and New Lenox will each be staffed by two samplers. On the rising limb of the storm, the West Branch samplers will also assist the Pomeroy team due to the rapid water level response during storms at this location. A two-person sampling team will rotate between the Woods Pond Headwaters and Woods Pond Footbridge locations. The runners will periodically meet the sampling teams to retrieve samples, deliver sample bottles and other equipment needs, and assist the sampling teams if necessary. Sampling teams should be prepared with extra sampling containers in the event that the runner gets off schedule. Samples will be brought back to the office and stored on ice until shipped to the laboratory.

## 2.4 ANALYTICAL PARAMETERS

### 2.4.1 Surface Water Samples

The following parameters will be analyzed in selected surface water samples:

1. Total organic carbon (TOC).
2. Total suspended solids (TSS) and Volatile Suspended Solids (VSS).
3. Polychlorinated biphenyls (PCBs) (total and Aroclors).

Samples collected from three sample periods during rising stream conditions, one sample period during peak stream conditions, and one sample period during falling stream conditions will be selected for analysis. Sample selection may be altered from these criteria based on current storm and river conditions (and apparent sediment transport quantities). Susan Svirsky (EPA) and Ed Garland will select the samples to be submitted for analysis based on the evaluation of the hydrograph developed from the staff gage readings for each location. QA/QC samples will be collected on the falling limb of the storm.

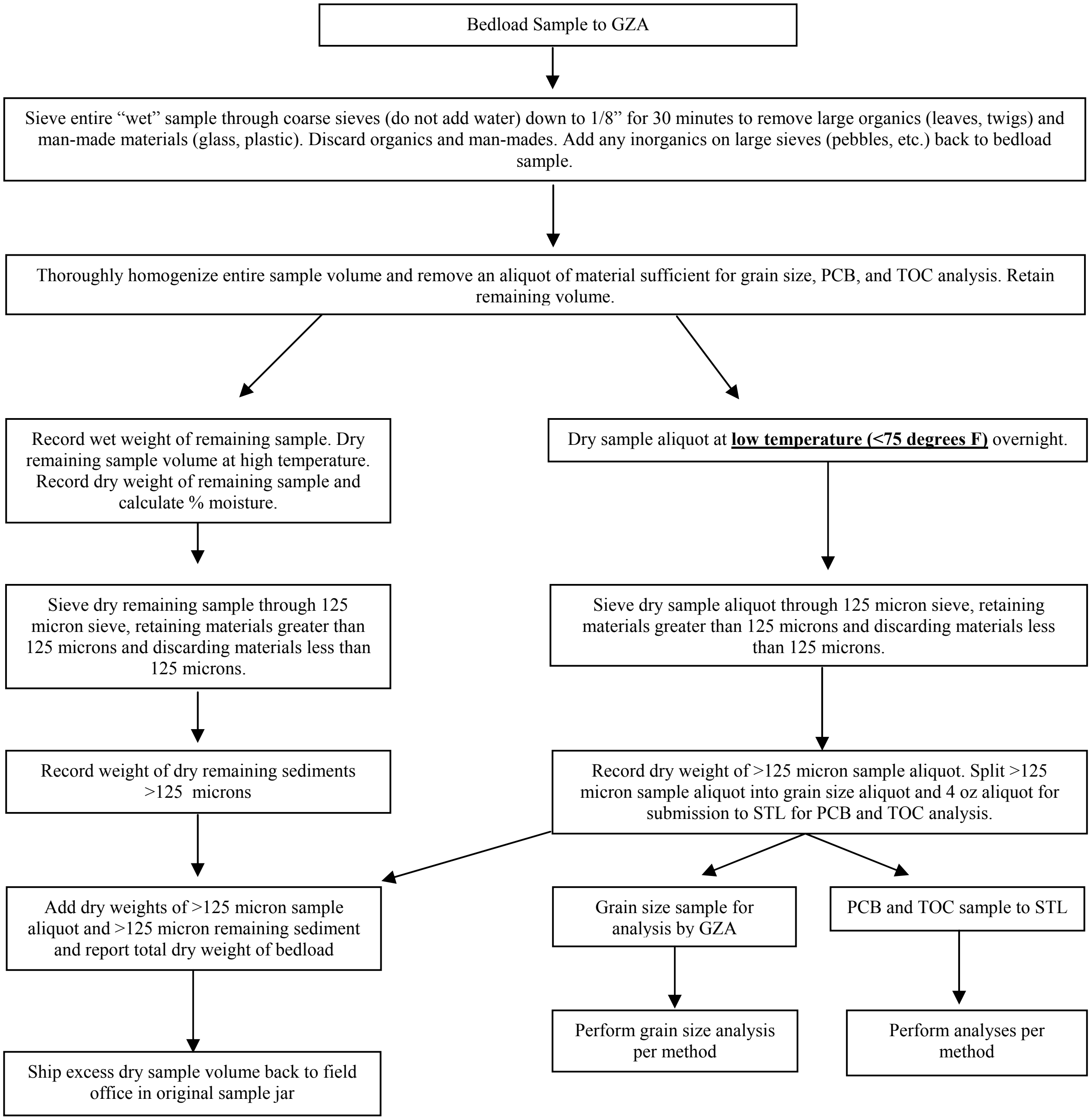
### 2.4.2 Bedload Sediment Samples

The following parameters will be analyzed in selected bedload sediment samples:

1. Total organic carbon (TOC).
2. Polychlorinated biphenyls (PCBs) (total and Aroclors).
3. Grain size distribution greater than 125 microns.
4. Total dry sediment mass.

For each location, three bedload sediment samples will be submitted for analysis. One of the samples will be selected to best measure the peak sediment transport, which usually occurs slightly prior to the peak water discharge. Two additional bedload samples will be selected from the total samples to bracket the peak sediment transport sample or to evaluate other sediment transport features dependent on the specific storm conditions. Susan Svirsky (EPA) and Ed Garland will select the samples to be submitted for analysis based on the evaluation of the hydrograph developed from the staff gage readings for each location. Figure 1 presents a flow chart for the laboratory processing and analysis of the bedload samples. QA/QC samples will be collected from those samples selected for analysis that contain sufficient sample mass for additional QA/QC volumes.

# Figure 1 Laboratory Bedload Sample Processing and Analysis



GZA to report % moisture of bedload minus organics and man-mades, total dry weight of bedload >125 microns, and grain size analysis.

STL to report PCB and TOC analysis.

### 2.4.3 Methods

Analytical methods, required containers, preservation techniques, and holding times for the above samples are contained in the *Quality Assurance Project Plan* (QAPP) (WESTON, 2001, 00-0507) and are summarized below.

| Parameter | No. of Bottles | Bottle | Preservative | Holding Time |
|---|---|---|---|---|
| **Surface Water Samples** | | | | |
| TOC (EPA Method 415.1) | 2 | 40-ml glass vials | $H_2SO_4$,<br>Cool 4°C | 28 days |
| TSS (EPA Method 160.2) | 1 | 1-L amber glass | Cool 4°C | 7 days |
| Total PCB (SW846 8082) | 2 | 1-L amber glass | Cool 4°C | Extract within 7 days, analyze within 40 days following extraction |
| **Bedload Sediment Samples** | | | | |
| TOC (EPA Method 415.1)<br>Total PCB (SW846 8082) | 1 | 4-oz glass | Cool 4°C | TOC - 28 days<br>PCB - Extract within 14 days, analyze within 40 days following extraction |
| Grain Size Distribution (ASTM D422) | 1 | 2,000-mL glass* | Cool 4°C | N/A |

*Oversized sample container selected to allow homogenization of sample. Minimum sample volume required for analysis is approximately 250 mL (8 oz).

The number of samples to be submitted for analysis along with the relevant QA/QC samples are summarized below.

| | Number of Samples | | | | | |
|---|---|---|---|---|---|---|
| | **PCBs - Sediment** | **PCBs - Aqueous** | **TOC - Sediment** | **TOC - Aqueous** | **TSS/VSS - Aqueous** | **Grain Size** |
| Bedload Composites | 9 | | 9 | | | 9 |
| Surface Water Grabs | | 30 | | 30 | 30 | |
| Field Blanks* | | 1 | | 1 | 1 | |
| Field Duplicates | 1 | 2 | 1 | 2 | 2 | 1 |
| Matrix Spikes (MS/MSD) | 1 | 2 | 1 | 2 | | |
| Totals | 11 | 35 | 11 | 35 | 33 | 10 |

*Field blank for depth-integrated surface water samples will consist of D.I. water poured into and out of sample collection bottle following post-sampling decon (D.I. water rinse).

Surface water samples will be collected with a model USDH-76 sampler, as described in Subsection 2.5. Bedload sediment samples will be collected with a Model 8035 Helley-Smith design bedload sampler as described in Subsection 2.6. This is a 65-lb, cable-suspended bedload sampler with a 3-inch x 3-inch opening and 3.22 expansion ratio. Velocity measurements will be taken with a Marsh-McBirney FloMate 2000 at each location as described in Subsection 2.7.

## 2.5 SURFACE WATER SAMPLE COLLECTION METHODS

The samples will be collected with a model USDH-76 sampler deployed from a manual winch system and cable. The model USDH-76 sampler samples water isokinetically (i.e., at the same velocity as the stream); therefore, the sample volumes are proportional to the velocity. This sampler is typically used as a depth-integrated sampler; however, for this study the sampler will be used to collect a grab sample from a specified depth. The sample procedure involves inserting a 1-liter collection bottle to the device, which will be quickly lowered to the specified depth and allowed to fill completely at that depth.

The following sampling protocol will be used for the collection of the surface water samples:

- The location and river bottom elevation of the thalweg at each location are included on the cross-sectional survey tables that are included in Attachment 2 of this SOP. The zero elevation of the staff gages are also included on these sheets. The staff gage reading and calculated surface water elevation will be recorded on the field data sheet included in Attachment 3. Using the surface water elevation and river bottom elevation, the total water depth and 6/10 water depth at the thalweg will be calculated and recorded on the field data sheet.

- A 1-liter collection bottle will be loaded into the sampler and the sampler connected to the sampling cable of the winch or cable system. A clip or flagging will be placed on the sample cable at the calculated 6/10 depth above the sampler intake port. The sampler will be lowered to the water surface, then quickly lowered into the water until the clip or flagging reaches the water surface. The sampler will be allowed to hang at the 6/10 water depth to fill completely.

- After the retrieval of each collection bottle, the bottle will be closed and shaken to mix the sample. The sample will then be split equally into the one TSS and two PCB 1-liter sample bottles. The sampler will continue to be deployed and the sample split until the three 1-liter sample bottles are filled. Two 40-mL TOC sample vials will be filled completely from one of the 1-liter sample jars after capping and shaking. The sample containers will be labeled and placed in a cooler on ice for transport back to the office by the runner. Following sample collection, the depth-integrated collection bottle will be rinsed with deionized water and retained for reuse at that sample location.

Susan Svirsky (EPA) and Ed Garland will select the samples to be submitted for analysis based on the evaluation of the hydrograph developed from the staff gage readings for each location and event.

## 2.6 BEDLOAD SAMPLE COLLECTION METHODS

Following completion of the surface water sampling at Pomeroy, Holmes Road, and New Lenox, a composite bedload sample will be collected from the following five pre-established sample points:

| Station No. | Pomeroy | Holmes Road | New Lenox |
|---|---|---|---|
| 1 | L8 (8 ft left of center) | L36 (36 ft left of center) | L34 (34 ft left of center) |
| 2 | Center of span | L18 (18 ft left of center) | L17 (17 ft left of center) |
| 3 | R8 (8 ft right of center) | Center of span* | Center at plaque* |
| 4 | R16 (16 ft right of center)* | R18 (18 ft right of center) | R17 (17 ft right of center) |
| 5 | R20 (20 ft right of center) | R36 (36 ft right of center) | R34 (34 ft right of center) |

* - Thalweg

The nylon mesh sample bag will be attached to the bedload sampler, and bedload collection will begin at the sampling point closest to the right bank (facing upstream - Station 5). The sample start time and the staff gage reading will be recorded on the field data sheet included in Attachment 3. Using the bridge winch, the sampler will be lowered into the water and allowed to orient to the flow, then lowered slowly until it rests on the bottom. The sampler will be allowed to rest on the bottom and collect bedload sediment for 2 minutes. The sampler will then be raised out of the water and moved to the next sampling point. Sampling will be continued across the channel, allowing the sampler to rest on the bottom for 2 minutes at each of the five sampling points.

The next step is dependent on the amount of sediment collected in the initial pass (e.g., 2-minute collection at each of the five sampling points):

1. Adequate amount of bedload sediment is collected. If an amount of bedload sediment adequate to fill the analytical sample bottles (e.g., total volume of approximately 750 mL) is obtained in the initial pass, the sample may be processed as noted below in Subsection 2.6.1.

2. Too much bedload sediment is collected. **If the 2-minute grab at each sampling point results in the bag filling with sediment before all of the points are sampled, or the bag is so full that it likely prevented sediments from entering the bag, the sample is void and must be discarded.** The collection protocol will be repeated with a shorter period of time for the sampler collecting at each sampling point. The shorter period of time will be determined by the field team and will be based on current river conditions and estimated bedload transport. For example, if the sediment collected just slightly overfilled the bag by the fifth (and last) sampling point, the sample would be discarded and the sampling time at each point could be reduced to 1 minute.

3. An inadequate amount of bedload sediment is collected. If the amount of bedload sediment collected in the initial pass is not adequate to fill the analytical sample bottles (e.g., total volume of approximately 750 mL), additional sediment must be collected. With the collected sediment remaining in the mesh bag, return to the first sampling point and repeat the collection protocol for a second pass.

**Note: Once a sampling pass is initiated, the collection time at each of the five sample points within that pass may not be adjusted (e.g., the collection time for each of the five points must be the same); however, the collection time on subsequent passes may be different (e.g., you can combine the bedload sediment from a 2-minute per point pass with the bedload sediment from a 5-minute per point pass). On subsequent bedload samples, the field team may adjust the collection time of the first pass (increase or decrease from 2 minutes per location) based on earlier experience in an attempt to collect sufficient volume on the first pass. The maximum cumulative sample time spent at each point will be 10 minutes. If after a total of 10 minutes collection time at each point insufficient volume has been collected, whatever sample volume has been collected will be processed as described below and retained for potential total dry mass determination.**

Selected samples may also be collected with a 125-micron bedload sampling bag and submitted for analysis for comparison purposes with earlier 250-micron bedload data.

### 2.6.1 Processing

Once an adequate amount of bedload sediment is obtained in the composite sample, the time spent at each sampling point, the number of passes, and the sample completion time will be recorded on the field log included in Attachment 3. Following sample collection, the sampler will be retrieved and the nylon mesh sample bag removed. The sample bag with sediment will be allowed to drain until no water drips from the bag for a 5-second period. The entire bedload sediment composite (five sample collection points per pass and multiple passes if performed) will be emptied into a 1-gallon wide-mouth sample jar.

The sample jars will be labeled and placed in a cooler with ice for transport back to the office by a runner. Following sample collection, the nylon bag will be washed in an Alconox/water solution, rinsed with deionized water, and retained for reuse at that sample location.

Three bedload samples from each location will be analyzed for TOC, PCB, grain size distribution and total dry sample mass. Susan Svirsky (EPA) and Ed Garland will select the samples to be submitted for analysis based on the evaluation of the hydrograph developed from the staff gage readings for each location and event. The lithology of all bedload samples will be recorded and the selected samples submitted to the laboratory for processing and analysis as outlined in Figure 1.

## 2.7 VELOCITY MEASUREMENTS

Velocity measurements, along with staff gage measurements, will be used to track the progress of the Housatonic River responses to the storm. Because of safety requirements that prohibit personnel from entering the river during storm flows, velocity measurements will be taken from the bridges or through the use of an over-water suspended cable at Woods Pond Headwaters. Rain gage readings will be recorded prior to each set of velocity measurements and recorded on a field data sheet included in Attachment 3. The field team will also note the time if the river rises out of its banks.

Velocity measurements will be made using a Marsh-McBirney FloMate 2000 portable electronic current meter. The meter uses an electromagnetic sensor to measure the velocity in a conductive fluid such as water using Faraday's law of electromagnetic induction to measure fluid flow. As a conducting fluid, such as impure water, moves through a magnetic field produced by the meter a voltage will be induced (Gordon et al., 1992, 99-0199).

At West Branch, Pomeroy, Holmes Road, New Lenox, and Woods Pond Footbridge, velocity measurements will be recorded in accordance with USGS protocols (Buchanan et al., 1969, 99-

0198) at pre-established intervals across the river channel, starting at the left-most interval, using the following protocol:

The staff gage will be read to determine the elevation of the water surface. Using the surface water elevation and cross-sectional elevation data of the riverbed, the depth of the water will be calculated at each pre-established interval across the river. At velocity measurement locations with a water depth of 2.5 ft or less, the velocity will be measured at 6/10 of the water depth from the surface. At depths greater than 2.5 ft, the velocity will be measured at 2/10 of the water depth and 8/10 water depth from the surface. The velocity probe will be allowed to remain at each sampling depth for approximately 10 seconds to allow the meter to stabilize. Once the meter has stabilized, the second reading will be recorded. The velocity and stage data will be entered on the field data sheet in Attachment 3. Pre-calculated velocity spreadsheets for specific stage intervals may also be used at selected locations to cut down on field calculations.

At Woods Pond Headwaters, velocity measurements will be recorded at the following five points throughout the entire event instead of the 2-foot intervals across the Housatonic River due to the difficult logistics of operating the cable system.

| **Station No.** | **Woods Pond Headwaters** |
|---|---|
| 1 | 120 ft from winch post |
| 2 | 101 ft from winch post |
| 3 | 82 ft from winch post |
| 4 | 67 ft from winch post |
| 5 | 52 ft from winch post |

Velocity measurements will be recorded at 1-foot depth intervals from the water surface to the river bottom instead of the fractional water depths (therefore no calculations are necessary). The 1-foot depth intervals will be estimated from the cable length used to lower the instrument.

The following general information will be recorded on the field data sheet included in Attachment 3:

1. Flow monitoring location and point across the river
2. Date

3. Time
4. Water elevation from staff gage
5. Water depth at monitoring point
6. Velocity at depth monitored
7. Staff gage reading at start and end of velocity measurements

## 2.8 REPORTING

The results of the sampling event will be summarized and presented as a report memo. At a minimum, the report will include the following:

1. Documentation of conditions and activities likely impacting the amounts of PCBs and suspended material in the surface water of the river for 7 days prior to and during the sampling event. This will include a daily summary of the remedial activities and storm events during this period. The flow and velocity information from the USGS Coltsville Station will be presented in graphical format for the same time period prior to and during the sampling event.

2. Velocity measurements with date and time for each location and measurement point.

3. Sample collection information on the sampling date and time, and river and sampling observational notes. Any deviations from the decontamination or collection protocols will be noted.

4. River elevations and temperatures for the duration of the storm event which have been downloaded from the pressure transducers at each location following the storm event. If a rating curve for a location is available at the time of the report draft, the curve will be presented with the estimation of the flow during the sampling at each location.

5. Sample processing information regarding the submission and transport of the samples to the laboratory for analysis.

6. Summary tables of the sample results for each event, organized by location:

   - Dry mass (in grams) of the bedload sediment composite samples per unit collection time.

   - Total PCBs and Aroclors in bedload samples (reported as mg/kg).

   - Total PCBs and Aroclors in the surface water samples (reported as ug/L).

   - TOC in bedload samples (reported as mg/kg).

   - TOC in the surface water samples (reported as mg/L).

- TSS/VSS in the surface water samples (reported as mg/L).
- Grain size distribution (>125 microns) of the bedload samples.

