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FINAL SAMPLING AND ANALYSIS PLAN APRIL 2010 FOR PERFLOURINATED COMPOUNDS IN GROUNDWATER NAS SOUTH WEYMOUTH MA

4/15/2010

TETRA TECH

SAP Worksheet #1 -- Title and Approval Page
(UFP-QAPP Manual Section 2.1)

FINAL SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)
April 2010

Perfluorinated Compounds in Groundwater
Former Naval Air Station South Weymouth
Weymouth, Massachusetts

Prepared for:
Naval Facilities Engineering Command
Mid-Atlantic Division
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Prepared under:
Contract Number N62470-08-D-1001
“CLEAN” Contract Task Order No. WE 11

QAPP Worksheet #1 (UFP-QAPP Manual Section 2.1) -- Approval Page

Document Title: Final Sampling and Analysis Plan, Perfluorinated Compounds in Groundwater, Former Naval Air Station South Weymouth, Weymouth, Massachusetts, April 2010

Lead Organization: Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic

Preparer's Name and Organizational Affiliation: Tetra Tech NUS, Inc. (TtNUS)

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Preparation Date (Month/Year): April 2010

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Signature/Date
Tom Johnston, PhD, TtNUS

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Signature/Date
Brian Helland, Navy, BRAC PMO Northeast

Lead Organization QA Officer: See next page
Signature/Date
Government Chemist

QAPP Worksheet #1 (UFP-QAPP Manual Section 2.1) – Approval Page

Document Title: Draft Sampling and Analysis Plan, Perfluorinated Compounds in Groundwater, Former Naval Air Station South Weymouth, Weymouth, Massachusetts, February 2010

Lead Organization: Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic

Preparer's Name and Organizational Affiliation: Tetra Tech NUS, Inc. (TtNUS)

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Lead Organization's Project Manager: B. Helland 2/17/10
Signature/Date
Brian Helland, Navy, BRAC PMO Northeast

Lead Organization QA Officer: Donna Nelson 2/17/2010
Signature/Date
Government Chemist

EXECUTIVE SUMMARY

This Sampling and Analysis Plan (SAP) presents field sampling, laboratory analytical methods, and procedures to support a groundwater investigation to identify the presence of perfluorinated compounds (PFCs), components of aqueous film forming foam (AFFF), in groundwater in areas of NAS South Weymouth (the Base) where AFFF is known to have been used, released, and/or spilled. The groundwater investigation will focus on the Hangar 1 area and former Fire Fighting Training Area (FFTA) at Naval Air Station (NAS) South Weymouth, Weymouth Massachusetts. Both of these areas are in the central portion of the Base near runway 8-26.

AFFF was stored and used in Hangar 1 which is located near the center of the Base, immediately north of the east-west runway, former Runway 8-26. During the Environmental Baseline Survey (EBS), Review Item Area (RIA) 11 was established to address releases of AFFF in Hangar 1. RIA 11 was subsequently defined to include any inadvertent releases or spills of AFFF in the Hangar 1 area.

AFFF was also used at the FFTA in training exercises. No environmental investigations have to date been performed associated with the AFFF releases around Hangar 1 or FFTA. To date no samples from the Base have been analyzed for PFCs.

AFFF contains PFCs that are known to be stable and bioaccumulative compounds. Two PFCs, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), are considered marker compounds that serve to indicate the presence of other PFCs and are classified by DoD as emerging contaminants. There are no toxicity values or groundwater standards established for these compounds.

Since PFCs are water soluble and may have leached from soil into groundwater, shallow groundwater is considered the appropriate medium to sample for the presence of PFCs. The Project Team chose a biased sampling design for this project. The design requires collection of shallow groundwater samples from existing monitoring wells downgradient of known spill/release areas at two locations on the Base, Hangar 1 and FFTA. Shallow groundwater samples will also be collected from existing upgradient and background wells. This investigation will compare concentrations of PFCs downgradient of areas where spills/releases occurred to upgradient and background concentrations from areas of the Base where AFFF was not used. If PFCs are detected in any wells, a notification will be included in property transfer documents. The data may be used in the future in five-year review evaluations if regulatory limits and risk-based criteria become established.

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A Tetra Tech and USEPA Standard Operating Procedures
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C Project-Specific Field Task Procedures for Water Level Measurement and Groundwater Sampling
D Analytical Specification
E Analytical Standard Operating Procedures and Certifications
F Monitoring Well Construction Logs
G Supporting Information