## REFERENCES

Buchanan, T.J. and Somers, W.P. 1969. "Discharge Measurement at Gaging Stations." *Techniques of Water-Resource Investigations,* Book 3, Chapter A8, U.S. Geological Survey Washington, DC. (99-0198)

Gordon, N.D., McMahon, T.A. and Finlayson, B.L. 1992. *Stream Hydrology.* John Wiley & Sons. New York, NY. (99-0199)

WESTON (Roy F. Weston, Inc.). 2001. "Laboratory Standard Operating Procedures" In: *Final Quality Assurance Project Plan,* Volumes II and IIA. General Electric (GE) Housatonic River Project, Pittsfield, Massachusetts. DCN GE-021601-AAHM. (00-0507)

# ATTACHMENT 1

# CONTACT LIST

# STORM SAMPLER CONTACT LIST

| | |
|---|---|
| Ahsan, Quamrul (HydroQual) | 845-753-6844 (h) |
| | 201-529-5151 x7135 (w) |
| | 914-441-0364 (cell) |
| Campbell, Scott | 603-648-2903 (h) |
| | 603-656-5566 (w) |
| | 413-281-9574 (cell) |
| Cermak, Noah | 413-442-4224 (w) |
| | 413-281-9569 (cell) |
| Combs, Sean | 603-529-6536 (h) |
| | 603-656-5453 (w) |
| | 603-801-0380 (cell) |
| Czelusniak, Tom | 413-637-1342 (h) |
| | 413-442-4224 (w) |
| | 413-281-9568 (cell) |
| DiNitto, Rich (Sleeman, Hanley, & DiNitto | 617-424-9757 (h) |
| | 617-330-2800 (w) |
| | 617-285-9757 (cell) |
| Ditsch, Brian | 301-752-1415 (cell) |
| Eid, Ibrahim | 610-430-6911 (h) |
| | 610-701-3430 (w) |
| Garland, Ed (HydroQual) | 201-664-1371 (h) |
| | 201-529-5151 (w) |
| | 201-280-9742 (cell) |
| Hayter, Earl (EPA) | 864-882-2763 (h) |
| | 706-355-8303 (w) |
| | 706-714-1631 (cell) |
| Jendrasiak, Ryan | 413-442-4224 (w) |
| | 413-329-0205 (cell) |
| McGrath, Dick | 978-779-5253 (h) |
| | 978-779-6578 (home office) |
| | 508-561-0980 (cell) |
| Prevost, Shana | 860-292-6222 (h) |
| | 860-983-1859 (cell) |
| Soukup, Jim | 603-424-8088 (h) |
| | 603-656-5480 (w) |
| Steele, Amy | 413-458-2415 (h) |
| | 413-442-4224 (w) |
| | 413-822-7261 (cell) |
| Svirsky, Susan (EPA) | 978-546-9143 (h) |
| | 617-918-1435 (w) |
| | 617-413-4906 (cell) |
| Taylor, Kathleen | 603-424-8088 (h) |
| | 603-656-5574 (w) |
| | 603-315-4563 (cell) |
| Totino, Rich | 518-884-9464 (h) |
| | 413-442-4224 (w) |
| | 413-281-9573 (cell) |
| Zapisek, Izabela | 413-442-4224 (w) |
| | 508-414-1762 (cell) |
| Zoppel, Rich | 802-375-9270 (h) |
| | 413-442-4224 (w) |
| | 413-281-9567 (cell) |

# ATTACHMENT 2

# CROSS-SECTIONAL SURVEYS

**POMEROY AVENUE BRIDGE** SK SURVEY ON 10/15/2001

TBM:

RIVET ON N.E. BRIDGE ABUTMENT = 975.92

| OFFSET | ELEVATION | | |
|---|---|---|---|
| DISTANCE | LEFT | CENTER | RIGHT |
| | | | |
| 0 | | 958.30 | |
| 2 | 958.54 | | 957.95 |
| 4 | 958.84 | | 957.67 |
| 6 | 958.82 | | 957.59 |
| 8 | 959.10 | | 957.55 |
| 10 | 959.26 | | 957.47 |
| 12 | 959.56 | | 957.35 |
| 14 | 959.94 | | 957.15 |
| 16 | 960.27 | | 956.97 |
| 18 | 961.47 | | 957.17 |
| 20 | 962.37 | | 957.52 |
| 22 | 962.77 | | 958.25 |
| 24 | 962.95 | | 958.96 |
| 26 | 963.23 | | 959.27 |
| 28 | 963.09 | | 959.61 |
| 30 | 963.18 | | 959.79 |
| 32 | 963.27 | | 959.93 |
| 34 | 963.11 | | 960.77 |
| 36 | 963.06 | | 961.27 |
| 38 | 963.12 | | 963.24 |
| | | | |

Thalweg located at R16

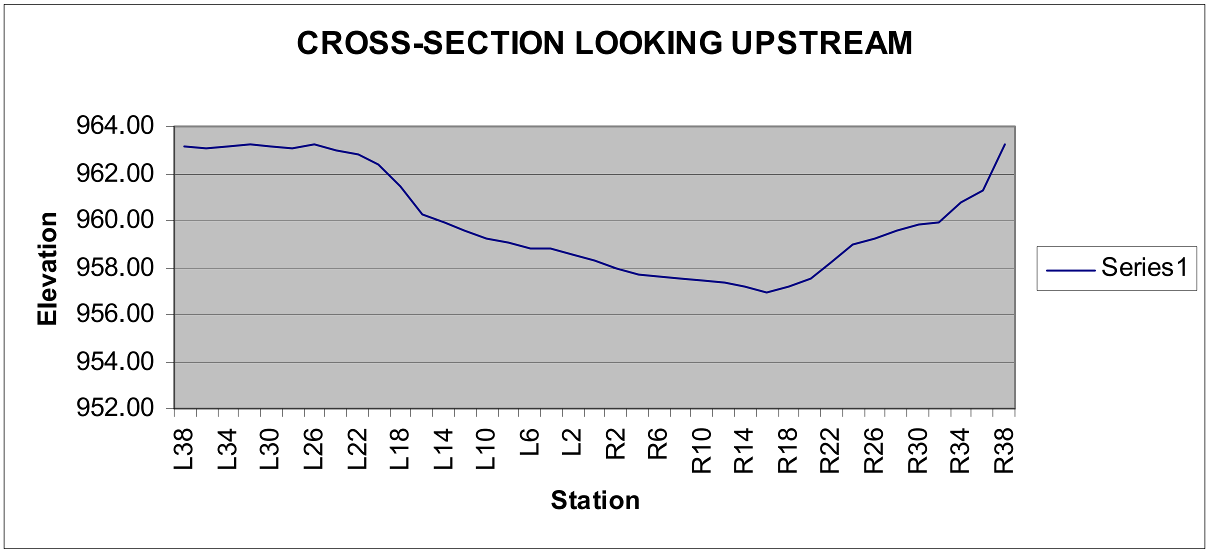
Streambed elevation = 956.97

LEFT AND RIGHT BASED ON LOOKING UPSTREAM

CENTER POINT SPACED EQUALLY BETWEEN LEFT AND RIGHT BRIDGE ABUTMENT

BENCHMARK FROM ACOE SURVEY 10/31/01. ELEVATION PULLED TO TBM FROM ACOE TBM E - (NGVD 1929 ELEVATION 0F 977.59) - DOUBLED HEADED NAIL ON UTILITY POLE (WMECO 36) - 42' EAST OF BRIDGE.

**ZERO ELEVATION OF STAFF GAGE = 957.15**



## HOLMES ROAD BRIDGE CROSS SECTION

RFW survey on 2/6/03

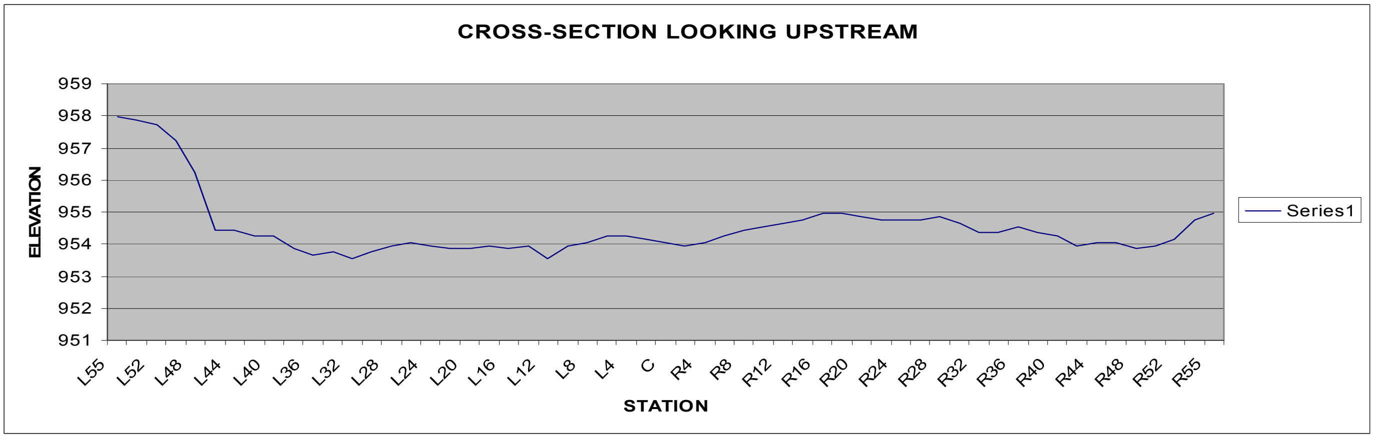
TBM:

Chiseled square on NE wingwall of bridge 977.93

NOTE: STATIONING RUNS FROM ABUTMENT ON SOUTH SIDE OF RIVER TO ABUTMENT ON NORTH SIDE OF RIVER

| STATION | depth | z | ELEVATION | REMARK |
|---|---|---|---|---|
| L55 | | 23.87 | 957.98 | ABUTMENT |
| L54 | | 23.98 | 957.87 | BANK |
| L52 | | 24.12 | 957.73 | BANK |
| L50 | | 24.63 | 957.22 | BANK |
| L48 | | 25.60 | 956.25 | EDGE OF WATER |
| L46 | 1.8 | | 954.45 | WATER |
| L44 | 1.8 | | 954.45 | WATER |
| L42 | 2 | | 954.25 | WATER |
| L40 | 2 | | 954.25 | WATER |
| L38 | 2.4 | | 953.85 | WATER |
| L36 | 2.6 | | 953.65 | WATER |
| L34 | 2.5 | | 953.75 | WATER |
| L32 | 2.7 | | 953.55 | WATER |
| L30 | 2.5 | | 953.75 | WATER |
| L28 | 2.3 | | 953.95 | WATER |
| L26 | 2.2 | | 954.05 | WATER |
| L24 | 2.3 | | 953.95 | WATER |
| L22 | 2.4 | | 953.85 | WATER |
| L20 | 2.4 | | 953.85 | WATER |
| L18 | 2.3 | | 953.95 | WATER |
| L16 | 2.4 | | 953.85 | WATER |
| L14 | 2.3 | | 953.95 | WATER |
| L12 | 2.7 | | 953.55 | WATER |
| L10 | 2.3 | | 953.95 | WATER |
| L8 | 2.2 | | 954.05 | WATER |
| L6 | 2 | | 954.25 | WATER |
| L4 | 2 | | 954.25 | WATER |
| L2 | 2.1 | | 954.15 | WATER |
| C | 2.2 | | 954.05 | WATER |
| R2 | 2.3 | | 953.95 | WATER |
| R4 | 2.2 | | 954.05 | WATER |
| R6 | 2 | | 954.25 | WATER |
| R8 | 1.8 | | 954.45 | WATER |
| R10 | 1.7 | | 954.55 | WATER |
| R12 | 1.6 | | 954.65 | WATER |
| R14 | 1.5 | | 954.75 | WATER |
| R16 | 1.3 | | 954.95 | WATER |
| R18 | 1.3 | | 954.95 | WATER |
| R20 | 1.4 | | 954.85 | WATER |
| R22 | 1.5 | | 954.75 | WATER |
| R24 | 1.5 | | 954.75 | WATER |
| R26 | 1.5 | | 954.75 | WATER |
| R28 | 1.4 | | 954.85 | WATER |
| R30 | 1.6 | | 954.65 | WATER |
| R32 | 1.9 | | 954.35 | WATER |
| R34 | 1.9 | | 954.35 | WATER |
| R36 | 1.7 | | 954.55 | WATER |
| R38 | 1.9 | | 954.35 | WATER |
| R40 | 2 | | 954.25 | WATER |
| R42 | 2.3 | | 953.95 | WATER |
| R44 | 2.2 | | 954.05 | WATER |
| R46 | 2.2 | | 954.05 | WATER |
| R48 | 2.4 | | 953.85 | WATER |
| R50 | 2.3 | | 953.95 | WATER |
| R52 | 2.1 | | 954.15 | WATER |
| R54 | 1.5 | | 954.75 | WATER |
| R55 | 1.3 | | 954.95 | ABUTMENT |

**ZERO ELEVATION OF STAFF GAGE = 954.87**



**NEW LENOX BRIDGE** SK SURVEY ON 10/22/2001

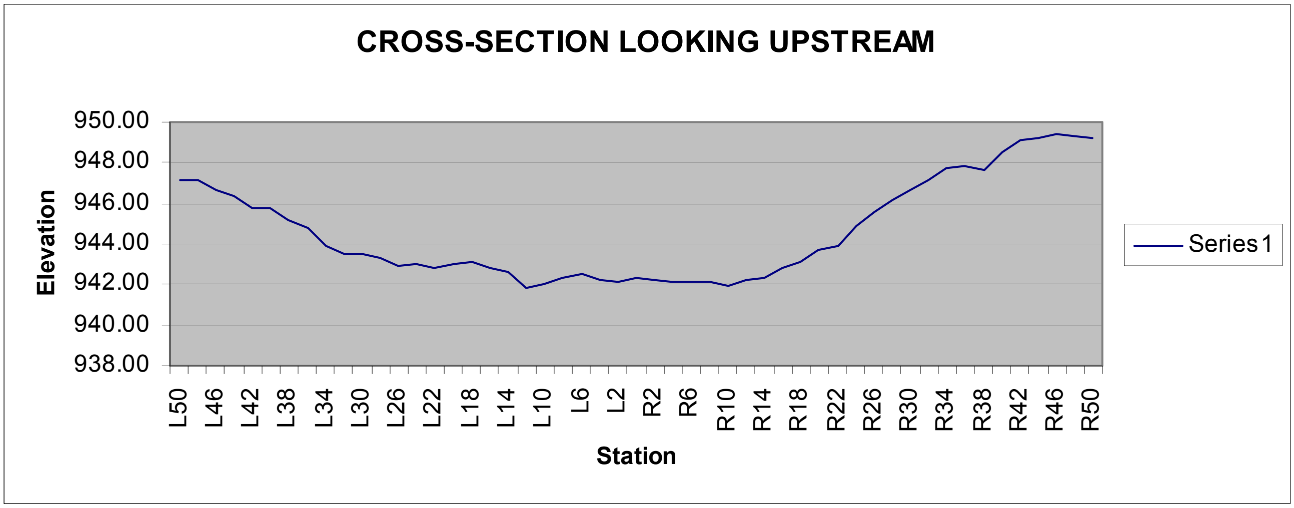
TBM:
CHISELED SQUARE CUT IN NORTHWEST WINGWALL OF
NEW LENOX ROAD BRIDGE. ELEVATION : 966.73

Thalweg set at Center of bridge at plaque for sampling purposes – elevation = 942.31.

| OFFSET DISTANCE | ELEVATION | | |
|---|---|---|---|
| | LEFT | CENTER | RIGHT |
| 0 | | 942.31 | |
| 2 | 942.16 | | 942.21 |
| 4 | 942.21 | | 942.11 |
| 6 | 942.51 | | 942.11 |
| 8 | 942.31 | | 942.11 |
| 10 | 942.06 | | 941.96 |
| 12 | 941.86 | | 942.21 |
| 14 | 942.61 | | 942.31 |
| 16 | 942.81 | | 942.81 |
| 18 | 943.11 | | 943.16 |
| 20 | 943.01 | | 943.71 |
| 22 | 942.81 | | 943.91 |
| 24 | 943.01 | | 944.91 |
| 26 | 942.96 | | 945.61 |
| 28 | 943.31 | | 946.16 |
| 30 | 943.46 | | 946.66 |
| 32 | 943.51 | | 947.19 |
| 34 | 943.91 | | 947.77 |
| 36 | 944.81 | | 947.86 |
| 38 | 945.16 | | 947.60 |
| 40 | 945.81 | | 948.51 |
| 42 | 945.81 | | 949.16 |
| 44 | 946.36 | | 949.26 |
| 46 | 946.66 | | 949.37 |
| 48 | 947.11 | | 949.31 |
| 50 | 947.16 | | 949.26 |

LEFT AND RIGHT BASED ON LOOKING UPSTREAM
CENTER POINT SPACED EQUALLY BETWEEN LEFT AND RIGHT ABUTMENT
BENCHMARK FROM ACOE SURVEY 10/31/01. ELEVATION PULLED TO TBM FROM NGS BENCHMARK T10 -
(NGVD 1929 ELEVATION OF 972.26') LOCATED 28' WEST OF WEST RAIL OF RAILROAD TRACKS, NEAR FENCE POST ADJACENT TO FORMER TRAIN STATION BUILDING (DEWEY'S CROSSING) NORTH OF NEW LENOX ROAD.

**ZERO ELEVATION OF STAFF GAGE = 948.02**



# ATTACHMENT 3

# FIELD DATA SHEETS

# Surface Water Sampling Field Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Location: | Pomeroy | West Branch 7&20 | Holmes Road | New Lenox | Woods Pond Headwaters | Woods Pond Footbridge |
| Staff Gage Zero Elevation: | 957.15 | 960.59 | 955.20 | 948.02 | 947.66 | 946.89 |

| **Date** | **Time** | **Staff Gage Reading** | **Staff Gage Zero Elevation** | **Surface Water Elevation** | **River Bottom Elevation** | **Total Water Depth** | **6/10 Water Depth** | **Sample ID*** |
|---|---|---|---|---|---|---|---|---|
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* Pomeroy = H2-ST000004-☐-☐☐☐☐-☐☐☐☐

West Branch 7&20 = HW-ST000012-☐-☐☐☐☐-☐☐☐☐

Holmes Road = H3-ST000011-☐-☐☐☐☐-☐☐☐☐

New Lenox = H3-ST000007-☐-☐☐☐☐-☐☐☐☐

Woods Pond Headwaters = H3-ST000010-☐-☐☐☐☐-☐☐☐☐

Woods Pond Footbridge = H4-ST000009-☐-☐☐☐☐-☐☐☐☐

# Bedload Sampling Field Data Sheet

Location: Pomeroy Holmes Road New Lenox

| Date | Sample Start Time | Staff Gage Reading | Sample Completion Time | Traverse # | Time Deployed (min) | | | | | Sample ID* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | #5 | #4 | #3 | #2 | #1 | |
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* Pomeroy = H2-BL000004-☐-☐☐☐☐-☐☐☐☐
New Lenox = H3-BL000007-☐-☐☐☐☐-☐☐☐☐
Holmes Road = H3-BL000011-☐-☐☐☐☐-☐☐☐☐

# Rain Gage Field Data Sheet

| | | | | | | |
|---|---|---|---|---|---|---|
| Location: | Pomeroy | West Branch 7&20 | Holmes Road | New Lenox | Woods Pond Headwaters | Woods Pond Footbridge |

| **Date** | **Time** | **River In or Out of Banks** | **Rain Gage Reading** | **Rain Gage Emptied?** |
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# Surface Water Velocities

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|---|---|---|---|---|---|---|
| Location: | Pomeroy | West Branch 7&20 | Holmes Road | New Lenox | Woods Pond Headwaters | Woods Pond Footbridge |
| Staff Gage Zero Elevation: | 957.15 | 960.59 | 955.20 | 948.02 | 947.66 | 946.89 |

| Station Location (#) | Date | Time | Staff Gage Reading | Staff Gage Zero Elev | Surface Water Elev | River Bottom Elev | Water Depth | Depth (ft) | | | | Velocity (ft/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 6/10 | 2/10 | 8/10 | One-Ft Interval | |
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# - From cross-sectional surveys (e.g., L16) or bedload sample locations

# STANDARD OPERATING PROCEDURE GW-1

# BOREHOLE/WELL ABANDONMENT

# STANDARD OPERATING PROCEDURE GW-1

# BOREHOLE/WELL ABANDONMENT

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) details the procedure for abandoning a borehole or a monitoring well. Borehole/well abandonment is conducted for one or more of the following reasons:

- Completion of a soil boring.
- Insufficient yield that precludes well installation.
- Excessive difficulties incurred during drilling.
- Requirement of a Regulatory Agency.

Proper grouting techniques are critical for the prevention of cross-contamination and to prevent a trip or falling hazard caused by an open hole. Thus, it is imperative that the field team closely observe all grouting operations.

## 2. EQUIPMENT

Portland cement

Pure sodium bentonite powder

Potable water

Calculator

## 3. RELATED PROCEDURES

G-1 Calibration of Field Screening Instruments

G-3 Field Documentation

# 4. PROCEDURE

## 4.1 BOREHOLE ABANDONMENT

The following borehole abandonment procedure will be practiced:

- Calculate the volume of grout needed to completely fill the borehole. Prepare an additional 10% of expected volume to compensate for settlement during grouting.

- Tremie pump cement/bentonite grout slurry into the borehole, starting from the bottom to the natural ground surface.

- The grout slurry will consist of the following ratio of components:

  - 94 pounds of Portland cement.
  - 4 pounds of pure sodium bentonite powder.
  - No more than 6.5 gallons of potable water.

- All grouted boreholes should be checked on the day after grouting if further settlement has occurred. Boreholes greater than 50 feet deep should be checked 2-3 days after the abandonment.

## 4.2 MONITORING WELL ABANDONMENT

Monitoring wells may be abandoned based on the following criteria:

- Results of a survey of the condition of the monitoring wells (e.g., well construction and damage).

- Difficulties encountered during drilling (e.g., prolonged loss of circulation and borehole collapse).

- Regulatory requirement.

The field team will document these or other difficulties in the GEOLIS logbook, and relay this information to the supervisor. One or more of these individuals will determine whether abandonment is necessary.

The following well abandonment procedures will be followed:

- Break up cement pad, remove demolition debris, pull outer steel protective casing with drilling rig (if possible), and remove PVC inner casing (if possible) or cut to a workable level.

- Overdrill to the total depth of the well using hollow-stem augers large enough to encompass the diameter of the original borehole.

- Remove remaining PVC casing and screen.

- Tremie pump a grout slurry into the borehole starting from the bottom to ground surface.

- An alternative option is to abandon the well in place by tremie pumping grout as directed previously. This procedure, however, must be approved before abandonment of the well.

## 5. REFERENCES

99-0164 American Society for Testing and Materials (ASTM). 1992. "Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities." ASTM Standard D5299-92, p. 156-171. In: American Society for Testing and Materials (ASTM), 1996, *ASTM Standards for Groundwater and Vadose Zone Investigations: Drilling, Sampling, Well Installation, and Abandonment Procedures*. West Conshohocken, PA, ASTM Publication: 03-418196-38.

# STANDARD OPERATING PROCEDURE GW-2

# LOW STRESS (LOW FLOW) GROUNDWATER PURGING AND SAMPLING

# STANDARD OPERATING PROCEDURE GW-2

# LOW STRESS (LOW FLOW) GROUNDWATER PURGING AND SAMPLING

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) is in accordance with the EPA Region I Low Stress (Low Flow) SOP: SOP No. GW 0001, Revision Number 2, dated July 30, 1996 (99-0167). This SOP provides a general framework for collecting groundwater samples that are indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with mobile particulates). This SOP emphasizes the need to minimize stress by low water-level drawdowns, and low pumping rates (usually less than 1 liter/min) in order to collect samples with minimal alterations to water chemistry. This SOP is aimed primarily at sampling monitoring wells that can accept a submersible pump and have a screen, or open interval length of 10 feet or less (this is the most common situation); however, this procedure is flexible and can be used in a variety of well construction and groundwater yield situations. Samples thus obtained are suitable for analyses of groundwater contaminants (volatile and semivolatile organic analytes, pesticides, PCBs, metals, and other inorganics), or other naturally occurring analytes.

This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs and DNAPLs).

The screen, or open interval of the monitoring well, should be optimally located (both laterally and vertically) to intercept existing contaminant plume(s) or along flowpaths of potential contaminant releases. It is presumed that the analytes of interest move (or potentially move) primarily through the more permeable zones within the screen, or open interval.

Proper well construction and development cannot be overemphasized, because the use of installation techniques that are appropriate to the hydrogeologic setting often prevents “problem well” situations from occurring. It is also recommended that, as part of development or redevelopment, the well should be tested to determine the appropriate pumping rate to obtain stabilization of field indicator parameters with minimal drawdown in the shortest amount of time. With this information, field crews can then conduct purging and sampling in a more expeditious manner.

The mid-point of the saturated screen length (which should not exceed 10 feet) is used by convention as the location of the pump intake; however, significant chemical or permeability contrast(s) within the screen may require additional field work to determine the optimum vertical location(s) for the intake, and appropriate pumping rate(s) for purging and sampling more localized target zone(s). Primary flow zones (high(er) permeability and/or high(er) chemical concentrations) should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock. Targeting these zones for water sampling will help ensure that the low stress procedure will not underestimate contaminant concentrations. The Work Plan should provide clear instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the remaining criteria in this procedure are met. If after 4 hours of purging indicator field parameters have not stabilized, one of 3 optional courses of action may be taken: (1) continue purging until stabilization is achieved; (2) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization); and (3) discontinue purging, collect samples, and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may not meet the sampling objectives). Option 3 is the normally selected option.

Changes to this SOP should be proposed and discussed when the site Work Plan is submitted for approval. Subsequent requests for modifications of an approved plan must include adequate technical justification for proposed changes. All changes and modifications must be approved before implementation in the field.

# 2. EQUIPMENT

## 2.1 EXTRACTION DEVICE

Adjustable rate, submersible pumps are preferred (for example, Redi-flo 2 or bladder pump constructed of stainless steel or Teflon).

Adjustable rate, peristaltic pumps (suction) may be used with caution. Note that EPA guidance states: "Suction pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" (EPA/5-40/P-87/001, 1987, page 8.5-11) (99-0185).

## 2.2 TUBING

Teflon or Teflon-lined polyethylene tubing is preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs, and inorganics.

PVC, polypropylene, or polyethylene tubing may be used when collecting samples for inorganics analyses; however, these materials should be used with caution when sampling for organics. If these materials are used, the equipment blank (which includes the tubing) data must show that these materials do not add contaminants to the sample.

Stainless steel tubing may be used when sampling for VOCs, SVOCs, pesticides, and PCBs; however, it should be used with caution when sampling for metals.

The use of 1/4 inch or 3/8 inch (inner diameter) tubing is preferred. This will help ensure the tubing remains liquid filled when operating at very low pumping rates.

Pharmaceutical grade (Pharmed) tubing should be used for the section around the rotor head of a peristaltic pump to minimize gaseous diffusion.

## 2.3 SUPPLIES

- Water level measuring device(s) capable of measuring to 0.01-foot accuracy (electronic "tape," pressure transducer). Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level “tape” at the start and end of each record.

- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Interface probe, if needed.
- Power source (generator, nitrogen tank, etc.).
  - If a gasoline generator is used, it must be located downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate the samples.
- Indicator field parameter monitoring instruments such as the YSI model 6820 - pH, Eh, dissolved oxygen (DO), turbidity, specific conductance, and temperature. Use of a flow-through-cell is required when measuring all listed parameters, except turbidity. Standards to perform field calibration of instruments and analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846. For Eh measurements, follow manufacturer’s instructions.
- Decontamination supplies (for example, non-phosphate detergent, distilled/de-ionized water, isopropanol, etc.) (see SOP G-2).
- Logbook(s) and other forms (for example, well purging forms).
- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags or labels.
- Well construction data, location map, field data from last sampling event.
- Well keys.
- Site-specific Work Plan.
- PID or FID instrument (if appropriate) to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

## 3. RELATED PROCEDURES

G-1 Calibration of Field Screening Instruments

G-2 Decontamination

G-3 Field Documentation

G-5 Field Measurements

G-6 Field Sample Numbering

G-7 Management of IDW

G-9 Quality Assurance/Quality Control Sampling

G-10 Sample Documentation

G-11 Sample Packing and Shipping

SS-1 Determination of Presence of Free Product

GW-4 NAPL Sampling

GW-8 Water Level Measurements

# 4. PROCEDURE

## 4.1 PRELIMINARY SITE ACTIVITIES

- Check well for security damage or evidence of tampering; record pertinent observations.

- Lay out sheet of clean polyethylene for monitoring and sampling equipment.

- Remove well cap and immediately measure VOCs at the rim of the well with a PID or FID instrument, and record the reading in the field logbook.

- If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook.

- A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. It is recommended that water level depth (to 0.01 ft) and total well depth (to 0.1 ft) be measured the day before, in order to allow for re-settlement of any particulates in the water column. If measurement of total well depth is not made the day before, it should not be measured until after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

- Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe are usually not needed unless analytical data or field head space information signal a worsening situation. Note: procedures for collection of LNAPL and DNAPL samples are addressed in SOP GW-4, NAPL Sampling.

## 4.2 PURGING AND SAMPLING PROCEDURE

Sampling wells in order of increasing chemical concentrations (known or anticipated) is preferred.

### 4.2.1 Install Pump

Lower pump, safety cable, tubing, and electrical lines slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. The Work Plan should specify the sampling depth, or provide criteria for selection of intake depth for each well. If possible, keep the pump intake at least two feet above the bottom of the well to minimize mobilization of particulates present in the bottom of the well. Collection of turbid free water samples may be especially difficult if there are two feet or less of standing water in the well.

### 4.2.2 Measure Water Level

Before starting pump, measure water level. If recording pressure transducer is used, initialize starting condition.

### 4.2.3 Purge Well

#### *4.2.3.1 Initial Sampling (Well Not Previously Sampled)*

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 foot). If the minimal drawdown that can be achieved exceeds 0.3 foot but remains stable, continue purging until indicator field parameters stabilize.

Monitor and record water level and pumping rate every 3 to 5 minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 0.1 - 0.4 l/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first 15 minutes of pumping in order to help minimize purging time. During pump startup, drawdown may exceed the 0.3-foot target and then "recover" as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally, the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

#### *4.2.3.2 Subsequent Sampling*

After the synoptic water level measurement round, check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). Perform purging operations as above.

### 4.2.4 Monitor Indicator Field Parameters

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, Eh, DO) every 3 to 5 minutes (or less frequently, if appropriate). Note: during the early phase of purging, emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at 3- to 5-minute intervals, are within the following limits:

- Turbidity (10% for values greater than 1 NTU).

- DO (10%).
- Specific conductance (3%).
- Temperature (3%).
- pH (± 0.1 unit).
- ORP/Eh (± 10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through cell. Transparent flow-through cells are preferred, because they allow field personnel to watch for particulate buildup within the cell. This buildup may affect indicator field parameter values measured within the cell, and may also cause an underestimation of turbidity values measured after the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities.

The flow-through cell must be designed in a way that prevents air bubble entrapment in the cell. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must be submerged in water at all times. If two flow-through cells are used in series, the one containing the dissolved oxygen probe should come first (this parameter is most susceptible to error if air leaks into the system).

### 4.2.5 Collect Water Samples

Water samples for laboratory analyses must be collected before water has passed through the flow-through cell (use a by-pass assembly or disconnect cell to obtain sample).

VOC samples should be collected first and directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help ensure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples: (1) add clamp, connector (Teflon or stainless steel) or valve to constrict sampling end of tubing; (2) insert small-diameter Teflon tubing into water-filled portion of pump tubing, allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing; (3) collect non-VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect sample, and record new drawdown, flow rate, and new indicator field parameter values.

Add preservative, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved. Check QAPP Section 6 (WESTON, 00-0507) for additional information on preservation. Check pH for all samples requiring pH adjustment to ensure proper pH value. For VOC samples, this will require that a test sample be collected during purging to determine the amount of preservative that needs to be added to the sample containers prior to sampling.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter is required, and the filter size (0.45 µm is commonly used) should be based on the sampling objective. Pre-rinse the filter with approximately 25 - 50 ml of groundwater prior to sample collection. Preserve filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in groundwater for human health risk calculations.

Label each sample as collected. Samples requiring cooling (volatile organics, cyanide, etc.) will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

### 4.2.6 Post Sampling Activities

If recording pressure transducer is used, remeasure water level with tape.

After collection of the samples, the pump tubing may either be dedicated to the well for resampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft), if not measured the day before purging began. Note: measurement of total well depth is optional after the initial low stress sampling event; however, it is recommended if the well has a "silting" problem or if confirmation of well identity is needed.

Secure the well.

# 5. DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires that are in contact with the well) will be decontaminated by one of the procedures listed below.

## 5.1 PROCEDURE 1

The decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump, or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropanol be used sparingly in the decontamination process, and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

1. Flush the equipment/pump with potable water.
2. Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.
3. Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.
4. Flush with isopropanol (pesticide grade). If equipment blank data from the previous sampling event show that the level of contaminants is insignificant, then this step may be skipped.
5. Flush with distilled/deionized water. The final water rinse must not be recycled.

## 5.2 PROCEDURE 2

1. Steam clean the outside of the submersible pump.

2. Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a 3- or 4-inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe, and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

3. Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

4. Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

5. Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

## 6. FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples shall be collected for each batch of samples (a batch may not exceed 20 samples). Trip blanks are required for the VOC samples at a frequency of one set per VOC sample cooler.

- Field duplicate.
- Matrix spike.
- Matrix spike duplicate.
- Equipment blank.
- Trip blank (VOCs).
- Temperature blank (one per sample cooler).

Equipment blank shall include the pump and the pump’s tubing. If tubing is dedicated to the well, the equipment blank will only include the pump in subsequent sampling rounds.

Collect samples in order from wells with lowest contaminant concentration to highest concentration. Collect equipment blanks after sampling from contaminated wells and not after background wells.

Field duplicates are collected to determine the precision of sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

If split samples are to be collected, collect split for each analyte group in consecutive order (VOC original, VOC split, etc.). Split sample should be as identical as possible to original sample.

All monitoring instrumentation shall be operated in accordance with EPA analytical methods and manufacturer's operating instructions (see SOP G-1). EPA analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846 with the exception of Eh, for which the manufacturer's instructions are to be followed. Instruments shall be calibrated at the beginning of each day. If a measurement falls outside the calibration range, the instrument should be re-calibrated so that all measurements fall within the calibration range. At the end of each day, check calibration to verify that instruments remained in calibration. Temperature measuring equipment, thermometers, and thermistors need not be calibrated to the above frequency. They should be checked for accuracy prior to field use according to EPA Methods and the manufacturer's instructions.

## 7. FIELD LOGBOOK

A field log shall be kept to document all groundwater field monitoring activities, and record all of the following:

- Well identification.
- Well depth and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid (NAPL) layers and detection method.
- Pumping rate, drawdown, indicator parameter values, and clock time, at the appropriate time intervals; calculated or measured total volume pumped.
- Well sampling sequence and time of each sample collection.

- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations during sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.
- Any problems encountered should be highlighted.
- Description of all sampling equipment used, including trade names, model number, diameters, material composition, etc.

## 8. REFERENCES

00-0507 WESTON (Roy F. Weston, Inc.). March 2001. *Quality Assurance Project Plan.* Environmental Remediation Contract, GE/Housatonic River Project. Volumes I, II, IIA, and IV. DCN GE-021601-AAHM.

99-0167 U.S. Environmental Protection Agency (EPA) Region I. 1996. *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells.* SOP No. GW 0001, Revision Number 2, July 30, 1996.

99-0185 U.S. Environmental Protection Agency (EPA). 1987. *A Compendium of Superfund Field Operations Methods.* Office of Emergency and Remedial Response, Washington, DC, EPA/5-40/P-87/001.

# STANDARD OPERATING PROCEDURE GW-3

# GROUNDWATER MONITORING WELL INSTALLATION

# STANDARD OPERATING PROCEDURE GW-3

# GROUNDWATER MONITORING WELL INSTALLATION

## 1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate the quality control measures required to ensure the accurate installation of groundwater monitoring wells. The term monitoring well is used to denote any environmental sampling well.

All groundwater wells will be installed in accordance with ASTM Standard D-5092-90, Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers (99-0164).

## 2. EQUIPMENT

### 2.1 DRILLING EQUIPMENT

- Appropriately sized drill rig adequately equipped with augers, bits, drill stem, etc.
- Steam cleaner and water obtained from an approved source for decontaminating drilling equipment
- PID
- Water level indicator
- LEL-oxygen monitor
- Steel drums for investigation derived waste (drill cuttings, contaminated PPE, decon solution) (if necessary)
- Source of approved water
- Heavy plastic sheeting
- Decontamination area

### 2.2 WELL INSTALLATION MATERIALS

The specifications for the following materials are included in the well construction:

- Well screen
- Riser pipe
- Plugs/caps
- Filter pack
- Bentonite
- Portland cement
- Steel protective casing
- Submersible pump
- Surge block
- Concrete

### 2.3 DOCUMENTATION

- Health and Safety Plan
- Excavation Permits
- Utility clearances
- Borehole logging form
- Well completion forms
- Appropriate work plan

### 2.4 PERSONAL EQUIPMENT

- Appropriate PPE (see HASP)
- Munsell color chart
- Hand lens
- Folding rule
- First aid kit
- Fire extinguisher

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| G-3 | Field Documentation |
| G-7 | Management of IDW |
| SS-1 | Determination of the Presence of Free Product |
| SS-6 | Soil Sampling |
| GW-1 | Borehole/Well Abandonment |

GW-8 Water Level Measurements

# 4. WELL DRILLING PROCEDURE

## 4.1 RATIONALE

Sound groundwater sample integrity is dependent primarily on strict adherence to properly conceived monitor well construction and development procedures. In addition, it is equally important that boreholes (i.e., soil borings, wells, and piezometers) be abandoned properly, when necessary, to preclude the possibility of cross-contamination of water-bearing zones. To ensure that these goals are met, the following monitoring well drilling and completion procedures will be utilized.

## 4.2 PRELIMINARY PROCEDURES

Never assume the rig will arrive on-site completely decontaminated from the previous job. Always inspect it. Road dust can have elevated levels of organics and inorganics attached to it. It is always a good idea to have the drillers lay out all the tools from their side tool panels and wash both the tools and the storage compartments. Between holes and on-site locations, ensure that dirty tools are decontaminated before being returned to these compartments.

The following standard field procedures should be followed at each borehole location:

- Check the location and number of the drilling location against a map and against the flag or stake. A good rule of thumb is to measure twice, and drill once. Make sure you have a utility clearance for that location.
- Back the rig into position so you do not have to drive over the finished hole.
- Set up the work area (and sample holding area) to be upwind of the rig exhaust. This may require the work area to be moved several times during the day.
- Check the condition of the driller's downhole measuring device. Often these devices are missing several inches, tenths of inches, or feet, and, if used, will result in contradictory hole and well completion information. Remove any electrical tape or materials from any devices that, if lost downhole, could result in possible contamination of groundwater. Ensure that the measuring device is decontaminated each time it is used.

- Drilling is a team effort that includes WESTON personnel and the driller. Arrange with the driller before activities begin to keep you informed of what he/she sees or believes is happening downhole. For example, the driller can often tell you when the soil is getting harder or softer, or when he/she is losing or gaining fluids (the hole is making water). These comments often may be related later to lithologic and hydrostratigraphic changes and, therefore, may verify WESTON logs.

## 4.3 HOLLOW-STEM AUGER DRILLING

Hollow-stem auger (HSA) drilling techniques will be employed to advance most of the borings. HSA drilling uses a series of interlocking auger flights that consist of a continuous spiral or thread that is wrapped around and welded to a central hollow (tubular) stem or axle. The finished tool resembles a wood or machine screw, but without the taper. The lead auger has a set of teeth that cut into the penetrated earth materials. The auger threads then convey the cuttings to the surface. Hollow-stem augers are specified by their inside diameter (ID) and not the outer diameter (OD) of the hole they drill. All HSA drilling will be conducted in accordance with ASTM Standard D5784-95, Standard Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water Quality Monitoring Devices (99-0164).

### 4.3.1 Advantages

- Usually smaller sized rig than other drilling methods, resulting in more mobility. Shorter boom also allows this type rig to drill in areas of low clearance.
- Generally less messy than mud rotary techniques that require a water supply and may result in the need to containerize drilling fluids (e.g., muds) as well as cuttings.
- Because no drilling muds are used (introduced to the hole), soil and groundwater samples are considered more accurate or representative. Well development time should also be less than for the methods that use mud.
- Sample moisture content is more likely to be representative of the formation.
- Small-diameter monitoring wells can be installed quickly and efficiently. The augers provide a temporary casing that prevents hole collapse, and there are no extra drilling fluids with which to contend.

### 4.3.2 Limitations

- Limited in depth of penetration to approximately 75 feet (even less as auger size increases), depending on the materials encountered and the size of the drill rig.
- Difficult to drill through running or heaving sands.
- Can smear a layer of fine-grained soil on the side of borehole that may prevent groundwater from entering. In tight formations or in areas of difficult drilling, the friction of the augers may bake this skin, resulting in the finished well having limited or no recharge. The finer the matrix, the greater the chance for smearing the side of the hole.
- The augers can carry contamination down the hole during the drilling process.
- In many formations, the auguring process can be slower than other methods.
- Not effective in gravelly or in bouldery soils.
- The method limits the size of hole that can be drilled.
- Generally limited to overburden, weathered, or extremely soft bedrock.

### 4.3.3 Procedures

- Once the rig is in place, ensure that it is level by insisting that the driller have a carpenter's level on each rig. Use the level on the rig and the auger. Some rigs have built-in bubble levels. Hanging the first auger and visually assessing its plumbness is not as acceptable, particularly on holes expected to be 15 feet or greater in depth.
- The first split-spoon is generally taken outside the augers. Standard blow count procedures, including the American Society of Testing Methods (ASTM) prescribed hammer weight and fall distances, must be followed and documented. Samples within the first 1 to 2 feet of the surface are often compressed by the split-spoon advancement process, resulting in what appears to be reduced recoveries.
- Be sure to measure and record the outer diameter of the augers (these may be worn and quite a bit less than the manufacturer's claim). These data are required for GEOLIS input (hole width).
- Do not allow the driller to *double spoon* during sampling. This is done by sampling an interval (e.g., 5 to 7 ft below ground surface (bgs)) and, without auguring over that interval, immediately sampling the next interval (e.g., 7 to 9 ft bgs) using the previous split-spoon's hole for guidance. This usually results in soil from the upper hole collecting in the second spoon, thereby compromising the sample.