ACRONYMS AND ABBREVIATIONS

AFFF	Aqueous Film Forming Foams
BCT	BRAC Cleanup Team
BRAC	Base Realignment and Closure
CA	Corrective Action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLP	Contract Laboratory Program
CSM	Conceptual Site Model
CTO	Contract Task Order
DoD	Department of Defense
DQI	Data Quality Indicator
DQO	Data Quality Objective
EBS	Environmental Baseline Survey
EPA	Environmental Protection Agency
FFTA	Fire Fighting Training Area
FOL	Field Operations Leader
FS	Feasibility Study
FSP	Field Sampling Plan
FMR	Field Modification Record
GC	Gas Chromatograph
GIS	Geographic Information System
GW	Ground Water
HASP	Health and Safety Plan
HPLC/MS	High Performance Liquid Chromatography/ Mass Spectrometer
IDQTF	Intergovernmental Data Quality Task Force
LCS	Laboratory Control Sample
LFB	Laboratory Fortified Blank
LIMS	Laboratory Information Management Systems
LOD	Limit of Detection
LOQ	Limit of Quantitation
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols (Manual)
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MOU	Memorandum of Understanding
MPC	Measurement Performance Criteria
MQO	Measurement Quality Objectives
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSR	Management Systems Review
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
PAH	Polycyclic Aromatic Hydrocarbons
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCBs	Polychlorinated Biphenyls
PDF	Portable Document Format
PFCs	Perfluorinated Compounds
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PM	Project Manager
PQOs	Project Quality Objectives
PRQL	Project-Required Quantitation Limit
PT	Proficiency Testing (previously known as performance evaluation (PE) sample)
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan

QAM	Quality Assurance Manager
QC	Quality Control
QL	Quantitation Limit
QMP	Quality Management Plan
QS	Quality System
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RIA	Review Item Area
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RTM	Remedial Technical Manager
RSD	Relative Standard Deviation
RT	Retention Time
SAP	Sampling and Analysis Plan
SD	Standard Deviation
SDG	Sample Delivery Group
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedure
SQLs	Sample Quantitation Limits
SRM	Standard Reference Material
SSO	Site Safety Officer
SSTTDC	South Shore Tri-Town Development Corporation
TBD	To Be Determined
TSA	Technical Systems Audit
UFP	Uniform Federal Policy

SAP Worksheet #2 -- SAP Identifying Information
(UFP-QAPP Manual Section 2.2.4)

Site Name/Number: Former Naval Air Station South Weymouth
Operable Unit: Perfluorinated Compounds in Groundwater
Contractor Name: Tetra Tech NUS, Inc. (Tetra Tech)
Contract Number: N62470-08-D-1001
Contract Title: Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Comprehensive Long-Term Environmental Action Navy (CLEAN)

Work Assignment Number (optional): CTO WE11

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (U.S. EPA 2005) and *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS (U.S. EPA 2002)* .

2. Identify regulatory program: National Contingency Plan (NCP); Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

3. This SAP is a project-specific SAP.

4. List dates of scoping sessions that were held:

Scoping Session	Date
BRAC Cleanup Team (BCT) Meeting	November 12, 2009
DQO conference call	December 22, 2009

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
None.	

6. List organizational partners (stakeholders) and connection with lead organization:

U.S. Environmental Protection Agency (EPA), Region I – lead regulatory agency
Massachusetts Department of Environmental Protection (MassDEP) – regulatory agency

7. Lead organization: Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic/BRAC PMO NE

8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

Not applicable. The table of individual cross-walk items, which usually follows this item, has been deleted because none of them apply to this project.

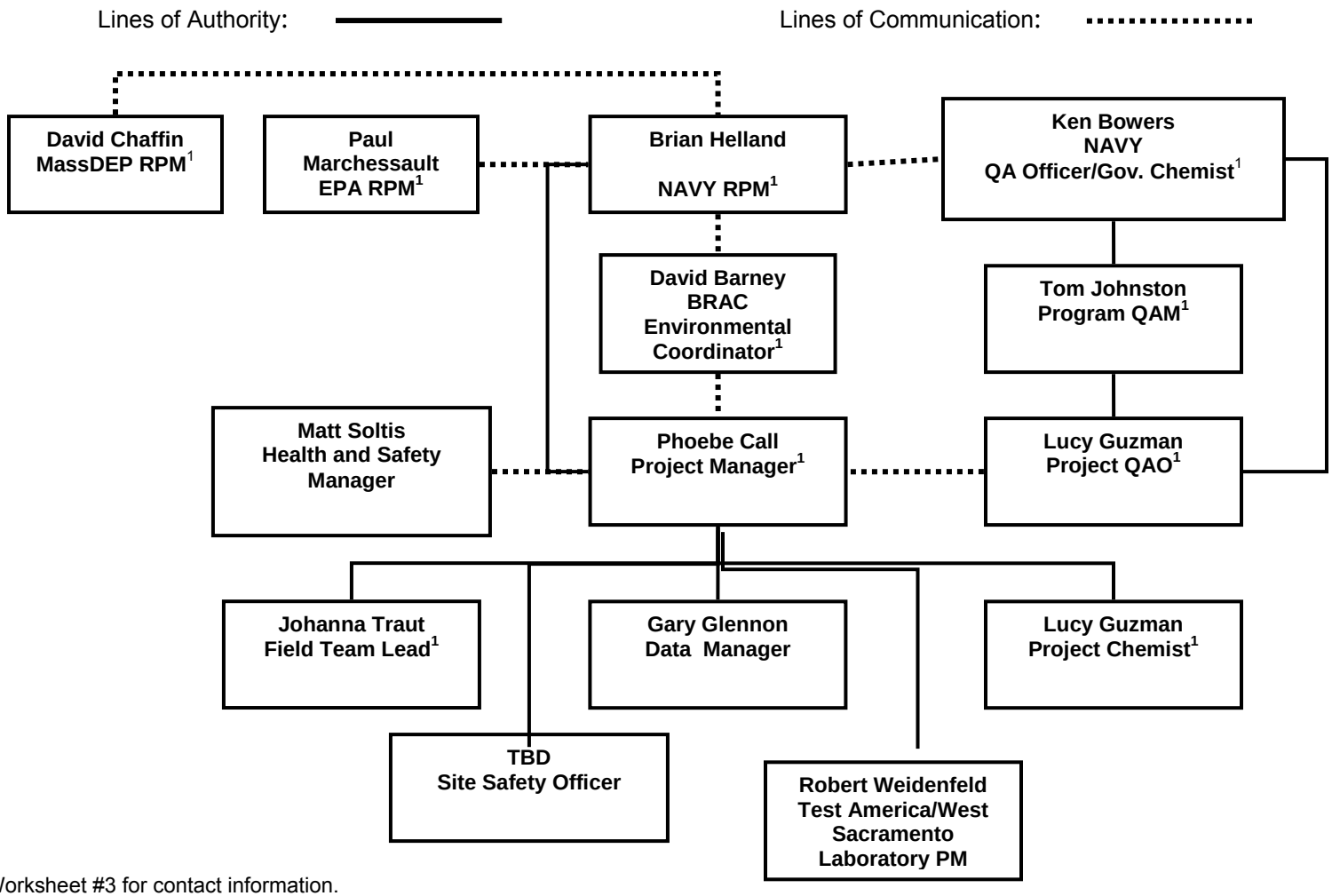
SAP Worksheet #3 -- Distribution List

(UFP-QAPP Manual Section 2.3.1)

Name of SAP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address
Brian Helland	Remedial Project Manager (RPM)	Navy, BRAC PMO Northeast	215-897-4912	brian.helland@navy.mil
David Barney	BRAC Environmental Coordinator	Navy, BRAC PMO Northeast	617-753-4656	david.a.barney@navy.mil
Paul Marchessault	Remedial Project Manager	USEPA	617-918-1388	marchessault.paul@epa.gov
David Chaffin	Remedial Project Manager	MassDEP	617-348-4005	david.chaffin@state.ma.us
Phoebe Call	Project Manager (PM)	TtNUS	978-474-8403	phoebe.call@tetratech.com
Lucy Guzman	Lead Chemist	TtNUS	978-474-8416	lucy.guzman@tetratech.com
Tom Johnston	Program QA Mgr/	TtNUS	412-921-8615	tom.johnston@tetratech.com
Johanna Traut	Field Operations Leader (FOL)	TtNUS	978-474-8442	johanna.traut@tetratech.com
Robert Weidenfeld	Laboratory PM	Test America/West Sacramento	916-374-4333	robert.weidenfeld@testamericainc.com

Note: Recipients of the SAP will distribute the SAP internally to all personnel implementing the SAP.

SAP Worksheet #4 -- Project Organization Chart
(UFP-QAPP Manual Section 2.4.1)



[1] See Worksheet #3 for contact information.

SAP Worksheet #5 -- Communication Pathways

(UFP-QAPP Manual Section 2.4.2)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Changes in schedule	Tetra Tech PM	Phoebe Call	978-474-8403	FOL informs PM by phone within same day; PM informs RPM by phone within 24 hours and prepares schedule concurrence letter, if deemed necessary by the RPM and PM.
Issues in the field that result in changes in scope of field work or SAP Amendments	Tetra Tech FOL	Johanna Traut	978-474-8442	FOL informs Tetra Tech PM by phone within same day. PM approves change same day, if warranted. Document via FMR form.
Issues in the field that result in changes in scope of work	Tetra Tech FOL Tetra Tech PM	Johanna Traut Phoebe Call	978-474-8442 978-474-8403	FOL informs PM by phone within same day; PM informs RPM by phone within 24 hours, if warranted. PM sends a concurrence letter to Navy RPM, if warranted, within 7 days. RPM signs the letter within 5 days of receipt. Scope change is to be implemented before work is executed. Document the change on a FMR form.
Recommendations to stop work and initiate work upon corrective action	• Tetra Tech FOL • Tetra Tech PM • Tetra Tech QAM • Tetra Tech SSO • Navy RPM	• Johanna Traut • Phoebe call • Tom Johnston • TBD • Brian Helland	978-474-8442 978-474-8403 412-921-8615 978-474-8400 215-897-4912	Responsible party informs subcontractors, the Navy, and Project Team by phone within 1 business day.
Analytical data quality issues	Test America/CA Tetra Tech Project Chemist	Nilo Ligi Lucy Guzman	916-373-5600 978-474-8416	Notify Tetra Tech Project Chemist by phone within 1 business day. Notify Data Validation Staff and Tetra Tech PM by phone or email, if necessary, within 1 business day.

Note: Telephone notifications to be documented via email.

SAP Worksheet #6 -- Personnel Responsibilities Table

(UFP-QAPP Manual Section 2.4.3 and Appendix A)

"All regulator project managers, Navy project managers, and prime contractor managers and supervisory personnel, including field supervisors, are responsible for ensuring that their subordinates and subcontractors adhere to this SAP."