- After the first sample is collected, a 5-foot length of auger is advanced, and a split-spoon sample is collected from 5 to 7 feet. This is referred to as a 5-foot sampling interval. Continuous sampling is done by split-spooning an interval (e.g., 10 to 12 feet), then advancing the augers over that same interval. So the next sample would be taken ahead of the augers, from 12 to 14 feet and so on.

- A center plug, which prevents earthen materials from moving up into the augers, should be used in all but the hardest of sediments. The center plug is connected to the drive head of the rig by rods to ensure that the plug and rods rotate with the auger flights.

- The rods used to lower the split-spoon into the augers are also used, along with the auger count, to measure the relative position of the spoon from the surface. Inspect the rods prior to use to ensure that they are the lengths the drillers perceive them to be.

- Carefully watch the progression of the spoon while recording blow counts and note irregularities in the penetration rate. The use of “fingers” or sand catchers in the sampler may help produce better retrieval volumes in non-cohesive soils.

- Record observations of:

  - Auger penetration rates.

  - Characteristics of auger cuttings (i.e., moisture content, color, and texture), including changes in the nature (behavior) of the cuttings. For example, if the soil begins to form balls or *rope,* moisture in the soil has probably increased at that depth.

  - Gravel, boulders, and competent bedrock will make the rig bounce, vibrate, or *dance* as well as chatter.

  - Steam coming off the augers. Slow the rig down if possible to prevent baking.

  - Remember that the cuttings appear at the surface after a time lag, and that this lag increases with the depth of the hole; therefore, it is not possible to correlate cuttings with the exact depth being drilled.

- Running, heaving, or flowing sands occur when augers intercept a saturated soil unit whose fluid or formational pressure pushes its materials out into the boring and up the augers. The use of a center plug can help prevent this from happening, but not after the fact. If running sands are encountered, the following techniques may be used:

  - Remove augers and continue the hole using the rotary-flush (case-and-wash or drive-and-wash) technique (this technique will be used unless directed otherwise; see Subsection 4.4).

  - Fill the augers with potable water to apply a reverse/positive pressure against that of the sands.

  - Drill down below the running sand unit and muck out the augers using a sand pump, dart bailer, and/or roller bit wash.

- Drilling into or through sand (flowing and non-flowing), gravel, or expanding clay (i.e., clay units that, because of overburden pressures, expand into the hole) can lock up and bind the augers. Avoid leaving the augers in the hole for any prolonged period (e.g., overnight) if any of these conditions are encountered. This may be difficult when rock coring is required.

- Record on a routine basis the levels of any fluids (depth to water and/or product) in the auger string.

- Depth to bedrock is based on a combination of both split-spoon and auger refusal. If spoon refusal (50 blows with no penetration) is met and the recovered sample does not verify bedrock, attempt to auger deeper. A boulder may have stopped the spoon. Continuing the hole using the augers may push the obstruction aside. If the augers advance, continue to the next scheduled sampling internal and attempt to collect another spoon sample. Continue this process until both the spoon and augers have met refusal. Document all refusals (being careful to label them as being either spoon or auger refusal), rig gyrations, and physical conditions of spoons. The only sure way to determine bedrock refusal is to take a core.

- If a boulder is struck with the augers and the target depth has not been achieved, move approximately 5 feet away from the hole if you are installing a well (10 feet away if you are not) and begin drilling a new borehole. Ensure that the original borehole is properly abandoned (see SOP GW-1).

- The 6-inch ID augers used for 2-inch diameter groundwater monitoring well placement can generally be used to a depth of 50 feet. At locations where the overburden is greater than 50 or where heaving sands are expected, HSA methods may be replaced with the case-and-wash drilling method described in the following subsections.

## 4.4 CASE-AND-WASH

In areas where the hollow stem auger method are inappropriate (e.g., drilling through a confining unit or in areas where the borehole will not stay open), case-and-wash drilling or drive-and-wash (DAW) procedures may be used. Once the casing depth is reached (not more than 5 feet into the confining unit), the augers are filled with water to keep the hole open after the augers are removed. A permanent casing is next set 5 feet into the confining unit. The casing should not be pushed or driven into the confining unit. The casing is cemented in place using a cement/bentonite grout. Once the cement has set (a minimum of 12 hours), a smaller diameter temporary drive casing is inserted into the permanent casing. The hole is then finished to the target depth by alternating split-spoon sampling and washing ahead using a roller bit (which cuts ahead of the temporary casing) and potable water as the circulating fluid. Intermediate casing can be installed without grouting if cross-contamination is not of concern and the primary purpose is to maintain an open hole in running sands.

### 4.4.1 Advantages

- More effective against running/heavy sands than HSA drilling techniques.
- Relatively rapid in terms of downhole drilling speed compared with HSA.
- Water is used to advance the hole (rather than mud), and development time is shortened with a resulting decrease in the volume of wastewater for disposal. Sample integrity is less likely to be uncertain.
- Reduced borehole smearing and baking.

### 4.4.2 Limitations

- Limited by the initial size of the auger hole.
- Slower than methods that do not require casing to be advanced with the bit.
- Requires a large source of potable water.
- Wastes and fluids may require disposal.

### 4.4.3 Procedures

- It is important to measure and document water levels during each of the drilling procedures. Measure water or fluid levels in the permanent casing and, as drilling proceeds, in the temporary casing as an indication of vertical head differences between the two intercepted units.
- Displace mud between the borehole wall and the permanent casing by tremie grouting with a cement/bentonite.
- Wait a minimum of 12 hours for the cement grout to harden before re-entering the hole to drill.
- Before the temporary casing has been put in-place and after the cement is cured, remove by suction, bailer, or pump the mud from inside the permanent casing. This mixture is potentially contaminated with chemicals from the upper water-bearing

zone, and needs to be containerized and disposed of properly. The casing needs to be rinsed out as thoroughly as possible to remove any residue of contaminated mud. Similarly, the mud pan also needs to be cleaned. Once these activities have been done, fresh, potable water can be added to the hole, and the temporary casing can be advanced through the low-permeability unit that the permanent casing is keyed into.

- Keep a record of downhole depths. When practical, measure or verify rod lengths.
- Document drilling rates as an indication of lithologic change. Ask the driller to inform you of the changes he/she feels with the rig, or when there are changes in fluid pressures. Fluid losses in unconsolidated materials may be indicative of porosity and permeability.
- Keep a log of fluid used and lost during the drilling process. The quantity of fluids lost in the targeted screened interval should be added to the net number of volumes of water evacuated from a well during development.

# 5. WELL CONSTRUCTION

## 5.1 MATERIALS

### 5.1.1 Casing/Screen

Typically, only polyvinyl chloride (PVC), Teflon (polytetrafluoroethylene or PTFE), and/or stainless steel will be used. All PVC screens, casings, and fittings will conform to the National Sanitation Foundation (NSF) Standard 14 for potable water usage or Annual Book of ASTM Standards: Volume 08.04, F-480-88A, and bear the appropriate rating logo. If screen and/or casing manufacturers or suppliers remove or do not apply this logo, WESTON will verify that NSF or ASTM has appropriately rated the screens and/or casing. All materials will be as chemically inert as technically practical with respect to the site environment. All well screens will be commercially fabricated, slotted or continuously wound, and have an inside diameter (ID) equal to or greater than the ID of the well casing. An exception may be needed in the case of continuously wound screens because their supporting rods may reduce the full ID. Stainless steel screens may be used with PVC or PTFE well casing. No fitting will restrict the ID of the joined casing and/or screen. All screens, casings, and fittings will be new. Screens will have the largest open area per unit length that is practical for the adjacent aquifer and available filter. Couplings within the casing and between the casing and screen will be compatibly threaded.

Thermal or solvent welded couplings on plastic pipe will not be used. This also applies to threaded or slip-joint couplings thermally welded to the casing by the manufacturer or in the field.

Each cap will be constructed to preclude binding to the well casing due to tightness of fit, unclean surface, or frost, and secure enough to preclude debris and insects from entering the well. Caps and risers may be threaded; however, sufficient annular space will be allowed between the well and protective casing to enable one to thaw any frosted shut caps. Preferably, unfiltered vents will *not* be placed in these caps or in the well riser/stickup. Unfiltered vents may compromise water sample integrity by allowing foreign materials to enter the well between sampling events. Caps will be loose enough to allow equilibration between hydrostatic and atmospheric pressures or have filtered vents. Special cap (and riser) designs will be provided for wells in floodplains and those instances where the top of the well may be below grade, e.g., in roadways and parking lots.

The use of well centralizers will be considered for wells deeper than 20 ft. When used, they will be of PVC, PTFE, or stainless steel and attached to the casing at regular intervals by means of stainless steel fasteners or strapping. Centralizers will not be attached to the well screen or to that part of the well casing exposed to the granular filter or bentonite seal. Centralizers will be oriented to allow for the unrestricted passage of the tremie pipe(s) used for filter pack and grout placement.

### 5.1.2 Filter Pack

All granular filters will be approved prior to drilling and will be discussed in the work plans. Discussions will include composition, source, placement, and gradation. If the actual gradation is to be determined during drilling, then more than one filter pack gradation will be on hand so that well installation will not be unnecessarily delayed.

Granular filter packs will be visually free of material that would pass through a No. 200 (75-micrometer (µm)) sieve, inert, siliceous, composed of rounded grains, and of appropriate size for the well screen and host environment. The filter material will be packaged in bags by the supplier and therein delivered to the site.

### 5.1.3 Bentonite Seal

Bentonite is the only material that is allowed for sealing or as drilling mud under normal circumstances. This includes any form of bentonite (powders, granules, or pellets) intended for drilling mud, grout, seals, etc. Chips or pellets of an appropriate size depending on the annular space available will be used to form the well seal. If chips are used, they should be sieved to remove fine-grained material.

Organic additives will not be used in drilling mud. An exception might be made for some high yield bentonites, to which the manufacturer has added a small quantity of polymer. The use of any bentonite will be discussed in the work plans. Bentonite will only be used if absolutely necessary to ensure that the borehole will not collapse or to improve cuttings removal.

### 5.1.4 Grout

Grout, when used in monitor well construction or borehole/well abandonment, will be composed of Portland cement, bentonite (0-10% dry bentonite per 94-lb sack of dry cement), and a maximum 6 to 7 gallons of approved water per sack of cement. The amount of water per sack of cement required for a pumpable mix will vary with the amount of bentonite used. The amount of water used will be kept to a minimum. Neither additives nor borehole cuttings will be mixed with the grout.

All grout materials will be combined in an aboveground rigid container or mixer, and mechanically (not manually) blended on-site to produce a thick, lump-free mixture throughout the mixing vessel. The mixed grout will be recirculated through the grout pump prior to placement. Grout will be placed using a grout pump and pipe/tremie. The grout pipe will be of rigid construction for vertical control of pipe placement. Drill rods, rigid PVC, or metal pipes are suggested stock for tremie pipes. If hoses or flexible plastics must be used, they may have to be fitted with a length of steel pipe at the downhole end to keep the flexible material from curling and embedding itself into the borehole wall. This is especially true in cold weather when the coiled material resists straightening. Grout pipes will have side discharge. The side discharge will help to maintain the integrity of the underlying material (especially the bentonite seal).

## 5.2 WATER SOURCE

To the extent practical, the use of drilling water will be held to a minimum. When water usage is deemed necessary, the source of any water used in drilling, grouting, sealing, filter placement, well installation, well decommissioning/abandonment, equipment washing, etc. will be approved prior to arrival of the drilling equipment on-site and specified in the work plans. Desirable characteristics for the source include:

- An uncontaminated aquifer origin.
- Wellhead upgradient of potential contaminant sources.
- Be free of survey-related contaminants by virtue of pretesting (sampling and analysis using a laboratory validated for those contaminants using methods within that validation).
- The water is untreated and unfiltered.
- The tap has accessibility and capacity (greater than 10 gpm) compatible with project schedules and equipment.
- Only one designated tap for access.
- Surface water bodies will not be used, if at all practical.

If a suitable source exists on-site, that source will be used. The drilling subcontractor will have the responsibility to procure, transport, and store the water required for project needs in a manner to avoid the chemical contamination or degradation of the water once obtained. The drilling subcontractor will also be responsible for any heating, thermal insulation, or agitation of the water to maintain the water as a fluid for its intended uses.

## 5.3 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

Materials will be delivered to the site and stored in a secure area. Subcontractors are generally responsible for scheduling delivery and ordering those supplies pertaining to the installation of wells. An inventory will be kept to track the materials. Perishable materials will be covered with tarps and secured to prevent water damage. All materials will be handled in a safe manner and in accordance with health and safety protocols.

# 6. WELL INSTALLATION

## 6.1 PREPARATION

Every morning before entering the field, the field team and drilling subcontractor will meet to discuss the location and construction criteria for the day's activities. The field geologist will also ensure that the drilling subcontractor obtains all necessary supplies for the day's work (e.g., bentonite, Portland cement, and screen and riser), and has decontaminated all equipment and manmade construction materials to be used downhole (e.g., augers and PVC or stainless steel screen and riser). All available areal data (e.g., borehole logs) should be reviewed to determine expected formation depths prior to the day's drilling.

## 6.2 DOCUMENTATION

During any activities pertaining to well construction, abandonment, or development, the field geologist will note in the GEOLIS logbook the following information:

- Length of time required to perform all drill rig activities (e.g., overdrilling, well construction, abandonment/grouting, development times, and pumping rates).
- All well construction/abandonment supplies used (e.g., bentonite, Portland cement, filter sand, and screen/riser footage).
- Any difficulties in well construction, development, or abandonment. This information may be used to substantiate a change of scope or explain anomalous sampling data.
- Exact measurements (using a tape measure) of screen, end cap trap, and riser lengths.
- A completed well construction diagram.

At the end of the day or the following morning, before commencing with daily activities, the field geologist should go over the day's billing (time and materials). The driller's signature should be obtained acknowledging the accuracy of the figures reported. This is the only information available to verify subcontractor invoices.

- Get a copy of Driller's Log of Activities for the same period.
- Submit Well Completion Form.
- Borehole Completion.

The following procedure will be used to drill wells and piezometers:

- Mobilize to decontamination area.
- Decontaminate all equipment according to SOP G-2.
- Inspect the rig for any leaks (e.g., oil or hydraulic fluid) and the equipment for cleanliness (i.e., lack of dirt and grease). The only lubricant that may be used on equipment that enters a borehole is Teflon tape (with the exception of Numa Lube, which may be used in a downhole hammer).
- Mobilize to the site.
- Survey the well location for utilities, access, and work areas.
- Set up exclusion zone and work areas.
- Set up sampling and monitoring equipment, including a sample description table covered with Visqueen, if appropriate.
- Lithologic samples will normally be collected, field screened with a PID or FID, and described for every 5-foot interval (minimum), or more often if a change in lithology is observed or is required. Augered intervals between split-spoon samples will be described from cuttings when practical.
- Record all observations in the GEOLIS® logbook. It is critical to note any change in lithology, texture, color, moisture content, and bedding.
- Complete borehole and record completion information in the GEOLIS® logbook.
- Mark boring by appropriate method.
- Clean up area (i.e., leave the site as close to its original condition as possible):
  - Drum or spread any cuttings.
  - Line up, properly seal, and label all drums, noting the type of material in the drum and field instrument readings (see SOP G-7).
  - Remove all trash.

Borehole completion may take one of two forms:

- Piezometer construction.
- Monitor well construction.

Completion procedures for each borehole type are described in the following subsections.

## 6.3 PIEZOMETERS

Piezometers are installed where additional information is needed to more accurately evaluate the groundwater flow direction in a given aquifer. Piezometers can also be used to collect groundwater samples for analytical screening purposes.

### 6.3.1 Construction

The following piezometer construction procedures will be followed:

- Piezometers will generally be constructed in boreholes advanced with 4.25-inch inner diameter (ID), hollow-stem augers.

- Piezometers will be constructed within the augers as the augers are pulled back and will typically be constructed using either 1- or 2-inch-diameter PVC with a 5-foot screen length and a threaded bottom cap with a drain hole drilled in the bottom cap to allow drainage if the water table drops below the total depth of the piezometer. The well screen will be machine-slotted with No. 10 slots (0.010 inch). The screened section will be threaded to attach to the PVC riser pipe. PVC cement will never be used to joint sections.

- Place decontaminated PVC screen and riser into the auger.

- Use Morie No. 1 or finer sand to create a filter pack that will extend from total depth to approximately 1 to 2 feet above the top of the screen as the augers are withdrawn from the borehole.

- Place a 2- to 3-foot-thick bentonite pellet seal above the filter pack. Add pellets slowly to minimize the risk of *bridging* that could result in inadequate sealing properties. Allow pellets to hydrate for 10 to 15 minutes. If the seal is located above the water table (dry), use a pure bentonite slurry or pour potable water on the pellets to cause them to hydrate. Depending on the hydrogeologic conditions encountered in the borehole and/or intended use, actual screen and filter pack lengths may vary (e.g., 1- or 2-foot screens may be used). The PM is responsible for approving any nonstandard construction details based on intended use and lithologic constraints.

- Tremie grout a cement/bentonite grout slurry from the top of the seal to 4 feet below ground surface (ft bgs). The grout slurry will consist of the following ratio of components:
  - 94 pounds of Type I Portland cement.
  - 4 pounds of pure sodium bentonite powder.
  - No more than 6.5 gallons of potable water.

- Proper grouting techniques are required to prevent cross-contamination. Thus, it is imperative that the field team closely supervise all grouting operations.

- Two piezometers may be installed in the same borehole if logistics warrant this type of procedure (i.e., difficult access or thick concrete at the ground surface). Nested piezometer installation will be conducted as described previously, except that a bentonite seal will be installed as an impermeable layer between the screened intervals. Specifically, the lower screen's bentonite seal will extend to 1 foot below the proposed depth of the upper screen. A minimum 1-foot-thick filter pack base (normally 2 feet thick) will be added to avoid possible contact of the upper screen with the bentonite seal.

- Complete the piezometer as directed in Section 7.

## 6.4 OVERBURDEN MONITORING WELLS

### 6.4.1 Specifications

Overburden monitor wells generally will be constructed in a borehole advanced by hollow-stem augers and without the use of drilling fluids, where possible; however, in areas of running sands or difficult drilling, case-and-wash techniques, using 8-inch ID, hardened-steel casing with a drive shoe and a tricone roller technique, will be used. For descriptive purposes, split-spoon samples will normally be collected at 5-foot intervals, or more frequently at the discretion of the supervising geoscientist. Lithology will be described following GEOLIS procedures. All water used for drilling operations and well development will be obtained from documented supply wells.

The overburden wells will generally monitor 5- to 10-foot intervals, or as specified in the work plan; however, screen length may be modified by the field geologist to accommodate specific data needs. Proposed screened intervals may be changed based on the results of soil screening with a PID or FID, or when highly permeable zones are encountered. Wells installed to monitor the water table will be screened from approximately 3 feet above the existing water level in the borehole to approximately 7 feet below this level to allow for seasonal groundwater table fluctuations. Where floating product is suspected to exist, screens will be installed to extend 5 feet above the water table.

After completion of the borehole, the monitor well will be constructed using either Schedule 40 PVC or Schedule 5 Type 304 stainless steel riser and well screen. PVC well screen will be machine-slotted, and stainless steel well screen will be steel-wound. Stainless steel materials may be used for recovery well construction or where very high concentrations of organic contaminants are suspected. Well screen slot sizes for both PVC and stainless steel wells will be No. 10 or 20 (0.010 or 0.020 inch), depending on the grain size of the formation outside the screen. Filter pack and well slot size will be selected based on the mean grain size of the most finely grained geologic deposits in the screened interval, and should be designed to retain most of the formation.

Morie or equivalent sand, used for the sand pack, should not extend less than 2 feet above the top of the screen. The mean grain size of the filter pack should be twice the mean grain size of the formation material based on lithologic information. A seal consisting of pure sodium bentonite pellets or chips, approximately 3 feet thick, will be placed above the filter pack. If the seal is above the water table, the pellets will be hydrated with potable water. Cement/bentonite grout will be tremied into place from the top of the bentonite seal to within 4 feet of the ground surface. The protective casing will then be installed, and grout will be added to the annulus between the borehole and the exterior wall of the protective casing. To prevent frost heaving, a pure bentonite slurry will be added to the annulus between the well casing and the interior of the protective casing. Each batch of grout will be mixed to consist of 94 pounds of Type I Portland cement or equivalent, 4 pounds of pure sodium bentonite powder, and not more than 6.5 gallons of potable water. The bentonite pellets and grout seal should be a minimum of 5 feet thick (2 feet of pellets and at least 3 feet of cement/bentonite grout).

All well casing will be decontaminated as described in SOP G-2. PVC and stainless steel casing and screen will be joined with flush-threaded joints. Glue is not permitted to join casing or screen. If a slip cap is used for a bottom cap, it should be affixed to the well screen using stainless steel screws. All PVC will conform to the ASTM Standard F-480-88A or NSF Standard 14 (plastic pipe system). All stainless steel casing will be seamless and free of any lacquers or coatings.

### 6.4.2 Construction

A diagram depicting single-cased groundwater monitoring well construction details is shown in Figure 1. The following construction details will be followed when installing single-cased overburden wells:

- Determine whether PVC or stainless steel materials are required at the location and discuss construction details (screen and filter pack size).
- Lower screen and riser into the augers or temporary casing to the bottom of the well. If the well exceeds 50 feet in depth, two centralizers will be used.
- Add the appropriate grade of Morie or equivalent sand to the annulus around the screen to 2 feet above the screen as the augers are pulled back. If case-and-wash methods are used, the sand will be added while the temporary casing is pulled back.
- Add a 3-foot-thick seal consisting of pure sodium bentonite pellets or chips. If the seal will be above the water table, potable water will be poured on the pellets to cause them to hydrate.
- Pellets will be tamped down to the top of the sand pack and allowed to hydrate for 10 to 15 minutes before the rest of the annulus is grouted.
- Tremie grout (above the bentonite seal).
- Complete well as directed in Section 7.
- **Note:** The bentonite and grout seal should be a minimum of 5 feet thick (2 feet of pellets or bentonite slurry and at least 3 feet of cement/bentonite grout). Deviations from these procedures are sometimes necessary because of field conditions, but must be approved.

# 7. WELL COMPLETION

## 7.1 BACKGROUND

Elements of well protection are intended to protect the monitoring well from physical damage, to prevent erosion and/or ponding in the immediate vicinity of the monitoring well, and to enhance the validity of the water samples.

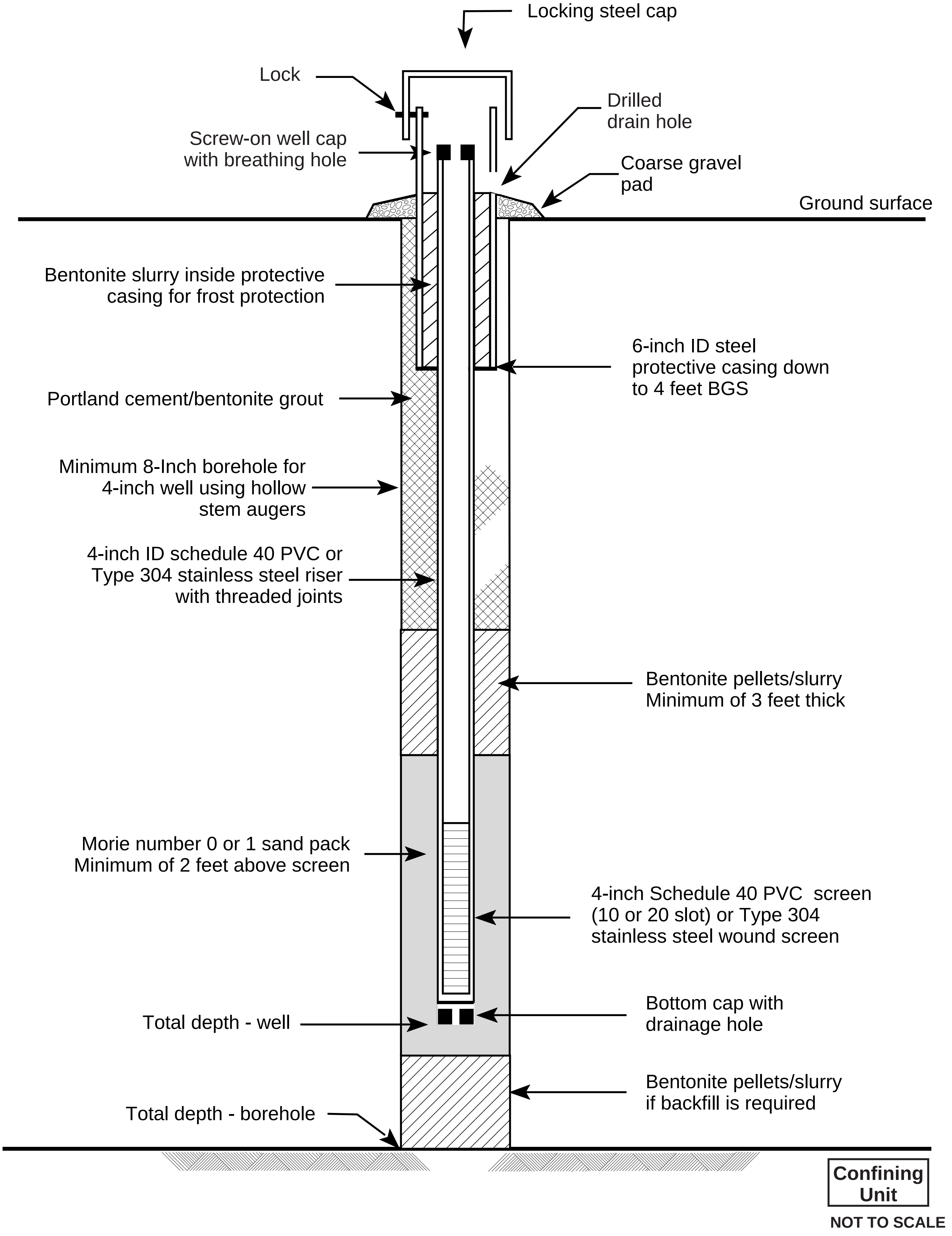


**FIGURE 1**
**TYPICAL OVERBURDEN WELL INSTALLATION**

99P-0604

The potential for physical damage is lessened by the installation of padlocked, protective iron/steel casing over the monitor well and iron/steel posts around the well (when needed for protection). The casing and posts will be new. The protective casing diameter or minimum dimension will be 2 in. greater than the nominal diameter of the monitor well, and the nominal length will be 5 ft. The concrete/cement filled posts will be at least 3 in. in diameter and the top modified to preclude the entry of water. Nominal length of the posts will be 6 ft. Special circumstances necessitating different materials will be addressed in the work plan.

Erosion and/or ponding in the immediate vicinity of the monitoring well may be prevented by assuring that the ground surface slopes away from the monitor well protective casing by the installation of a 2-ft by 2-ft coarse gravel blanket around the well.

Wells will contain a locking cover on the protective casing. The cover will be hinged or telescoped, but not threaded. All locks on these covers should be opened by a single key, if possible.

## 7.2 ABOVEGROUND WELL COMPLETION

Aboveground wells will be completed as follows:

- Extend the well casing 2 to 3 feet above ground surface.
- Provide an end plug or casing cap for each well. Use a filtered vented cap or drill a small (0.125-inch) hole into the PVC riser just below the PVC cap or into the PVC cap to allow air circulation in the well.
- Shield the extended well casing with a carbon steel protective casing that is set over the well casing and cap and extends to a depth of 3 ft bgs.
- Grout the annular space between the borehole and the protective casing with cement/bentonite grout to a depth of 4 ft bgs.
- Fill the annular space between the well casing and the protective casing with pure sodium bentonite slurry to protect the well casing from frost heave.
- Construct a 2- by 2-foot by 4-inch coarse gravel blanket at the surface, sloped away from the protective casing.
- Drill a small diameter hole (0.25- to 0.375-inch) in the protective casing (weep hole) near the top of the cement pad to allow for drainage, and mark a survey location on

the inner casing (mark with an indelible marker or cut a small notch in the PVC on the side toward the hinge).

- Install a lockable cap or lid on the protective casing.
- Mark the well number clearly on the protective casing cap using impact lettering.
- Install three 3-inch-diameter, concrete-filled steel guard posts, if directed to do so by the on-site geologist.
- The guard posts will be 6 feet in total length and installed radially from each well head.
- Recess the guard posts approximately 2 feet into the ground outside of the cement pad and set in concrete approximately 3 to 5 feet from the protective casing.
- Fill each guard post with concrete.
- All wells will be secured as soon as possible after drilling. Corrosion-resistant locks will be used for both flush and aboveground well assemblies. The locks must have extended shanks.

## 7.3 FLUSH-MOUNTED WELL COMPLETION

Groundwater monitoring wells will be completed aboveground at most locations. Where well stickup is of concern, the well will be completed as a flush mount, level with the ground surface.

Flush-mounted wells will be completed as follows:

- Cut the casing 2 to 3 in. bgs, and install a protective locking lid consisting of a cast-iron valve box assembly or manhole cover.
- Center the lid assembly in a 3-foot-diameter concrete pad sloped away from the valve box.
- Provide a cap with a filtered vent for equilibrium and to prevent infiltration of surface water.
- Maintain a minimum of 1 foot of clearance between the casing top and the bottom of the valve box.

Clearly mark the well number on the valve box lid and well casing using an impact-labeling method, and mark a surveying point on the inner casing.

## 8. MAINTENANCE

Wells need to be examined periodically (normally during sampling) to determine if they have been damaged, vandalized, or otherwise compromised, and also to check for evidence of disintegration such as cracked casing, pads, or surface seals, and to check the security of the well (locked cap).

## 9. PRECAUTIONS

- Refer to the Health and Safety Plan for discussions of hazards and preventive measures.
- Make sure all utility clearances have been obtained.
- Be especially observant of overhead hazards (electric, tree, etc.).
- Stop drilling if unexpected refusal is encountered within 10 feet of grade and evaluate cuttings. It may be an unmarked utility or other hazard.

## 10. REFERENCES

99-0164 American Society for Testing and Materials. 1990. ASTM D5092-90, "Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers." In: American Society for Testing and Materials (ASTM). 1996. *ASTM Standards on Ground Water and Vadose Zone Investigations: Drilling, Sampling, Well Installation and Abandonment Procedures,* p. 144-145. ASTM Publication No. 03-418196-38.

99-0164 American Society for Testing and Materials. 1995. ASTM Standard D5784-95, "Standard Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water Quality Monitoring Devices." In: American Society for Testing and Materials (ASTM). 1996. *ASTM Standards on Ground Water and Vadose Zone Investigations: Drilling, Sampling, Well Installation and Abandonment Procedures*, p. 227-233. ASTM Publication No. 03-418196-38.

99-0165 Driscoll, F.G. 1989. *Groundwater and Wells*, Johnson Filtration Systems, Inc., 1089p.

99-0175 Nielsen, D.M. 1991. *Practical Handbook of Groundwater Monitoring*, Lewis Publishers, Chelsea, MI, 717p.

# STANDARD OPERATING PROCEDURE GW-4

# NAPL SAMPLING

# STANDARD OPERATING PROCEDURE GW-4

# NAPL SAMPLING

## 1. SCOPE AND APPLICATION

LNAPLs are generally low-density, nonaqueous phase immiscible organics that have densities less than water. These chemicals tend to float on the water surface and commonly occupy the capillary fringe zone above the water table. For this reason, if LNAPL is suspected, the groundwater monitoring wells must be screened across the water table.

DNAPLs include chlorinated solvents and other chemicals such as PCBs and coal tar that have densities greater than water. DNAPL chemicals tend to migrate downward through the saturated zone until they encounter lower permeability beds within the aquifer; therefore, the well screen should intercept the groundwater-DNAPL interface, and the lower end of the screen should be placed as close as possible to the less permeable stratigraphic unit. Measurement of the thickness of the DNAPL must be performed prior to sampling.

## 2. EQUIPMENT

Oil/water interface probe

Heavy string

PID

Bottom filling bailer-LNAPL

Dual check value bailer-DNAPL

Bacon Bomb Sampler-DNAPL (Optional)

## 3. RELATED PROCEDURES

G-1 Calibration of Field Sampling Equipment

G-2 Decontamination

G-3 Field Documentation

G-6 Field Sample Numbering

SS-1 Determination of the Presence of Free Product

GW-8 Water Level Measurements

# 4. PROCEDURE

## 4.1 LNAPL SAMPLING

Measurement of the thickness of the floating layer may be determined by using an oil/water interface probe, tape with indicator paste (Kolor Kut Gasoline Gauging Paste), or clear bailer. The most widely tested and used oil/water detection probe employs a combination of optical and electrical conductivity measurements. This combination allows detection of air-liquid, floating product-water, and water-sinking product interfaces. The thickness of each product is obtained by subtracting the difference between subsequent interfaces as measured on the calibrated lowering tape. Indicator paste absorbs petroleum products and indicate this by a change in color. The tape is left in place for several seconds, then retrieved. The distance between the starting and end points of the color change indicate the product thickness. If a clear bailer is used to measure product thickness, it must be long enough to cover the entire thickness of the floating product.

Prior to the purging of groundwater from the well, a sample of the floating layer may be obtained using a bailer that fills from the bottom. Care should be taken to lower the bailer just through the floating layer, but not significantly into the underlying groundwater. A sample jar may also be used to sample the floating product, but it must be well secured to avoid being dropped down the well.

If more than one distinct LNAPL layer is present in a well, each layer should be sampled. Samples should be analyzed for chemical composition and physical parameters (e.g., specific gravity, water solubility, etc.).

## 4.2 DNAPL SAMPLING

Measurement of DNAPL thickness may be accomplished using an interface probe as described above for LNAPLs.

A DNAPL sample may be obtained by lowering a dual check value bailer or a Bacon Bomb Sampler to the bottom of the well. Samples should be analyzed for chemical composition and physical parameters (e.g., specific gravity, water solubility, etc.).

### 4.2.1 Bacon Bomb Sampler

#### *4.2.1.1 Bacon Bomb Sampler*

The Bacon Bomb Sampler is a widely used, commercially available sampler, designed for sampling petroleum products and viscous liquids. It is useful in collecting samples at various vertical locations. The Bacon Sampler remains unopened until it reaches the desired sampling depth. The Bacon Sampler is difficult to decontaminate, and it is difficult to transfer the sample into the sample bottles. The possibility of aerating the sample exists if the sampler does not completely fill with water and air is entrapped in the sampler during retrieval.

The Bacon Bomb Sampler is constructed of brass or stainless steel and is available in two sizes: 1.5 in. or 3.5 in. in diameter. Samplers range in volume from 4 oz to 32 oz. The Bacon Bomb Sampler is equipped with a trigger that is spring loaded. When opened, the trigger allows liquid to enter the collection chamber. When the trigger is released, liquid is prevented from flowing into the collection chamber or out of the collection chamber.

#### *4.2.1.2 Sampling Procedure*

- Spread new plastic sheeting on the ground at each sampling location to keep sampling equipment decontaminated and to prevent cross-contamination.
- Measure and mark the sampler line at the desired sampling depth.
- Lower the Bacon Bomb Sampler carefully to the desired sampling depth, allowing the line for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut.

- Release the trigger line and retrieve the sampler.
- Transfer the sample to the sample bottles by pulling on the trigger. Allow the sample to flow down the side of the sample bottle with minimal disturbance.
- Preserve the sample as necessary, and verify that the pH is sufficient for the criteria.
- Check that a PTFE liner is present in the cap. Secure the cap tightly.
- Label the sample bottle with an appropriate label. Be sure to complete the label with all necessary information.
- Place filled sample containers on ice immediately, along with the required trip blank, if analyzing for VOCs.
- Record the information in the field logbook and complete all chain-of-custody records and field sheets.
- Decontaminate the sampler.

## 5. REFERENCES

99-0171 U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response. 1991. *Dense Nonaqueous Phase Liquids,* EPA/540/4-91-002.

99-0172 U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response. 1995. *Light Nonaqueous Phase Liquids,* EPA/540/S-95/500.

# STANDARD OPERATING PROCEDURE GW-5

# POTABLE WATER SAMPLING

# STANDARD OPERATING PROCEDURE GW-5

# POTABLE WATER SAMPLING

## 1. SCOPE AND APPLICATION

Instructions presented in this Standard Operating Procedure (SOP) are for collecting representative potable water (tap water) samples. Discussions are based on the assumption that a supply tap is available for sampling the selected location, for example, a residence. Under this assumption, the only applicable sampling method would be the hand-held bottle.

Potable water samples may also be collected for evaluating contamination in a particular well or identifying the need for alternate water supply systems. When sampling residential wells, the sample tap should not be located after a household purification system (i.e., water softening or filtration) and/or after a water storage tank. In these cases, an outdoor tap may have to be sampled.

When sampling potable water, utmost care must be taken to ensure that samples are representative of the water being sampled. This is important not only from a technical and public health perspective, but also from a public relations standpoint. Poor sampling techniques may result in incorrect results (either not detecting a compound that is present, or by contaminating the sample and falsely indicating a compound that is not present). If incorrect results are disclosed to the public, it may be impossible to change public opinion when correct results are reported.

## 2. EQUIPMENT

pH meter

Conductivity meter

Thermometer

Sample bottles

Sample forms

Hach Kit-residual chlorine test

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-2 | Decontamination |
| G-3 | Field Documentation |
| G-6 | Field Sample Numbering |
| G-9 | Quality Assurance/Quality Control Sampling |

## 4. PROCEDURE

Potable water wells must be purged before the sample is collected. This procedure ensures that water representative of the formation is sampled.

- The tap should be opened and allowed to flow until the DO, ORP (oxidation reduction potential), Eh (redox potential), pH, conductivity, and temperature have reached equilibrium. This procedure ensures that any contaminants that might have entered the area of the tap from external sources have been avoided.
- If the project requirements make it necessary to distinguish the concentration of metals in solution from the concentration of metals associated with solids, filtration of the potable water sample will be required; however, the potable water samples should be representative of the water quality within the household or office under investigation and, therefore, are generally not filtered.
- The sampling tap must be protected from exterior contamination associated with being too close to the sink bottom or to the ground. Contaminated water or soil from the faucet exterior may enter the bottle during the collecting procedure because it is difficult to place a bottle under a low tap without grazing the neck interior against the outside faucet surface.
- Leaking taps that allow water to flow from around the stem of the valve handle and down the outside of the faucet or taps in which water tends to run up on the outside of the lip should be avoided as sampling locations.
- Aerator, strainer, and hose attachments on the tap must be removed before sampling. These devices can harbor a bacterial population if they are not cleaned routinely or replaced when worn or cracked. The tips of the faucets should be rinsed with alcohol

or bleach before samples are collected. Residual chlorine should also be tested prior to sampling using a Hach Kit.

- Whenever a steady stream of water cannot be obtained from taps, after such devices described above are removed, a more suitable tap should be sought. Taps where the water flow is not steady should be avoided because temporary fluctuation in line pressure may cause sheets of microbial growth that are lodged in some pipe section or faucet connection to break loose. A smooth-flowing water stream at moderate pressure without splashing should be obtained. Then, without changing the water flow, which could dislodge some particles in the faucet, the samples can be collected.

- Occasionally, samples are collected to determine the contribution of transmission pipes, water coolers, water heaters, etc., to the quality of water in private residences, offices, etc. The purpose of these investigations may be to determine if metals, e.g., lead, are being dissolved into the water supply. In these cases, it may be necessary to ensure that the water source has not been used for a specific time interval, e.g., over a weekend or a three- or four-day holiday period.

- Sample collection may consist of collecting a sample of the initial flush and collecting a sample after the indicator parameters have reached equilibrium. Regardless of the type of sample bottle being used, the bottle cap should not be placed on the ground or in a pocket. Instead, the bottle should be held in one hand and the cap in the other, using care not to touch the inside of the cap. Exercise care not to lose the PTFE liner in certain bottle caps. Contaminating the sample bottle with fingers or permitting the faucet to touch the inside of the bottle should be avoided.

- Sample bottles should not be rinsed before use. When filling any container, care should be taken not to splash drops of water from the ground or sink into either the bottle or cap. To avoid dislodging particles in the pipe or valve, the stream flow should not be adjusted while sampling. Care should be taken not to overfill the sample containers when they contain preservatives.

- Name(s) of the resident or water supply owner/operator and the resident’s exact mailing address. as well as his/her home and work telephone numbers, should always be obtained. This information is required in order that the residents or water supply owner/operators can be informed of the results of the sampling program.

# 5. SAMPLE CONTAINERS AND PRESERVATION

## 5.1 SAMPLE CONTAINERS

Samples should be collected and containerized in the order of volatilization sensitivity of the parameters. A preferred collection order for some common groundwater parameters is:

- Volatile organics (VOA).
- Total organic carbon (TOC).
- Extractable organics (BNAs or SVOCs).
- Total metals.
- Dissolved metals.
- Phenols.
- Cyanide.
- Sulfate and chloride.
- Turbidity.
- Nitrate and ammonia.