Name	Title/Role	Organizational Affiliation	Responsibilities
Brian Helland	RPM	Navy, BRAC PMO Northeast	Oversees project implementation, including contract management. scoping, data review, and evaluation.
David Barney	BRAC Environmental Coordinator	Navy, BRAC PMO Northeast	Oversees all Base BRAC activities, including field work coordination, scoping, data review, and evaluation.
Paul Marchessault	USEPA RPM	USEPA Region I	Participates in scoping, data review, evaluation, and review of the SAP. Oversees project execution for USEPA.
David Chaffin	MassDEP RPM	MassDEP	Participates in scoping, data review, evaluation, and review of the SAP. Oversees project execution for MassDEP.
Phoebe Call	PM	Tetra Tech	Oversees project, financial, schedule, and technical day to day management of the project, including the following: • Ensures timely resolution of project-related technical, quality, and safety questions associated with Tetra Tech operations. • Functions as the primary Tetra Tech interface with the Navy RPM, NAS Weymouth, Tetra Tech field and office personnel. • Ensures that Tetra Tech health and safety issues related to this project are communicated effectively to all personnel and off-site laboratories. • Monitors and evaluates all Tetra Tech subcontractor performance. • Coordinates and oversees work performed by Tetra Tech field and office technical staff (including data validation, data interpretation, and report preparation). • Coordinates and oversees maintenance of all Tetra Tech project records. • Coordinates and oversees review of Tetra Tech project deliverables. • Prepares and issues final Tetra Tech deliverables to the Navy.

Johanna Traut	FOL	Tetra Tech	As FOL, supervises, coordinates, and performs field sampling activities, including the following: • Ensures that health and safety requirements are implemented. • Functions as the on-site communications link between field staff members, the SSO, NAS Weymouth, and the Tetra Tech PM. • Alerts off-site analytical laboratories of any special health and safety hazards associated with environmental samples. • Oversees the mobilization and demobilization of all field equipment and subcontractors. • Coordinates and manages the field technical staff. • Adheres to the work schedules provided by the Tetra Tech PM. • Ensures the proper maintenance of site logbooks, field logbooks, and field recordkeeping. • Initiates FMRs when necessary. • Identifies and resolves problems in the field, resolving difficulties via consultation with the Tetra Tech PM, implementing and documenting corrective action procedures, and providing communication between the field team and project management.
TBD	Site Safety Officer (SSO)	Tetra Tech	Will be responsible for training and monitoring site conditions related to personnel safety. Details of the SSO's responsibilities are presented in the site-specific Health and Safety Plan (HASP) and include the following: • Controls specific health and safety-related field operations such as personnel decontamination, monitoring of worker heat or cold stress, and distribution of safety equipment. • Conducts and documents a daily health and safety briefing each day while on site. • Assures that field personnel comply with all procedures established in the HASP. • Identifies an assistant SSO in his absence. • Terminates work if an imminent safety hazard, emergency situation, or other potentially dangerous situation is encountered. • Ensures the availability and the condition of health and safety monitoring equipment. • Coordinates with the PM to institute and document any necessary HASP modifications. • Ensures that facility personnel and subcontractors are adequately advised and kept clear of potentially contaminated materials.

Tom Johnston	Quality Assurance Manager (QAM)	Tetra Tech	Reviews the SAP, oversees preparation of the laboratory scope, coordinates with laboratory, and conducts data quality review. Ensures quality aspects of the CLEAN program, including the following: • Develops, maintains, and monitors QA/QC policies and procedures. • Provides training to Tetra Tech staff in QA/QC policies and procedures. • Conducts systems and performance audits to monitor compliance with environmental regulations, contractual requirements, SAP requirements, and corporate policies and procedures. • Audits project records. • Monitors subcontractor quality controls and records. • Assists in the development of corrective action plans and ensuring correction of non-conformances reported in internal or external audits. • Ensures that this SAP meets Tetra Tech, Navy, EPA, and MassDEP requirements. • Prepares QA reports for management
Lucy Guzman	Project Chemist, QA/QC Advisor	Tetra Tech	Coordinates analyses with laboratory chemists, ensures the laboratory scope or work is followed and that QA has been performed for QA data packages, and communicates with Tetra Tech staff. • Ensures that the project meets objectives from the standpoint of laboratory performance. • Provides technical advice to the Tetra Tech team on project chemistry matters. • Monitors and evaluates subcontractor laboratory performance. • Ensures timely resolution of laboratory-related quality, or other issues effecting project goals. • Functions as the primary interface with the subcontracted laboratories and the Tetra Tech PM. • Coordinates and oversees work performed by the subcontracted laboratory. • Oversees the completion of Tetra Tech data validation. • Coordinates and oversees review of laboratory deliverables. • Recommends appropriate laboratory corrective actions. • Quality of data validation deliverables and compliance with Worksheet #19 to #21 requirements. As the Site QA/QC Advisor, will be responsible for ensuring adherence to all quality assurance/quality control (QA/QC) requirements as defined in this SAP. The following is a summary of the Site QA/QC Advisor's responsibilities:

Lucy Guzman	Project Chemist, QA/QC Advisor	Tetra Tech	• Ensuring that field QC samples are collected at the proper frequencies. • Ensuring that additional volumes of sample are supplied to the analytical laboratory with the proper frequency to accommodate laboratory QA/QC analyses. • Ensuring that measuring and test equipment are calibrated, used, and maintained in accordance with applicable procedures and technical standards. • Acting as liaison between site personnel, laboratory personnel, and the QAM. • Managing bottle ware shipments and overseeing field preservation.
Matt Soltis	HSM	Tetra Tech	Oversees CLEAN Program Health and Safety Program • Provides technical advice to the Tetra Tech PM on matters of health and safety. • Oversees the development and review of the HASP. • Conducts health and safety audits. • Prepares health and safety reports for management.
Robert Weidenfeld	Laboratory, Test America/West Sacramento PM	Test America	• Ensures that the analytical scope is followed. • Coordinates sample analyses with laboratory chemists. • Performs QA on data packages. • Communicates with Tetra Tech staff.
Cheng Vue	Test America/West Sacramento Sample Custodian	Test America	• Receives samples and signs chain-of-custody forms • In charge of sample storage and proper sample disposal
David Allameh	Test America/West Sacramento HPLC/MS/MS Manager	Test America	• Oversees sample extraction within holding times • Oversees the HPLC/MS/Ms analysis of the samples in accordance with approved laboratory SOP • Review instrument calibration and sample analysis results • Approves analytical reports.

SAP Worksheet #7 -- Special Personnel Training Requirements Table

(UFP-QAPP Manual Section 2.4.4)

Each site worker will be required to have completed a 40-hour course (and 8-hour refresher, if applicable) in Health and Safety Training as described under Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(b)(4). Safety requirements are addressed in greater detail in the site-specific Health and Safety Plan (HASP), prepared under separate cover.

SAP Worksheet #8 -- Project Scoping Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1)

Project Name: Perfluorinated Compounds in Groundwater **Projected Date(s) of Sampling:** April 2010 **Project Manager:** Phoebe Call	**Site Name:** Former Naval Air Station South Weymouth **Site Location:** Weymouth, Massachusetts

Date of Session: November 12, 2009
Scoping Session Purpose: Discuss path forward to address aqueous film forming foam (AFFF) releases/spills at NAS South Weymouth

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Dave Barney	BRAC Environmental Coordinator	Navy, BRAC PMO Northeast	617-753-4656	david.a.barney@navy.mil	BRAC Environmental Coordinator
Brian Helland (via telephone)	RPM	Navy, BRAC PMO Northeast	215-897-4912	brian.helland@navy.mil	Navy RPM
Kymberlee Keckler	RPM	EPA Region I	617-918-1385	keckler.kymberlee@epa.gov	EPA RPM
Dave Chaffin	RPM	MassDEP	617-348-4005	david.chaffin@state.ma.us	MassDEP RPM
Phoebe Call	Program Manager	Tetra Tech	978-474-8403	phoebe.call@tetratech.com	PM

Comments:

- AFFF is an issue of concern to the regulators due to the documented usage/spills of AFFF and potential impacts of PFCs, which are components of AFFF. To date the BCT has not determined a path forward to address the issue since there are no regulatory standards established for the key components of concern, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). Navy provided a memorandum to EPA and MassDEP prepared by Tetra Tech that included a research summary on the components of AFFF and analytical methods to detect fluorinated compounds, also referred to as perfluorinated compounds (PFCs).
- Dave Barney reviewed the history of the use of AFFF at Hangar 1 and documented spills and releases. Generally spills inside the hangar would have been directed to sumps and floor trenches which drained into an oil/water separator. Outside spills on the apron would likely have been directed to the storm drain system which eventually discharges to French Stream. AFFF was also used at FFTA and could have reached French Stream. Maintenance actions in the hangar would likely have eliminated any problems within the hangar.
- Spills may have infiltrated through soil into groundwater which may have discharged to French Stream. Sampling from existing groundwater monitoring wells located near Hangar 1 and FFTA would provide data on the presence of PFCs. However, there are no risk-based values to evaluate any potential human health impacts. If PFCs are detected, Navy can include recommendations in the next five-year review should the regulatory situation have changed. Also if PFCs are detected, this could be mentioned in the property transfer documents as a notification to future property owners.

Action Items: Navy will develop a SAP and collect groundwater samples for PFC analysis.

Consensus Decisions: A SAP will be prepared and groundwater samples collected to identify the presence or absence of PFCs in groundwater near the two locations and compare the concentrations to background concentrations. If concentrations are detected, a notification will be included in the property transfer documents and PFCs will be re-evaluated in the next five-year review.