## 5.2 SAMPLE PRESERVATION

Many of the chemical constituents and physiochemical parameters that are to be measured or evaluated in monitoring programs are not chemically stable; therefore, sample preservation is required. Appropriate preservation techniques for various parameters and sample containers that the sampler should use for each constituent or common set of parameters are specified in the QAPP Section 6 (WESTON, 00-0507).

Water samples to be analyzed for purgeable organic compounds should be stored in 40-ml septum vials with screw caps and, like all other samples, a PTFE-silicone disk should be placed in the cap to prevent contamination of the sample by the cap. Disks should be placed in the caps (PTFE side to be in contact with the sample) in the laboratory prior to the beginning of the sampling program. The 40-mL vials should be completely filled to prevent volatilization, and extreme caution should be exercised when filling a vial to avoid any turbulence that could also produce volatilization. The sample should be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to gently pour the last few drops into the vial so that surface tension holds the water in a “convex meniscus.” The cap is then applied and some overflow is lost, but air space in the bottle is eliminated. After the bottle is capped, it should be turned over and tapped to check for bubbles. If any bubbles are present, the procedure must be repeated. Care should be taken to ensure that no loss of preservative occurs, if applicable.

The following general precautions should be taken when sampling:

1. A clean pair of new, disposable gloves should be worn each time a different location is sampled, and gloves should be donned immediately prior to sampling.

2. All work should be conducted on a clean surface, such as a stainless steel table.
3. Sample containers for source samples or samples suspected of containing high concentrations of contaminants should be placed in separate plastic bags immediately after collecting, preserving, tagging, etc.
4. Samples of waste or highly contaminated samples should never be placed in the same ice chest as environmental samples.
5. If possible, one member of the field team should take all the notes, fill out sample tags, field sheets, etc., while the other members collect all of the samples.
6. Sample collection activities should proceed progressively from the suspected least contaminated area to the suspected most contaminated area.
7. Field personnel should use equipment constructed of PTFE, stainless steel, or glass that has been properly pre-cleaned. PTFE or glass is preferred for collecting samples where trace metals are of concern.
8. Collection of adequate field control samples.

## 6. FIELD QUALITY CONTROL SAMPLING PROCEDURES

Field control samples are collected by the sampling team to determine whether the data are of suitable quality. They include blanks, replicates, and/or background (upgradient) sample replicates. QC samples are replicates collected by the sampling team for use by the primary laboratory. A discussion of field control samples is contained in SOP G-9.

## 7. DECONTAMINATION PROCEDURES

All equipment that will enter the well must be decontaminated prior to its entry. The inside surface of pumps and tubing apparatus must be decontaminated by drawing the decontamination solution through the equipment. Field measurement equipment such as water level indicators should be cleaned as described in SOP G-2. If the sampling equipment is being prepared for later use, it should be wrapped in cleaned foil. The sampling equipment should remain wrapped in this manner until immediately prior to use. Additional sampling devices may be needed on-site to ensure an adequate drying time. Decontamination procedures for field equipment are discussed in SOP G-2.

## 8. DOCUMENTATION

Bound field logbooks should be used for the maintenance of field records. All aspects of sample collection and handling, as well as visual observations, shall be documented in the field logbooks as outlined in SOP G-3. All entries in field logbooks should be legibly recorded, and contain accurate and inclusive documentation of an individual's project activities.

## 9. REFERENCES

00-0507 WESTON (Roy F. Weston, Inc.). March 2001. *Quality Assurance Project Plan.* Environmental Remediation Contract, GE/Housatonic River Project. Volumes I, II, IIA, and IV. DCN GE-021601-AAHM.

99-0184 New Jersey Department of Environmental Protection and Energy (NJDEPE). 1992. *Field Sampling Procedures Manual*, pp. 181-186.

# STANDARD OPERATING PROCEDURE GW-6

# PUMPING TEST AQUIFER TESTING

# STANDARD OPERATING PROCEDURE GW-6

# PUMPING TEST AQUIFER TESTING

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) identifies the requirements for performing tests that are used to determine the hydrologic characteristics of a water-bearing zone. The requirements of this procedure are applicable to monitoring well hydraulic testing. The scope of this procedure is limited to testing used to characterize the hydrologic parameters of an aquifer and to determine the presence of a hydraulic connector between wells of a given water-bearing zone.

### 1.1 DISCUSSION

An aquifer test is a controlled field procedure to determine the hydraulic properties of water-bearing soils and rocks. Groundwater flow varies in space and time, and depends on the hydraulic properties of the saturated porous or fractured media, and the boundary conditions imposed on the groundwater system. Pumping tests provide results that are more representative of aquifer characteristics than those predicted by slug tests, and can be used to determine the hydraulics of groundwater flow. These tests require a greater degree of activity and expense than slug tests, and are not always justified for all levels of investigation. As an example, slug tests may be acceptable at the reconnaissance level, but pumping tests are usually performed as part of a feasibility study in support of designs for aquifer restoration.

Aquifer characteristics that may be obtained from pumping tests typically include hydraulic conductivity (K), transmissivity (T), specific yield (Sy), storage coefficient (S), anisotropy, boundary effects, heterogeneity, and leakage factors. These parameters can be determined by graphical solutions and computerized programs.

A pumping test may also provide information about the effectiveness or productive capacity of the well. This type of information is often required for the design and installation of aquifer recovery systems.

There are a variety of aquifer pumping test types. This procedure focuses on the general procedures used for step drawdown tests and constant discharge tests.

## 2. EQUIPMENT

Water pressure transducer

Electric water level indicator

Steel tape (subdivided into tenths of feet)

Electronic data logger (if transducer method is used)

Tape measure (subdivided into hundredths of feet)

Watch or stopwatch with second hand

Semi-log graph paper (if required)

Waterproof ink pen

Thermometer

Appropriate references and calculator

Barometer or recording barograph (for tests conducted in confined aquifers)

Calibrated container

Storage tanks to collect the water discharged from the well

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-2 | Decontamination |
| GW-8 | Water Level Measurements |

## 4. PROCEDURE

Field personnel performing aquifer pumping tests, at a minimum, will need to be familiar with the following:

- ASTM D4043-96 Selection of Aquifer Test Method in Determination of Hydraulic Properties by Well Techniques (99-0177).

## 4.1 PREPARATION

It is required that Field Team Leaders and other key project members meet with the Project Manager to discuss contractual requirements for aquifer pumping tests. At a minimum, this discussion needs to address the following items:

- The extent and methods of the aquifer tests to be performed. Review available background information (i.e., topographic maps, aquifer data, geologic survey maps, well records, other site reports, etc.). If appropriate, prepare a work plan.
- Review associated operating practices for information on the performance of all relevant field activities that will be required to complete aquifer tests.
- Obtain appropriate permission for property access and off-site testing.
- Determine necessary testing and monitoring equipment. Decontaminate or pre-clean equipment. Inspect and test, if possible, all equipment to determine the operating condition of equipment to be utilized prior to performance of field activities.
- Obtain the appropriate GEOLIS® forms. The GEOLIS® forms will include the Log Book Identification form and optional Notes and Sketch forms. Obtain a logbook for documentation of equipment checks and all other miscellaneous activities not documented in GEOLIS® forms.
- Contact delivery service to confirm ability to ship all equipment and samples to and from the site. Determine if shipping restrictions exist, and confirm regulations and specifications.
- Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate.

## 4.2 STEP DRAWDOWN AND CONSTANT DISCHARGE TESTS

### 4.2.1 Field Preparation

Obtain information concerning the completion of the well installation, development, and the availability of the necessary equipment to conduct the pumping test. The field team is responsible for completing the following tasks and supplying the equipment listed below:

1. Drill, install, complete, and develop all pump wells and at least one observation well to the proper specifications identified.
2. Install a submersible or turbine pump into the pumping well.
3. Install a totalizer meter and a flow meter in the discharge line of the pump well to accurately measure and monitor the volume and rate of discharge.
4. Install sufficient pipe to transport the discharge from the pumping well away from the area to prevent infiltration in the pumped zone.
5. Install a gate valve on the discharge pipe to control the rate.
6. Place an outlet near the well head, but past the totalizer and flow meters, for water quality determination and sampling.

WESTON personnel are responsible to calibrate all gauges, transducers, flow meters, and other equipment used in conducting pumping tests before use. Where possible, check all flow-measurement devices on-site using a container of measured volume and a stopwatch. Verify the accuracy of the meters before testing proceeds.

Collect background water levels at the test site (typically over a weekend) before performing the test. This can be accomplished by using a continuous recording device like a transducer. When utilized in conjunction with a barometer, these records establish the barometric efficiency of the aquifer. The records also help determine if the aquifer is experiencing an increase or decrease in head with time caused by recharge or pumping in the nearby area or diurnal variations. Record changes in barometric pressure during the test in order to correct water levels for any possible fluctuations that may occur from changing atmospheric conditions. Project the pretest water level trends for the duration of the test. These trends or barometric changes may be used to correct water levels during the test so that they are representative of the hydraulic response of the aquifer from pumping the test well.

The duration of the test is determined by the needs of the project and the aquifer properties. In general, longer tests produce more-definitive results. A duration of one to several days is desirable, followed by a similar period of monitoring the recovery of the water level. A knowledge of the local hydrogeology and a clear understanding of the overall objectives are necessary in determining the duration of the test. The effect of any hydrogeologic boundaries should be considered. There is no need to continue the test if the water level becomes constant with time.

When using automatic data logging equipment, use the following steps:

- Determine if the screened section of the well and the filter pact is fully saturated. Note in the logbook or on a Pump Test Information Sheet if the screen or the filter pack is not saturated.
- Unpack the data logging equipment. Examine it for visible damage. Check the operation of the data logging equipment. Record the results of the equipment check in the logbook.
- Pad the edges of both the inner and outer well casings with several layers of duct tape to protect the transducer cable from sharp edges.
- Connect the transducer to the data logger.
- Measure out a length of transducer cable sufficient to lower a transducer to a point approximately 10 feet below the water level measured in the well. The transducer should not be lowered to a depth greater than 1 foot above the measured bottom of the well because it could become clogged with sediment.
- Securely tape the transducer cable with duct tape to the outside of the well protective casing.
- Enter the required information into the electronic data logger. The type of information required by the logger may vary depending on the model used. Consult the operator's manual for the proper data entry sequence to be used. Typically, the following items must be entered:
    - Station ID or well numbers.
    - Test and step numbers.
    - Date and time.
    - Scale factors and serial numbers for each transducer.
    - Initial water level.
    - Sampling rate.

## 4.3 OPERATION

The procedure to conduct step drawdown and constant head pumping tests includes monitoring the water level over time in the pumping well and each observation well while the pumping well is discharged at a known rate. Periodic checks of pumping rate will be recorded on a Pumping Rate Data form.

When the pumping test is performed using an electronic data logger and pressure transducer, store all data internally or on computer diskettes or tape. Directly transfer the information to the computer and analyze it. Maintain a computer printout of the data in the files for documentation. Take manually determined measurements periodically to verify data recorded by the data logger, and record both on a Transducer QA form.

Data collected manually during a logged transducer pumping test will be recorded on the forms as completely as possible. During a pumping test, manual water level measurements should be taken as often as necessary in wells without transducers to produce a meaningful indication of hydraulic properties of the aquifer.

During the early part of the test, station at least one person at each observation well and at the pumping well. After the first two hours, two people are usually needed to continue monitoring the test. It is not necessary for readings at the wells to be taken simultaneously. It is very important that depth-to-water readings are measured accurately and recorded at the exact time they are measured.

After pumping is concluded, measure recovering water levels to verify the results obtained from the pumping portion of the test. Measure the recovering water levels in the pumping well and the observation wells for a period immediately following the cessation of pumping. Monitoring during recovery should occur for at least half the length of the pumping portion of the aquifer test. The decision to cease monitoring water levels will be based on the percent of aquifer recovery.

### 4.3.1 Post Operation

If using an electronic data logger, follow the steps listed below:

1. Stop the logging sequence.
2. Download the data to the computer.
3. Decontaminate all equipment in accordance with decontamination procedures.
4. Put the testing equipment in storage containers.

5. Ensure that all equipment is accounted for, decontaminated, and ready for shipment.
6. Restore the site to pretesting conditions as specified in the work plan.

### 4.4 DOCUMENTATION

Record cleanup procedures and any uncompleted work in the logbook.

Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

Review data collection forms for completeness.

### 4.5 OFFICE

Deliver original GEOLIS forms and logbooks for technical review. Have forms reviewed, signed, and transmitted to the appropriate personnel (copies to the files) for placement in the project document control system, if required.

Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the Equipment Manager and report incidents of malfunction or damage.

Interpret the pumping test results with the project hydrogeologist.

Analyze data using appropriate analytical techniques.

## 5. REFERENCES

99-0168 Dawson, K.J. and J.D. Istok. 1991. *Aquifer Testing: Design and Analysis of Pumping and Slug Tests.* Lewis Publishers. 344 p.

99-0177 American Society for Testing and Materials (ASTM). 1995. *Standard Guide for Selection of Aquifer-Test Method in Detemining of Hydraulic Properties by Well Techniques,* ASTM D4043-96.

# STANDARD OPERATING PROCEDURE GW-7

# SLUG TEST AQUIFER TESTING

# STANDARD OPERATING PROCEDURE GW-7

# SLUG TEST AQUIFER TESTING

## 1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) defines the methods for collecting data to calculate in situ hydraulic conductivity by the use of the slug test method.

Slug tests are used to estimate the hydraulic conductivity (K), the transmissivity (T), and the storage coefficient (s) of a water-bearing zone. These parameters (K, T, and s) are used to determine the rates of groundwater flow and contaminant transport.

Three types of tests are commonly used to characterize aquifer properties:

- **Laboratory Tests**—Provide point estimates of the one-dimensional vertical hydraulic conductivity while ignoring all but small-scale heterogeneities.
- **Slug Tests**—Provide in situ estimates of the two-dimensional horizontal hydraulic conductivity (and sometimes T and s) for a localized zone around a borehole.
- **Pumping Tests**—Provide in situ estimates of three-dimensional flow parameters for a relatively large area around a pumping well (see SOP GW-6).

Typically, all three types of tests will be used together to characterize a site. The usefulness of laboratory tests, however, is limited because: (1) they do not effectively test macro-scale hydrologic features, such as fractures; and (2) they can only test flow in one dimension (usually vertical flow) and are not useful for evaluating two-dimensional horizontal flow. The use of pumping tests is limited by the expense of the tests and the need to dispose of large volumes of contaminated groundwater.

Slug tests involve displacing a known volume of water in a well instantaneously and measuring changes in the water level over time as the water level in the well returns to equilibrium. Displacing the water in the well is accomplished by lowering or raising a slug. A slug is a solid cylinder (or hollow, weighted, and capped cylinder) of PVC (or Teflon or stainless steel) with an attachment point for a hauling line. Other variations of the test include the instantaneous addition or removal of a known volume of water to or from the well. Tests performed by lowering the slug into the well and raising the water level are called falling-head slug tests. Tests performed by raising the slug out of the well and lowering the water level are called rising-head slug tests. Data from both types of tests are comparable so long as the screened and filter pack section of the well is fully saturated (falling-head slug tests will produce erroneous results if the well screen or filter pack is partially saturated). Typically, falling-head tests and rising-head tests are conducted in pairs (when appropriate) as a quality control check to measure consistency of test results.

**Slug tests** have several advantages over other types of aquifer tests in that they:

- Can evaluate the hydraulic conductivity of small portions of a water-bearing zone to assess aquifer heterogeneity.
- Are technically simple to conduct in the field.
- Are relatively inexpensive to complete, even in large numbers.
- Can be completed in a relatively short time.
- Pose fewer risks to the health and safety of field personnel.
- Pose little or no problems with the disposal of contaminated water.

However, slug tests are frequently presumed to have a low reliability. This is a significant criticism, because as Chu et al. [00-0224] noted, the accurate estimation of aquifer properties (i.e., K, T, and s) is the most sensitive parameter in groundwater flow and contaminant transport modeling next to boundary conditions.

Slug test data are usually analyzed using the methods proposed by Hvorslev [00-0226], Cooper et al. [00-0225], and Bouwer and Rice [00-0223]. Hvorslev's method can be applied to a variety of different well and aquifer geometries, but has been used most commonly for unconfined systems. The Bouwer and Rice method is also designed for unconfined systems, and has been used more commonly than Hvorslev's method because it is somewhat easier to calculate. The Cooper Bredehoeft Papadopulos (CBP) method is the most commonly used method for analyzing slug tests in confined aquifers. The CBP method is the only one of the three that uses type-curve matching instead of straight-line fitting to analyze the water level change data.

## 2. EQUIPMENT

Water pressure transducers

Electronic data logger

Electric water level indicator

Stainless steel, Teflon™, or PVC slug of a known volume

Watch or stopwatch with second hand

Duct tape

Semi-log graph paper (if required) and straight edge

Appropriate references and calculator

Slug Test Information Forms

Non water-soluble black ink marking pens

Rope (1/8 to 3/16 inch in diameter)

Portable personal computer

Portable field printer and accessories (optional)

Field notebook

Clean cloth and plastic sheeting

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screen Instruments |
| G-2 | Decontamination |
| GW-8 | Water Level Measurements |

# 4. PROCEDURE

Most field efforts, work projects, and sampling events will require participants to have a thorough understanding of multiple operating practice. Field personnel performing aquifer slug tests, at a minimum, will need to be familiar with the following associated procedures:

| | |
|---|---|
| ASTM D4043 | Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques |
| ASTM D4044 | Test Method (Field Procedure) for Instantaneous Change in Head (Slug Tests) for Determining Hydraulic Properties of Aquifers |
| ASTM D4104 | Test Method (Analytical Procedure) for Determining Transmissivity of Non-Leaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Test) |

## 4.1 PREPARATION

It is required that Field Team Leaders and other key project members meet with the Project Manager to discuss contractual requirements for surface aquifer slug tests. At a minimum, this discussion needs to address the following items:

- The extent and methods of the slug tests to be performed. Review available background information (i.e., topographic maps, aquifer data, geologic survey maps, well records, other site reports, etc.). If appropriate, prepare a work plan.
- Review associated operating practices for information on the performance of all relevant field activities that will be required to complete slug tests.
- Obtain appropriate permission for property access and off-site testing.
- Determine necessary testing and monitoring equipment. Decontaminate or pre-clean equipment. Inspect and test, if possible, all equipment to determine the operating condition of equipment to be utilized prior to performance of field activities.
- Obtain the appropriate GEOLIS forms. The GEOLIS forms will include the Location Identification Form, and optional Notes and Sketch Forms.
- Obtain a logbook for documentation of equipment checks and all other miscellaneous activities not documented in GEOLIS forms.

- Contact delivery service to confirm ability to ship all equipment and samples to and from the site. Determine if shipping restrictions exist, and confirm regulations and specifications.
- Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate.

## 4.2 FIELD PREPARATION

- Confirm that all equipment has been decontaminated or pre-cleaned before testing.
- Conduct a site survey prior to site entry in accordance with the Health and Safety Plan.
- Locate the monitor wells to be tested, and check for proper labeling and signs of vandalism.
- Open the well lock and protective casing, remove the well cap, and monitor the well head with an organic vapor detector (PID or FID) or as specified in the Site Safety Plan. The resultant readings will determine the protective level required when working around the well head.
- Record in the logbook the appearance and physical condition of the monitoring well, the depth to water, the stickup, and the depth of the well. Calculate the volume of standing water in the well.
- Calibrate the transducer.

## 4.3 AQUIFER SLUG TEST OPERATION

The following are general procedures for performing slug tests. The procedures required for a particular slug test may vary slightly from those described, depending on site-specific conditions.

Take precautions to minimize the potential for cross-contamination between wells. Slugs and measuring devices that contact aquifer water must be properly decontaminated prior to initiating each test. If tests are performed on more than one monitoring well, begin testing at the least contaminated well (usually the upgradient well(s)) and work downgradient in order of least to most contaminated wells thereafter.

Conduct the slug tests on undisturbed wells. If a test is conducted on a well that has recently been pumped for water-sampling purposes, the measured water level must be within 0.1 ft of the static water level before sampling, or the slug test must not be conducted within 24 hours of sampling, whichever occurs first.

At least one week should elapse between the completion and development of a well and the performance of the aquifer slug test.

When the slug test is performed with an electronic data logger and pressure transducer, store all data internally on the logger. Download the data to a computer as soon as possible after the test to ensure that the data were collected properly. Maintain a hard copy printout of the data in the files as backup to electronic data loss or failure.