Project Name: Perfluorinated Compounds in Groundwater **Projected Date(s) of Sampling:** April 2010 **Project Manager:** Phoebe Call	**Site Name:** Former Naval Air Station South Weymouth **Site Location:** Weymouth, Massachusetts

Date of Session: December 22, 2009 (teleconference)
Scoping Session Purpose: DQO

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Dave Barney	BRAC Environmental Coordinator	Navy, BRAC PMO Northeast	617-753-4656	david.a.barney@navy.mil	BRAC Environmental Coordinator
Dave Barclift	Risk Assessor	Navy, NAVFAC Atlantic	215-897-4913	david.barclift@navy.mil	Navy risk assessor
Jon Tucker	Navy Chemist	Navy, NAVFAC Atlantic	757-322-8288	jonathan.tucker@navy.mil	Navy chemist
Phoebe Call	Project Manager	Tetra Tech	978-474-8403	phoebe.call@tetratech.com	PM
Lucy Guzman	Project Chemist	Tetra Tech	978-474-8416	lucy.guzman@tetratech.com	Chemist
Tom Johnston	Quality Assurance Manager	Tetra tech	412-921-8615	tom.johnston@tetratech.com	QAM

Comments:

- AFFF was used at two locations in the NAS South Weymouth: Hangar 1 and FFTA (see Figure 1). AFFF was stored in the hangar; spills and releases have been documented. AFFF was used at FFTA during training exercises. Both sites are located in the center of the Base and are not far from each other.
- The contaminants of concern are PFOA and PFOS. Tetra Tech is proposing to use PFOA and PFOS as markers for contamination to identify the presence of PFC contamination.
- Focus is on shallow groundwater as the medium of concern due to possible infiltration of AFFF components through soil and into groundwater. Since research has shown PFCs to be persistent and bioaccumulate, but water soluble, samples will be collected to determine if these compounds are present in groundwater. Because PFCs are ubiquitous and there are no risk-based criteria or regulatory standards, downgradient concentrations will be compared to upgradient concentrations.
- Surface water or sediment will not be sampled because spills in Hangar 1 would have ultimately discharged to the west branch of French Stream; since PFCs are water soluble they would have been carried downstream. Use of AFFF at FFTA would have potentially impacted the east branch of French Stream and would have also been carried downstream. Soil is not a medium of concern since the hangar has a concrete floor and floor drain system maintenance actions have been performed; a soil removal action was completed at FFTA. Sample groundwater downgradient from both areas and background locations for comparison purposes.
- Receptors are human health only: Concrete hangar floor prevents human and ecological exposures. During the remedial action performed under the Massachusetts Contingency Plan at FFTA, 3-4 feet of soil were removed because of petroleum contaminants; AFFF in the soil would likely have been removed as well. Therefore, human health impacts from groundwater exposure are the only concern.

Action Items:

- Tetra Tech will send the Navy the list of possible wells to be sampled.
- Tetra Tech will procure a laboratory. The selected laboratory must have or acquire DoD accreditation for the target PFCs before sample shipment.
- Tetra tech will develop a SAP by middle of January 2010.

Consensus Decisions:

- Identify presence of PFCs in groundwater at the two identified areas of the Base and compare to background locations. Sample existing monitoring wells from locations upgradient and downgradient of Hangar 1 and FFTA and collect data to determine PFC concentrations in groundwater.
- Perform low flow sampling and collect standard field quality parameters.
- No regulatory limits are established for PFOS/PFOA but there are provisional health advisory values for PFOA and PFOS. PFCs are considered emerging contaminants. There is no Navy guidance regarding these contaminants. Therefore the data will be used to compare downgradient concentrations to the maximum upgradient concentration.
- Standard field QA/QC: field duplicates and rinsate blanks. Perform standard Tier II data validation on the laboratory data.
- TtNUS located two DoD certified laboratories that perform PFC analysis, although neither is certified for the full suite of PFCs. These laboratories routinely report a list of target analytes. Request full suite of PFCs, ranging from perfluorobutanoic to perfluorododecanoic acids and selected perfluorosulfonates).

Project Name: Perfluorinated Compounds in Groundwater **Projected Date(s) of Sampling:** April 2010 **Project Manager:** Phoebe Call	**Site Name:** Former Naval Air Station South Weymouth **Site Location:** Weymouth, Massachusetts

Date of Session: January 14, 2010 and January 15, 2010 (email correspondence)
Scoping Session Purpose: Laboratory Certification Status

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Dave Barney	BRAC Environmental Coordinator	Navy, BRAC PMO Northeast	617-753-4656	david.a.barney@navy.mil	BRAC Environmental Coordinator
Brian Helland	RPM	Navy, NAVFAC Atlantic	215-897-4912	brian.helland@navy.mil	Navy RPM
Dave Barclift	Risk Assessor	Navy, NAVFAC Atlantic	215-897-4913	david.barclift@navy.mil	Navy risk assessor
Ken Bowers	Navy Chemist	Navy, NAVFAC Atlantic	757-322-8341	Kenneth.a.bowers@navy.mil	Navy chemist
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Comments: The selected laboratory, Test America Arvada, CO, will not be able to obtain the ELAP certification for the 12 PFCs using the specified method and run samples until late April or May. Tetra Tech then contacted the Test America laboratory in West Sacramento, CA. This laboratory obtained ELAP certification last month but for just two PFCs: PFOA and PFOS (PFC markers). This laboratory will be able to run the 12 PFCs, but not until June or July.

Action Items: Tetra Tech will award the work to Test America, West Sacramento, CA.

Consensus Decisions: Given the objective of the groundwater investigation at NAS South Weymouth, reducing the analyte list to the two marker compounds would be adequate and would enable us to move forward consistent with Navy's schedule. On January 14th, Dave Barclift indicated that this plan is acceptable. This decision was also discussed with Brian Helland and Dave Barney, who also concurred.

SAP Worksheet #9 -- Conceptual Site Model
(UFP-QAPP Manual Section 2.5.2)

9.1 SITE LOCATION, BACKGROUND, AND HISTORY

NAS South Weymouth is located approximately 15 miles southeast of Boston, Massachusetts and is situated in Norfolk and Plymouth counties. Portions of the Base are located in the Towns of Weymouth, Abington, and Rockland. Hangar 1 is located in Weymouth near the center of the Base, immediately north of the east-west runway, former Runway 8-26.

AFFF was stored in Hangar 1 in the above-ground storage tank (AST) shown on the site figure in Appendix G. The primary use of Hangar 1 was the storage and maintenance of aircraft; historic site activities are thought to include metal working, engine work, painting, arming, washing, hydraulic system repair, welding, parachute packing, photo development, training, and plating and anodizing (Foster Wheeler Environmental, 2001a). During the Environmental Baseline Survey (EBS), Review Item Area (RIA) 11 was established to address releases of AFFF in Hangar 1 (Stone & Webster, 1996). Releases occurred in the area of the AFFF AST and pump room shown on the site figure in Appendix G. RIA 11 was subsequently defined to include any inadvertent release spills of AFFF in the Hangar 1 area. AFFF was also used at the Fire Fighting Training Area (FFTA) in training exercises. FFTA is also located in the center of the Base (Figure 1).

MassDEP raised concerns about the components of AFFF and in 2003 Navy proceeded to research the specific types of AFFF used at the Base. In 2005 MassDEP commented that recent research indicated that AFFF used at the Base may have included fluorinated alkyl substances which have toxic and bioaccumulative properties. MassDEP also noted concerns with the documented spills and releases of AFFF from the Hangar 1 area and FFTA. Additional research information was compiled by Navy in 2009 on the fluorinated compounds likely present in AFFF and laboratories were identified that can perform analysis for these compounds (Tetra Tech NUS, Inc., 2009a).

In 1999, Navy performed a removal of two oil water separators from Hangar 1 as well as cleaning/testing of the floor drain systems, and soil samples were collected near the separators (Foster Wheeler, 2001a; 2001b). Between 2000 and 2001, the floor drain system was removed and soil samples were collected along the former pipelines and at other suspected areas of contamination based on visual, field screening, and olfactory evidence. Based on the analytical results, soil was excavated and removed in areas where elevated chemical concentrations (primarily polychlorinated biphenyls (PCBs)) were detected. In 2002, three monitoring wells were installed downgradient of Hangar 1 to assess the impact on groundwater of contaminated soil beneath the main hangar floor drain system.

Navy completed investigations and removals of the storm drain system in North and South Lean-tos. Those investigations and excavations included cleanup criteria for polycyclic aromatic hydrocarbons

(PAHs), metals, and PCBs (Tetra Tech FW, 2004). Groundwater monitoring wells were installed and sampled during specific investigations. The groundwater elevations from all the wells in the Hangar 1 area were used to determine the groundwater flow direction (see Figure in Appendix G). The predominant groundwater flow direction is toward the south-southwest.

9.2 SITE PHYSICAL CHARACTERISTICS

The area surrounding Hangar 1 is paved. Hanger 1 and its surrounding aircraft apron are where the majority of aircraft maintenance and refueling activities for the Base were conducted. The area consists of a number of sites located within and adjacent to Hangar 1. Hangar 1 is a large building with an arched roof with two-story structures, referred to as “lean-tos,” on the north and south sides of the hangar. The North and South Lean-Tos (RIA 10C) are long narrow two-story structures attached to the north and south sides of Hanger 1. The lean-tos extend to the east of the main building and enclose a paved area (Tetra Tech NUS, 2009b).

The combined size of the Hangar 1 area is approximately 165,290 square feet; the main bay of the hangar is approximately 68,800 square feet. No water bodies are located within 1,500 feet of the Site. Only sparse vegetation exists on the Site (Foster Wheeler Environmental, 2001a).

IR Program Site 4, the former FFTA, comprises approximately 3.8 acres located south of Runway 8-26 and east of Taxiway C (Figure 1). This site currently consists of a cracked asphalt pad and concrete containers (burn pits), which were installed in 1988.

9.3 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Since the AFFF spills in Hangar 1 were managed in accordance with the Base SPCC (Spill Control and Countermeasures) Plan and the AFFF Materials Safety Data Sheets indicate AFFF as non-hazardous, No Further Action was recommended for the site. No environmental investigations have been performed associated with the AFFF releases around Hangar 1. To date no samples from the Base have been analyzed for PFCs.

During training exercises at the FFTA, containers were partially filled with water and JP-5 fuel was placed on top of the water. The fuel was ignited and then extinguished to provide fire fighting practice. Reportedly, the only spill or release would have occurred if water or foam splashed out of the containers during training. The Phase II RI report was completed in April 2001. The RI determined that groundwater flow is generally toward the west (see figures in Appendix G) and concluded there were no exceedances of human health or ecological risk thresholds for the current and future use scenarios that were evaluated (Tetra Tech NUS, 2001). The Navy and EPA signed the Final ROD in September 2004 that specified No Action under CERCLA. The Navy has addressed the petroleum residuals at the site pursuant to

applicable Massachusetts state law. All site activities under the state program were completed in July 2008 (Tetra Tech EC, 2008).