The time required for a slug test is a function of the volume of the slug, the hydraulic conductivity of the formation, and the type of well completion. The slug volume should be large enough that a sufficient number of water level measurements can be made before the water level returns to equilibrium conditions, yet not so large that water flow is impeded or a suction is caused on slug withdrawal. The length of the test may range from seconds to several hours, but is typically in the range of minutes.

Before beginning the slug test, enter the required information into the electronic data logger. The type of information may vary, depending on the model used. When using different models, consult the operator's manual for the proper data-entry sequence to be used.

## 4.4 AQUIFER SLUG TEST PROCEDURE

To complete a slug test in the field, the following steps will be performed:

- Determine if the screened section of the well and the filter pack is fully saturated. Note in the logbook or on a Slug Test Information Sheet if the screen or the filter pack is not saturated.
- Unpack the data logging equipment. Examine it for visible damage. Check the operation of the data logging equipment. Record the results of the equipment check in the logbook.
- Pad the edges of both the inner and outer well casings with several layers of duct tape to protect transducer cables from sharp edges. Connect the transducer to the data logger.

- Measure out a length of transducer cable sufficient to lower a transducer to a point approximately 10 feet below the water level measured in the well. The transducer should not be lowered to a depth greater than 1 foot above the measured bottom of the well to avoid being clogged with sediment.

- Securely tape the transducer cable with duct tape to the outside of the well's protective casing.

- Enter the required information into the electronic data logger. The type of information required by the logger may vary depending on the model used. Consult the data logger manual for the proper data entry sequence to be used. Typically, the following items must be entered:

  - Station ID or well numbers.
  - Test and step numbers.
  - Date and time.
  - Scale factor and off set for each transducer.
  - Initial water level.
  - Sampling rate.

- Attach a disposable rope to a slug of known volume. Measure and mark a length of rope sufficient to lower the top of the slug below the initially measured depth to water. Mark a point on the rope corresponding to where the bottom of the slug will be suspended just above the initial (top of) water level. Tie an attachment loop in the end of the rope.

- Lower the slug into the well to the marked point where the bottom of the slug is suspended just above the initial water level.

- Begin taking data on the electronic logger and lower the slug quickly and smoothly to displace and raise the water level to conduct a falling-head slug test. It is important to remove or add the slug as quickly and smoothly as possible because the accurate analysis depends on an instantaneous change in water volume in the well.

- Continue measuring and recording depth-time measurements until the water level returns to a minimum 90 percent of pretest equilibrium conditions, or if a sufficient number of water level measurements have been made to clearly show a trend on a plot of the data showing recovery versus the logarithm of time. Generally, 10 to 30 minutes is adequate.

- Reset (step) the data logger data collection schedule, and quickly and smoothly remove the slug from the water until it is at a point where the slug bottom is just above the initially measured water level (i.e., lower marked point on the rope) to conduct a rising-head slug test. Secure the rope to the outer casing and repeat preceding step.

- Stop the data logger operation and remove all equipment from the well.

- Re-lock the well.
- Connect a field printer up to the data logger and generate a hard copy of the results of the slug test just conducted (if possible). Download data from the slug test onto a floppy disk if a portable computer is available at the well site. If no computer is available at the well site, download the data at the earliest opportunity, but before the capacity of the logger is exceeded.
- Review the recorded data (if possible) to determine whether additional testing is required. If adequate information has been recorded, remove the transducer and slug from the well.
- Decontaminate the slug, the transducer cable, and any other equipment used in the well for the test. Do not reuse rope between wells.

### 4.5 DOCUMENTATION

- Ensure that all equipment is accounted for, decontaminated, and ready for shipment.
- Make sure all slug test well locations are properly identified and readily visible.
- Deliver the original GEOLIS forms and field notebook to the Project Manager (or his designee). The original field documents should be copied and filed.
- Follow the QA/QC regimen established for the data. This should include documentation of all corrections or changes to the field forms. The field personnel should review these changes for accuracy at appropriate times during the QA/QC process.
- Analyze the slug test data using appropriate software packages or graphical solution methods. If the well screen was not fully saturated, do not analyze the falling head test unless the aquifer conductivity is very low.

## 5. REFERENCES

00-0223 Bouwer, H. and R.C. Rice. 1976. "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells." *WRR*, Vol. 12, No. 3, p. 423-428.

00-0224 Chu, W., E.W. Strecker, and D.P. Lettenmaier. 1987. “An Evaluation of Data Requirements for Groundwater Contaminant Transport Modeling.” *WRR*, Vol. 23, No. 3, p. 408-424.

00-0225 Cooper, Jr., H.H., J.D. Bredehoeft, and S.S. Papadopulos. 1967. "Response of a Finite-Diameter Well to an Instantaneous Charge of Water." *WRR*, Vol. 13, No. 1, p. 263-269.

00-0226 Hvorslev, M.J. 1951. "Time Lag and Soil Permeability in Ground-Water Observations." 50. U.S. Army Corps of Engineers, Bulletin No. 36. Washington, DC.

# STANDARD OPERATING PROCEDURE GW-8

# WATER LEVEL AND WELL DEPTH MEASUREMENTS

# STANDARD OPERATING PROCEDURE GW-8

# WATER LEVEL AND WELL DEPTH MEASUREMENTS

## 1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for measuring water level and well depth. This procedure is applicable to the sampling of monitoring wells and must be performed prior to any activities that may disturb the water level, such as purging or aquifer testing.

These measurements will be taken at least 24 hours after development or immediately before sampling. Measurement will be made using an electronic water level meter. The depth to groundwater will be measured and reported to the nearest 0.01 ft. Measurement will be made from the highest point on the rim of the well casing or riser (not protective casing). This same point on the well casing will be surveyed for vertical control. Surface water levels will be measured at least to the nearest 0.1 ft using an adjacent temporary or permanent survey marker as a datum for current and future reference.

## 2. MATERIAL

Electronic water level indicator with cable measured at 0.01-foot increments

Tape for total depth measurement (optional)

Transducer and datalogger (optional for continuous monitoring)

Oil-water interface probe

Plastic sheeting

Photoionization detector (PID) or intrinsically safe flame ionization detector (FID)

## 3. RELATED PROCEDURES

G-1 Calibration of Field Screen Instruments

G-2 Decontamination

G-3 Field Documentation

G-5 Field Measurements

GW-4 NAPL Sampling

# 4. PROCEDURE

## 4.1 PRELIMINARY STEPS

- Locate the well and verify its position on the site map. Record whether positive identification was obtained, including the well number and any identifying marks or codes contained on the well or protective casing. Note any damage or missing locks.

- Open the well.

- Locate the permanent reference mark at the top of the casing. The reference point will be scribed, notched, or otherwise noted on the top of the casing. If no such marks are present, measure from the highest point of the well casing, and note this in the field notebook.

- Record any observations and remarks regarding the completion characteristics and well condition, such as evidence of cracked casing or surface seals, security of the well (locked cap), and evidence of tampering.

- Keep all equipment and supplies protected from gross contamination; use plastic sheeting. Keep the water level indicator probe in its protective compartment when not in use.

## 4.2 OPERATION

- Sample the air in the well head for gross organic vapors by lifting the well cap only high enough for an organic vapor monitor (PID or FID) probe to be entered into the well casing. This will indicate the level of gross volatile contaminants as well as indicate the potential for sampler exposure. Always perform NAPL checks in wells with suspected NAPL contamination, and in wells where headspace tests reveal the presence of volatiles. Always perform a NAPL check the first time a well is sampled.

- Remove cap. Allow well to vent for at least 90 seconds.

### 4.2.1 NAPL Present

If non-aqueous phase liquid (NAPL) contamination is suspected, use an interface probe to determine the existence and thickness of NAPLs.

- Open the probe housing, turn the probe on, and test the alarm. Slowly lower the probe into the well until the alarm sounds. A continuous alarm indicates a NAPL, while an intermittent alarm indicates water. If a NAPL is detected, record the initial level (first alarm). Mark the spot by grasping the cable with the thumb and forefinger at the top of the casing. If a mark is present on the casing, use the mark as the reference point. If no mark is present, use the highest point on the casing as the reference point. Record the depth.
- Continue to slowly lower the probe until it passes into the water phase. Record the water level and the thickness of NAPL (NAPL – water depths).
- Continue to slowly lower the probe through the water column to check for the presence of DNAPL.
- Measure depths to DNAPL and the bottom of the well, and record the thickness of any DNAPL layer.
- Fully decontaminate the probe (see SOP G-2).

### 4.2.2 No NAPL Present

If no NAPL is present, use an electronic water level detector as follows:

- Remove the probe from the retainer, turn on the sounder, and test the battery and sensitivity scale by pressing the red button. Adjust the sensitivity scale (volume) until you hear the buzzer.
- Slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowing until the meter buzzes. Very slowly, raise and lower the probe until the point is reached where the meter just buzzes. Mark the spot by grasping the cable with the thumb and forefinger at the top of the casing. If a mark is present on the casing, use the mark as the reference point. If no mark is present, use the highest point on the casing as the reference point. Record the depth.
- To measure the well depth, lower the water level indicator probe or tape until slack is noted. Raise and lower the tape until the bottom is felt. Record the depth. Note: if the electric water level indicator is used to determine the depth of the well, the offset distance from the tip to the electrode must be added to the depth.

- Withdraw the tape and probe, and wipe with paper towels and water spray. Generally proceed from clean to “dirty” wells to minimize the possibility of cross contamination.

## 5. CALIBRATION

No field calibration is necessary.

## 6. PRECAUTIONS

- Check instrument batteries prior to each use.
- Fully decontaminate probe and tape if exposed to NAPL.
- Make sure that the cable is not twisted and that the cable is intact and the lengths are correct (cables are sometimes spliced and may be shortened in the process).

## 7. REFERENCES

99-0170 U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response. 1989. *Accuracy of Depth to Groundwater Measurements.* EPA Superfund Groundwater Issue. EPA/540/4-89/002.

# STANDARD OPERATING PROCEDURE GW-9

# WELL DEVELOPMENT

# STANDARD OPERATING PROCEDURE GW-9

# WELL DEVELOPMENT

## 1. SCOPE AND APPLICATION

Well development is the process by which foreign materials and solids are removed from the screen filter pack or open hole, allowing water to flow freely into the well. This process is accomplished by moving water through the well screen or borehole into and out of the surrounding material. Well development serves four principal purposes:

- Removes materials that have built up in the openings of the screen or borehole during the well drilling and installation process.
- Removes fine materials from the side of the borehole that result from the drilling procedures (e.g., drilling mud).
- Increases hydraulic conductivity of the filter pack and adjacent geologic materials by removing fine materials.
- Stabilizes the fine materials that remain in the vicinity of the well, thereby retarding their entry into the well.

The benefits are increased yield and reduced suspended solids.

The well will be developed using mechanical surging and overpumping. In this method (surge blocking), a surge block is pushed in and pulled out of the well in a plunger-like fashion. As fines are flushed into the well, they are pumped out or bailed out. This method is the most effective method of development, but is only used to develop screened wells because it may cause collapse in an open borehole.

All materials placed in the wells must be decontaminated prior to their use. All pumps must be equipped with clean wiring (no electrical or duct tape), and have either PVC or polyethylene tubing.

## 2. EQUIPMENT

Well development forms and pens

De-ionized water and decontamination supplies

Stopwatch/wristwatch

Electronic water level measurement device

Flow rate/volume measurement devices

Turbidity meter

Thermometer

pH meter

Electrical conductivity meter

Organic vapor detector (PID or FID)

Dissolved oxygen meter (optional)

Eh meter (optional)

1,000-ml Imhoff cone (optional)

## 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| G-3 | Field Documentation |
| G-7 | Management of IDW |
| GW-9 | Water Level Measurements |

## 4. WELL DEVELOPMENT PROCEDURES

Overburden wells are developed as follows:

- Development should not be performed sooner than 48 hours after installation to ensure that the grout has had ample time to cure, unless grout is above the depth of the water table.

- Overburden well development will be performed using surge block techniques. Depending on well construction design, the surging will either be performed manually using a surge block connected to a tremie pipe (or equivalent) or operated mechanically from the drilling rig. The entire length of the saturated well screen will be surged. Surging will alternate with pumping for a minimum of 1 hour or up to 4 hours, until sediment production nearly ceases.

- The wells will then be pumped (if yields are high enough: >0.5 gpm) using a decontaminated submersible pump (low-yielding wells should be pumped with a 2-inch OD adjustable rate pump or manually bailed). All pumps will be equipped with clean wiring and PVC or polyethylene tubing. The submersible pumps should be capable of operating at a range of pumping rates (generally from 1 to 10 gpm), either by use of different pumps or throttling back on pump flow to meet well yield conditions.

- At regular intervals, such as every 15 minutes during development, purge rate; depth to water; and groundwater pH, temperature, electrical conductivity, PID/FID readings, turbidity, incremental, and total volume purged will be recorded. All purge water will be containerized. Well development will continue until turbidity measurements are 5 NTUs or less, and readings stabilize over 3 successive 5-minute intervals, or for a minimum of 1 hour or a maximum of 4 hours. After 4 hours, if a turbidity of 5 NTU cannot be achieved, well development will discontinue, and the final turbidity will be noted in the log.

- Because one of the objectives during well development is the determination of well yield in gpm, the depth to water will be measured at the same time as the other parameters, and the flow of the submersible pump (if used) will be adjusted so that the water level stabilizes. At that point, flow rate should be approximately equal to well yield. If the well goes dry during development, water levels should be recorded during a 10-minute recovery test that will be run to determine the rate that groundwater is entering the well. Water levels are taken at intervals of 0 seconds, 15 seconds, 30 seconds, 1 minute, 2 minutes, 5 minutes, and 10 minutes. At the end of development, an estimation of yield will be recorded on the GEOLIS Well Development Form.

## 5. REFERENCES

99-0165 Driscoll, F. 1986. *Groundwater and Wells*. Second Edition. Published by Johnson Filtration Systems, Inc., St. Paul, MN.

# STANDARD OPERATING PROCEDURE A-1

# AMBIENT AIR MONITORING

# STANDARD OPERATING PROCEDURE A-1

# AMBIENT AIR MONITORING

## 1. SCOPE AND APPLICATION

An ambient air monitoring program will be conducted to support a human health and ecological risk assessment for the Lower Housatonic River. The monitoring program is designed to make seasonal measurements of polychlorinated biphenyls (PCBs) in ambient air and to supplement those measurements with meteorological data collected at a nearby Prevention of Significant Deterioration (PSD) air quality monitoring site. The technical approach and procedures that will be part of the ambient air and meteorological monitoring program are documented in the following sections of this Standard Operating Procedure (SOP).

The design of the monitoring program is based on recommendations contained in U.S. EPA technical guidance documents. Specifically, the ambient air monitoring programs will follow recommendations contained in the following documents:

- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, U.S. EPA-600/4, June 1998 (99-0162).
- *Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)*, U.S. EPA-450/4-87-007 (99-0161).
- *Quality Assurance Handbook for Air Pollution Measurement Systems; Volume II. Ambient Air Specific Methods*, U.S. EPA-600/4-77/027a (99-0163).

## 2. EQUIPMENT

General Metal Works Model GPS-1 Polyurethane Foam (PUF) Sampler

Quartz glass fiber filter

Magnehelic gauge

Calibration equipment

Meteorological data

Hexane

Forceps

Latex gloves

Aluminum foil

Plastic resealable bags

Labels

Sampling data sheet (see Attachment A)

# 3. RELATED PROCEDURES

| | |
|---|---|
| G-1 | Calibration of Field Screening Instruments |
| G-2 | Decontamination |
| G-6 | Field Sample Numbering |
| G-10 | Sample Documentation |

# 4. PROCEDURE

## 4.1 MONITORING SITES

The specific sites for the ambient air sampling program will be identified based on an upcoming site visit. It is intended that one of the air samplers will be located in the upper portion of Reach 5 where there is a greater concentration of residents, and the other would be at a location near Woods Pond to allow for a direct comparison to previous air sampling results.

## 4.2 AMBIENT AIR SAMPLING

The objectives of the ambient air-monitoring program are as follows:

- Collect data by using time-integrated ambient air sampling methods.
- Establish seasonal measurements and annual average concentrations of PCBs.

Two ambient air monitoring stations will be set up to sample for PCBs. All ambient air monitoring and analysis will be performed using a modified version of EPA Method TO-4 *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (EPA/600/4-84-041, April 1984, Air Sampling for PCBs [99-0162]). The ambient air sampling component of the program was designed to collect air samples for PCB analysis during each of the four seasons. The following subsections discuss the sampling methodology and analytical methods.

## 4.3 SAMPLING METHODOLOGY

Ambient air sampling for PCBs will be conducted using General Metals Works Model GPS-1 polyurethane foam (PUF) samplers for particulate and vapor collection of PCBs. The sample media used for the PCB sampling will be a PUF and a quartz glass fiber filter. The PUF plug is designed to collect the vapor phase of PCBs. The quartz glass fiber filter precedes the PUF plug and collects any particulate-bound PCBs. The samples will be collected by drawing ambient air at a rate of approximately 9 cubic feet per minute (cfm) through the filter and PUF plug. The sample flow rate will be monitored using a calibrated magnehelic gauge. The sample flow will be determined by the average of the pre- and post-sampling magnehelic gauge readings. After sampling is completed, both filter and PUF plug will be recovered and sent to the laboratory for extraction and analysis. WESTON's Standard Operating Procedures for the installation and operation of the PUF sampler are presented as Attachment A of this appendix.

All ambient air monitoring and analysis will be performed using a modified version of the U.S. EPA Method TO-4, *Determination of Organochlorine Pesticides and Polychlorinated Biphenyls in Ambient Air* (99-0162). Method TO-4 has been modified to allow for quarterly calibration of the PS-1 sampler instead of the daily calibration and the use of seasonal average barometric pressure and ambient temperature measurements to determine the volumetric flow for standard conditions.

## 4.4 ANALYTICAL METHODS

The analytical method to be used for the analysis of PCBs will be a modified EPA Method TO-4, using gas chromatography/electron-capture detector (GC/ECD). This method specifies that all samples should be extracted within 1 week after collection. The PUF cartridges are extracted for 14 to 24 hours at approximately 4 cycles/hour with methylene chloride. The quartz fiber filter can be placed in the extractor with the PUF cartridges.

Following the soxhlet extraction, the solvent is switched to hexane and the extract is concentrated. Analysis is carried out on a HP 5890 GC/ECD and second column confirmation is used to positively identify the pesticide results.

The method is Aroclor-specific. The following compounds will be analyzed:

- Aroclor 1016
- Aroclor 1221
- Aroclor 1232
- Aroclor 1242
- Aroclor 1248
- Aroclor 1254
- Aroclor 1260

# 5. QUALITY CONTROL AND QUALITY ASSURANCE PROCEDURES

Quality Assurance (QA) includes the planned and systematic actions necessary to provide adequate confidence that a measurement or process will satisfy a given requirement for accuracy. QA is typically achieved through the use of independent auditing procedures and duplicate measurement procedures. Quality Control (QC) consists of the operational techniques and activities that are used to fulfill requirements for quality. The QC procedures for the ambient air monitoring component of the program will include planned calibrations, preventive maintenance, and field/trip blanks.

## 5.1 QUALITY CONTROL FOR TIME-INTEGRATED PUF HIGH-VOLUME SAMPLING

### 5.1.1 Calibration

The calibration of the PUF sampler is a multipoint calibration of the flow indicator on the PUF sampler. A multipoint calibration is performed because the sampler is not equipped with a mass or volumetric flow controller. The calibration is performed at several flow rates to determine the actual air flow rates corresponding to readings on the flow indicator device (magnehelic gauge) attached to the sampler venturi. An adapter plate, NIST-traceable orifice calibration unit, and a manometer are used to measure the pressure drop ($\Delta$H) in inches of water across the calibration orifice. The $\Delta$H for a calibration orifice corresponds to a specific flow rate. The calibration results are used to determine the flow rate of the PUF sample. Calibration of the sampler will be performed at the beginning and end of the program of the baseline air monitoring and at least once per quarter during the program.

### 5.1.2 Preventive Maintenance

The PUF samplers consist of three basic components. These components include the sampling media system, the flow controlling and measurement system, and the motor system. Of the three components, only the motor system requires any substantial preventive maintenance beyond normal general cleaning.

Prior to the start of each week-long sampling event, the motors on the PUF samplers will be checked. The condition of the motor brushes will be determined and, if necessary, replacement brushes will be installed. The condition of the armature and the windings will be checked to reduce the potential for motor failure.

### 5.1.3 Blank Samples

Two types of blank samples (field and trip) will be collected to measure the possible contamination introduced by field sampling procedures, sampling media, sampling equipment, or shipment of samples. Field blanks are handled in the same manner as actual samples, undergoing the same preparation, installation in the sampler module, and cleanup procedures. The only difference between a field blank and an actual sample is that there is no air volume drawn through the field blank. A trip blank is a sample that is handled similarly to an actual sample, but is not exposed to the environment (i.e., it is kept in the shipping container). One field blank and one trip blank will be collected during each week-long seasonal sampling event.

## 5.2 QUALITY ASSURANCE FOR TIME-INTEGRATED PUF HIGH-VOLUME SAMPLING

Precision and accuracy checks are both methods of QA. Precision checks are a measure of agreement among individual measurements of the same parameter, usually under prescribed similar conditions. Accuracy is the degree of agreement between an accepted reference measurement and the field measurement, and is accomplished through independent auditing procedures. Accuracy may be expressed as a total difference, a percentage of the reference value, or a ratio.

### 5.2.1 Audits

An audit of the PUF sampler to determine the accuracy of flow measurements is performed using the same procedure as a calibration, but with a different orifice to ensure that the multipoint calibration was performed correctly. An audit of each sampler will be performed at the beginning and end of the program, and quarterly during the program. If the audit indicates the flow rate of the PUF sampler deviates by more than 7% from the calibration, recalibration of the sampler will be performed.

### 5.2.2 Precision

Precision checks will be performed by obtaining collocated measurements. One PUF sampler will be designated as a precision check sampler to collect a collocated or duplicate sample. The percentage difference between the concentrations measured by the reporting sampler and the precision sampler will be calculated and used to generate precision probability intervals as described in *40 Code of Federal Regulations (CFR) Part 58* (99-0160).

Samples will be collected at both sampling locations for 5 consecutive days in each of the four seasons of the program. A duplicate sample will be collected at one of the two locations each of the 5 days for a total of 15 samples.

# 6. DATA REPORTING

A Data and Quality Control Report (DQCR) will be prepared summarizing each of the week-long seasonal sampling events. The DQCR will contain the following information:

- Summary of the sampling events (comments on exceedences, problems with sampling equipment, site activities, laboratory problems, and results of QA samples).
- Wind rose for the 24-hour sample periods obtained from the nearby meteorological station.
- Printed hourly meteorological data for all measured parameters for the sample periods.
- Summary table of results for the sampling period.
- The initial laboratory report.
- Sample data sheets.

WESTON will maintain a copy of this data file for 5 years following the completion of this project.

# 7. REFERENCES

99-0160 U.S. Environmental Protection Agency (EPA). 1998. "Quality Assurance Regulations for Prevention of Significant Deterioration (PSD) for Monitoring—Appendix B to Part 58," *40 CFR 58*.

99-0161 U.S. Environmental Protection Agency (EPA). 1987. *Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD),* EPA-450/4-87-007.

99-0162 U.S. Environmental Protection Agency (EPA). 1994. "Determination of Organochlorine Pesticides and Polychlorinated Biphenyls in Ambient Air—EPA Method TO-4. In: *Compendium of Methods for Determination of Toxic Compounds in Ambient Air*. Research Triangle Park, NC, EPA-600/4-84-041.

99-0163 U.S. Environmental Protection Agency (EPA). 1985. *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Specific Methods,* EPA-600/4-77/027a.

# ATTACHMENT A

# INSTALLATION AND OPERATION OF PUF HIGH VOLUME SAMPLER

**STANDARD OPERATING PROCEDURES**

**SOP-003**
**PAGE 1 of 8**
**ORIGINATOR __________________**
**APPROVED _____________________**
**EFFECTIVE ____________________**

## SUBJECT: INSTALLATION AND OPERATION OF PUF HIGH VOLUME SAMPLER

## 1.0 SCOPE:

The following procedures describe the installation and operation of the General Metal Work Polyurethane Foam (PUF) high volume sampler. This method uses a modified high volume sampler consisting of a glass fiber filter with a PUF back-up absorbent cartridge to collect particles of polychlorinated biphenyls (PCBs), dioxins/furans, and polycyclic aromatic hydrocarbons (PAHs) in ambient air. This method and corresponding analytical analysis is designated by the EPA as Methods TO-4, TO-9, and TO-13.

## 2.0 REFERENCES/FORMS

**2.1** Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. EPA 600/4-84-041, EPA Method TO-4, TO-9, and TO-13.

**2.2** High Volume Sampling Data Form

## 3.0 INSTALLATION

The PUF sampler is generally shipped complete and requires no assembly with the exception of the sampler lid. There are several items that need to be checked before the sampler is put into operation (see Figure 1).

**3.1** Attach the sampler lid.

**3.2** Connect the front and rear hasps to hold open and keep shut the sampler lid.

**3.3** Check for the rubber gasket between the blower -motor housing and housing assembly.

**3.4** Connect the exhaust hose with the hose clamp and extend away from sampler.

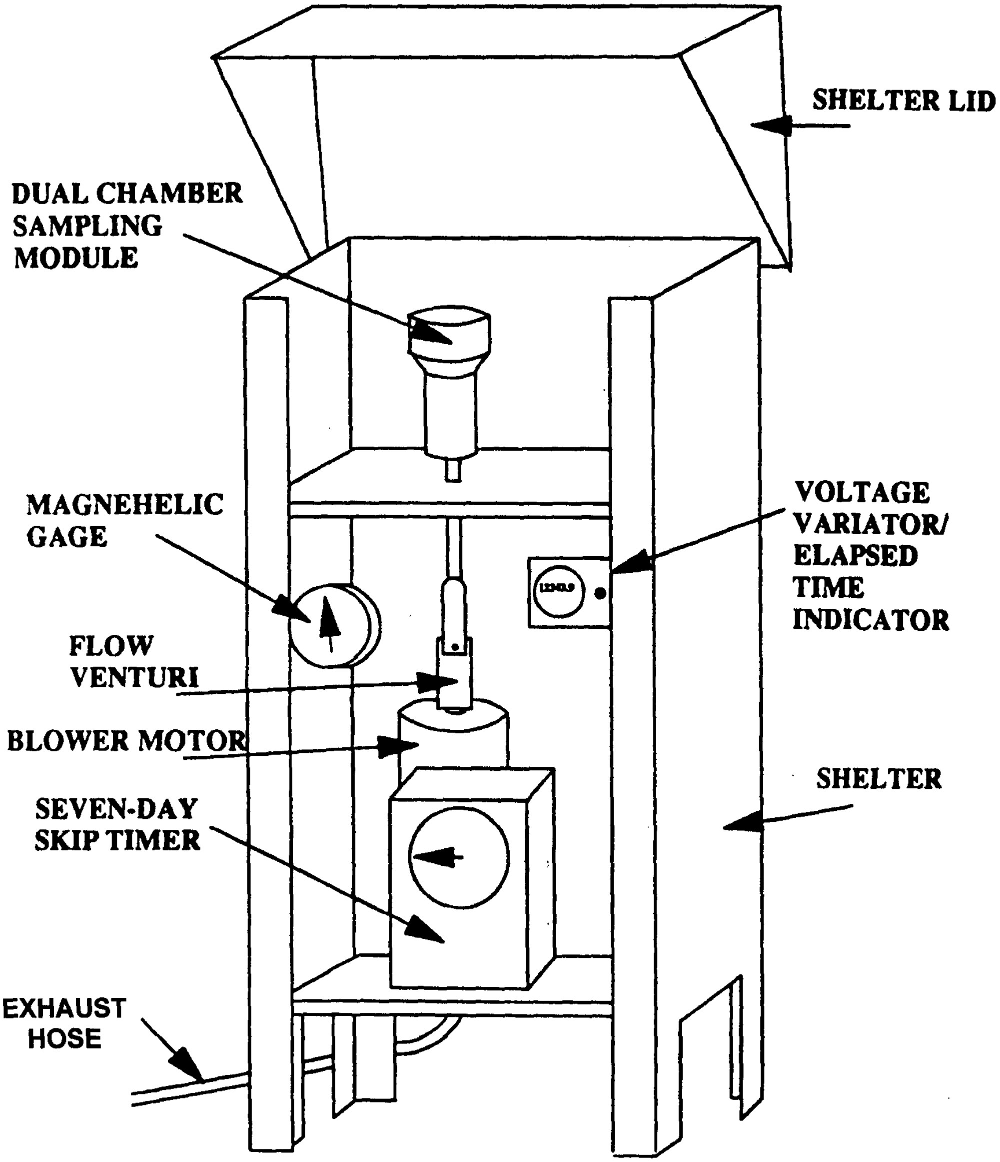
**3.5** Connect the timer controlled side of the plug to the voltage variator/elapsed timer and then to the blower motor.

**3.6** Connect 115 VAC 10 amp power to the timer.

**3.7** With the flow Venturi in the open position and the dual chamber sampling module removed, turn on the sampler.

FIGURE 1

# HIGH VOLUME PUF SAMPLER



**3.8** Turn the voltage variator to the motor's highest speed.

**3.9** The magnehelic gauge should read over 100 in. $H_2O$. If not, check for obstruction in the tubing between the Venturi and magnehelic gauge and/or check that that motor is operating properly and at the highest speed.

**3.10** Check for a small rubber gasket between the sampling module and the guide connection.

**3.11** Check to see if all parts of the sampling module are present (see Figure 2).

**3.12** Secure the sampler to a solid and level surface.

## 4.0 OPERATION

After the sampling system has been assembled and calibrated as described in the SOP for Calibration of the PUF High Volume Sampler, it can be used to collect air samples as described in the following sections.

**4.1** The samples should be located in an unobstructed area at least two meters from any obstacle to air flow. The exhaust hose should be stretched out in the downwind direction to prevent recycling of air.

**4.2** The Teflon O-rings and filter holder should be cleaned with hexane between sampling events. The entire sampling module should be cleaned with hexane on an as needed basis.

**4.3** Remove a clean glass cartridge and quartz fiber filter from their sealed transport containers and place in the sampling module using hexane-rinsed forceps and new latex gloved hands. Seal the module tightly into the sampling system as described below. Place the aluminum foil wrapping back into a plastic 1-gallon Ziploc bag for later use.

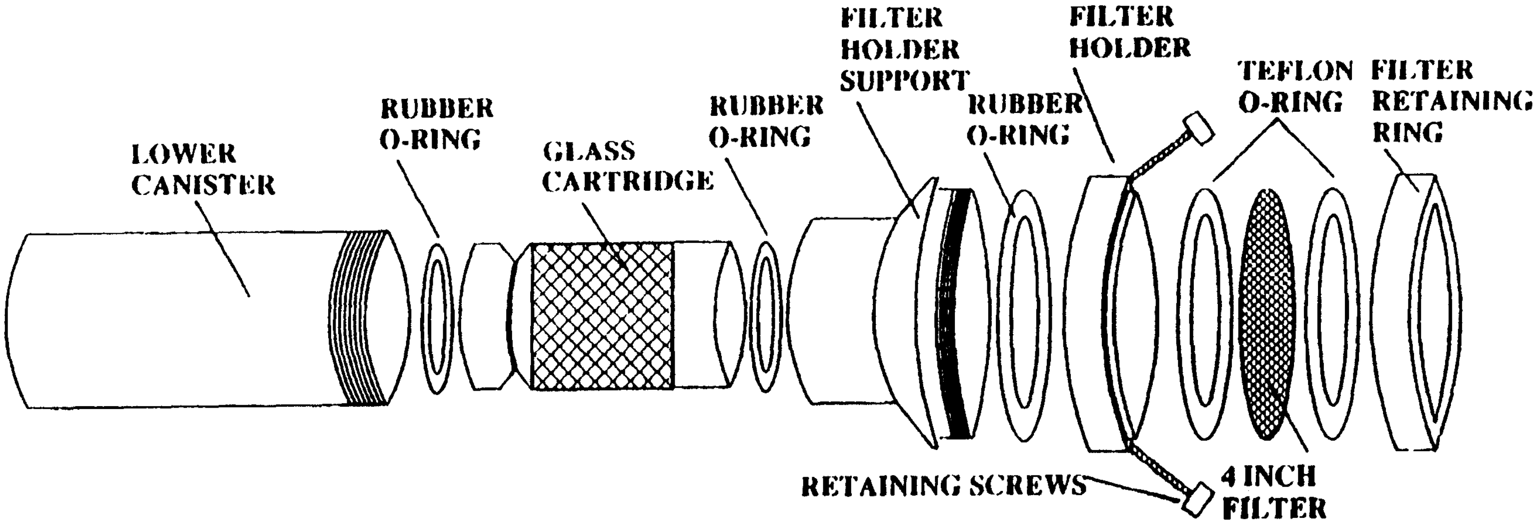
**4.3.1** Place glass cartridge with PUF into the lower canister of the sampling module using the following guidelines:

- For PAH/PNA and Pesticides PCB sampling, use 1-inch PUF, 1-inch XAD, and 1-inch PUF (see Figure 2).
- For PCDD + PCDF (dioxin/furan) sampling, use one whole PUF (see Figure 2).

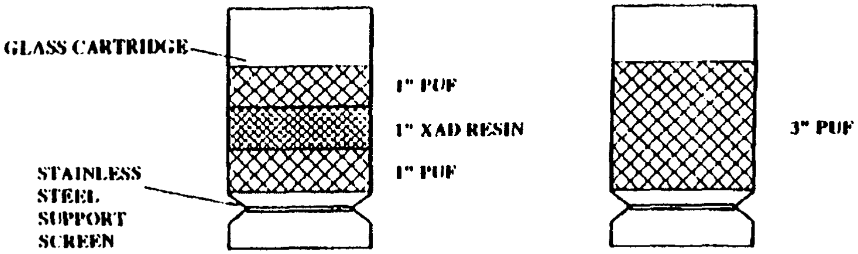
In some cases this glass cartridge will be prepared in the laboratory and sent to the site assembled.

FIGURE 2

# SAMPLING MODULE SET-UP



## GLASS CARTRIDGE CONFIGURATIONS



GLASS CARTRIDGE CONFIGURATION FOR PAH/PNA SAMPLING

GLASS CARTRIDGE CONFIGURATION FOR DIOXIN/FURAN AND PCB SAMPLING

**4.3.2** Next, place the glass fiber filter (coarse side up) on the filter holder of the sampling module by placing the filter between the two Teflon (white) O-rings (see Figure 2). Seal the module as shown in Figure 2 and place the aluminum cover or aluminum foil over the module.

**4.4** Check for a zero reading of the Magnehelic and then record the elapsed time meter setting, sampler serial number, filter, and PUF sample number on the high volume sampler data form.

**4.5** Turn on the PUF sampler. Ensure the flow venturi (yellow or orange handle) is in the up, open position (see Figure 3).

**4.6** Let the sampler warm up for approximately 15 minutes before installing sampling module. After approximately 15 minutes, remove the aluminum cover on the sampling module, install the sampling module onto the sampler, and record the Magnehelic gauge reading (Mag). The Mag reading for a PUF should be approximately 60 to 70 inches and for a combined PUF resin, between 30 and 45 inches. If the readings are higher, it means there is a leak. Check the sampling module for tightness (not too tight on the lower-canister section, the glass cartridge can break if it is over-tightened). Check that the sampling module is seated in the sampler correctly. (The module should not be loose when the O-rings with tabs at the base of the module are fully depressed (see Figure 4).

**4.7** Once the Mag reading has been taken, shut off the unit and record the setting on the elapsed time indicator. Record both setting and Mag readings on the data sheet (see Figure 5).

**4.8** Set the timer to the correct time and correct sampling period.

Example: Sampling period is 48 hours.
Sampling day is 11 Dec. (Friday), 1999.

Sampling will begin on 10 Dec. at 12:00 noon and end on 12 Dec. at 12:00 noon.

(The sampling day is called the 11th of Dec. 1999, 12/11/99).

Rotate the timer one or two complete rotations to check that the timer trips work properly.

**4.9** Turn on the unit to begin sample collection.

**4.10** Once the sampling period has begun and the unit is sampling, go back and check the sampler for proper operation ( i.e., time correct, Mag reading normal, no unusual noises).

FIGURE 3

## FLOW VENTURI

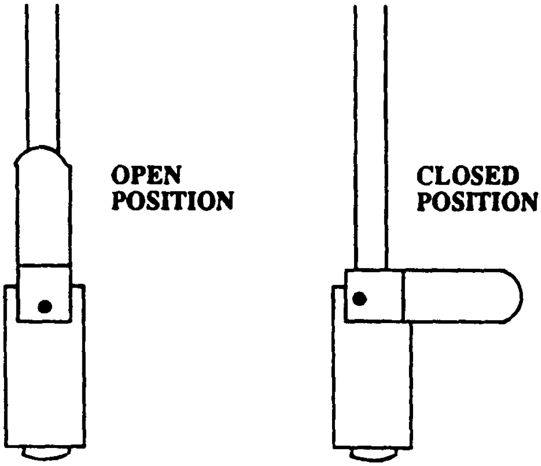
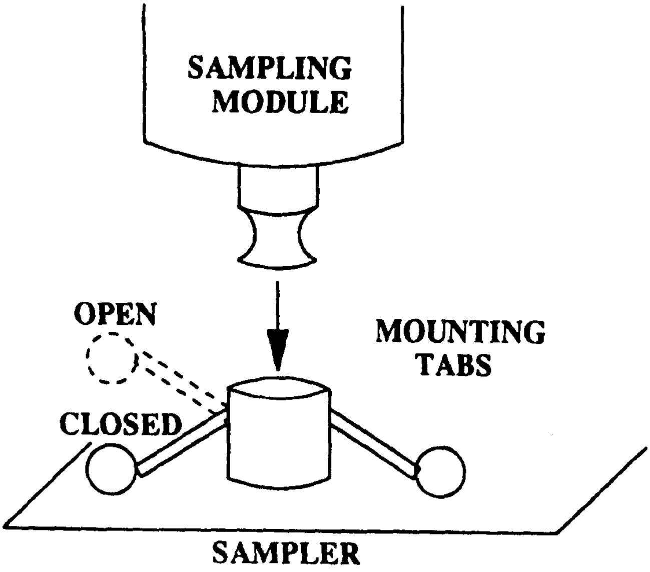


FIGURE 4

## SAMPLING MODULE CONNECTION



## FIGURE 5
## HIGH VOLUME SAMPLING DATA SHEET

**Site:** ______________________________________

**Prepared by:**________________________________________

| Date | Sampling Location ID | Filter Number | Sampling Period (hrs) | | Pump Hours (min or hrs) | | | DIAL GAUGE READING | | Indicated Flow | | Sampler Number | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Start | Stop | Start | Stop | Elapsed | PRE | POST | PRE | POST | | |
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### CHECKLIST

**LOADING**

☐ 1. Load filter.
☐ 2. Record filter number.
☐ 3. Turn sampler on, record dial gauge reading and indicated flow.
☐ 4. Turn sampler off and record pump hours.
☐ 5. Set timer for operation.

**UNLOADING**

☐ 1. Record pump hours.
☐ 2. Turn sampler on and record final dial gauge reading and indicated flow.
☐ 3. Turn sampler off.
☐ 4. Unload filter and place in envelope.
☐ 5. Sampler may be reloaded for next sample at this time.

### ADDITIONAL COMMENTS:

Data Checked by: _______________________

Date: _______________________

**4.11** When the sampling period has ended, record the final setting from the elapsed time indicator on the data sheet and turn the flow venturi to the OFF position. Turn the sampler on.

**4.12** Allow the sampler to run for approximately 15 minutes to warm up. Once the sampler has warmed up, turn the venturi to the ON position and wait for the Mag reading to stabilize before recording the final Mag value on the data sheet. Turn the unit off.

**4.13** Remove the sampling module and cover the module with the aluminum cover.

**4.14** Remove the glass cartridge from the sampling module, wrap in hexane-rinsed foil, and label with sampling date, location, and sample number.

**4.15** Remove the filter from the sampling module with a hexane-rinsed spatula, place the filter inside the glass cartridge with the PUF plug, and place the glass cartridge in a Ziploc bag.

**4.16** Automatic Operations - The procedures given are for automatic or timer operations that can start and stop the PUF sampler at predetermined times.

**4.17** Manual Operations - If the sampler is operated manually, as for a 12-hour sample at a work site, the sampler can be turned on and off manually. The procedures given can be simplified.

**4.17.1** Follow the steps outlined in Sections 4.1 through 4.5.

**4.17.2** Load sampling module and start the sampler at the designated time. The correct Mag reading should be as indicated in Section 4.6.

**4.17.3** Record the barometric pressure (uncorrected to sea level). If continuous temperature readings are not available, use a max/min thermometer to determine the average temperature during the sampling period. The barometric pressure and temperature are used to calculate the actual volumetric flow during the sampling period.

**4.17.4** Once the flow has stabilized (after about 15 minutes), record the Mag reading.

**4.17.5** At the completion of the sampling period, record the Mag reading, barometric pressure, and max/min temperature.

**4.17.6** Turn the sampler off and record elapsed time and stop time.

**4.17.7** Follow the steps outlined in Sections 4.13 through 4.15.