9.4 CONCEPTUAL SITE MODEL

The following sections present possible contaminant release mechanisms, the nature and extent of contamination associated with the use and release of AFFF, contaminant migration routes, and routes of exposure to human and ecological receptors.

9.4.1 Contaminant Release Mechanisms

A spill of 5,000 to 10,000 gallons of AFFF occurred on October 21, 1987 inside Hangar 1. The spill was contained in the oil-water separator which flows to the sanitary sewer. This spill was managed in accordance with the SPCC Plan. Several inadvertent releases of AFFF from the two AFFF ASTs in the North Lean-to were reported [the ASTs were drained in January 1997]. Inadvertent releases were reported from the fire hose nozzles and piping from the ASTs and pump room (shown on a figure in Appendix G). Some releases in the Hangar 1 area would likely have been directed to the outside floor drains which connect to the stormwater drainage system.

AFFF used during training exercises at FFTA was released to soils while fighting fires and could have reached French Stream.

AFFF is widely used for fire fighting by the military and municipal fire departments. The fluorinated compounds found in AFFF are also used in herbicides, insecticides, cosmetics, greases, lubricants, and adhesives. They are now considered to be ubiquitous in the environment.

9.4.2 Contaminant Migration

AFFF releases in Hangar 1 were either directed to the sanitary system or the storm water system. The storm water system eventually discharges to French Stream and any AFFF would have been carried downstream. Foam has been observed in French Stream downstream of the Base. Since all Base operations ceased in 1996, enough time has passed that the perfluorinated compounds, which are very soluble, have likely been flushed from the surface water and sediments.

Since the hangar has a concrete floor and floor drain system maintenance and removal actions have been performed in the hangar, migration to soil is unlikely. Spills on the hangar apron which were directed to the storm drain system may have infiltrated through soil into groundwater.

While there were releases to soil at FFTA, soil in the training area has been excavated as part of a removal action completed in 2008.

It is not known whether PFCs are present in site soils. Since PFCs are water soluble, they may have leached from soil to groundwater. Detections of PFCs in groundwater may be useful in assessing whether soil is a medium of concern.

9.4.3 Nature and Extent of Contamination

The constituents of concern in AFFF are PFCs. They are very stable chemicals that do not break down in the environment or in living organisms due to the strong carbon to fluorine bond. No degradation pathways have been identified for either PFOS or PFOA, which are the two predominant PFCs found in the environment and appear to be the final degradation products of longer chain fluorinated compounds. The contaminants of concern are PFOA and PFOS. Both compounds have similar characteristics and are very stable compounds which resist degradation in the environment. For this reason, they will be used as an indicator of the presence of the other perfluorinated compounds.

Since research has shown that PFCs are persistent and bioaccumulate, but are water soluble, shallow groundwater is considered the appropriate medium to sample for the presence of PFCs.

9.4.4 Routes of Exposure

As groundwater is the medium of concern, there are no ecological receptors likely to be at risk. The concrete hangar floor prevents human exposure to surface soil; the floor drain and storm drain systems have been removed as Navy maintenance actions.

During the removal action performed at FFTA under the Massachusetts Contingency Plan, 3-4 feet of soil were removed because of petroleum contaminants. Any AFFF constituents in the soil would have likely been removed as well.

Therefore, infiltration through soil to groundwater is considered the most likely exposure pathway and human health is the only concern.

SAP Worksheet #10 -- Data Quality Objective Specifications
(UFP-QAPP Manual Section 2.6.1)

10.1 PROBLEM STATEMENT

AFFFs which contain PFCs were used at NAS South Weymouth at Hangar 1 and FFTA. Groundwater is the medium of concern and is an indicator of the presence of past PFC contamination at the sites, especially for soluble contaminants such as the PFCs associated with fire fighting foams. Because of the potential environmental concerns due to PFCs in fire fighting foam, the project team needs to determine whether these compounds have been introduced to the groundwater as a result of past use of AFFFs at the Base.

There are no established human health criteria or regulatory limits for PFCs. The State of Minnesota has developed health risk limits for PFOS (0.3 µg/L) and PFOA (0.5 µg/L, but has proposed to lower this limit to 0.3 µg/L). EPA has also identified provisional health advisories for PFOS and PFOA of 0.2 µg/L and 0.4 µg/L, respectively. PFOS and PFOA will be used as a marker for the other perfluorinated compounds. The groundwater data will be used to identify the presence of PFCs at the two areas.

10.2 INPUTS TO PROBLEM RESOLUTION

The inputs needed to resolve the project problem identified above include field observations and laboratory measurements as described below.

- PFC concentrations in groundwater (see Worksheet #17 for list of compounds).
- Groundwater levels to establish the groundwater flow direction and migration of possible PFC contamination.
- Well stabilization parameters (temperature, dissolved oxygen [DO], pH, specific conductance, oxidation-reduction potential [ORP], and turbidity) in groundwater collected from the same wells where groundwater samples are collected for laboratory analysis.
- Field duplicate, equipment blank, and MS/MSD samples as listed in Worksheet # 16.
- Fixed laboratory data to assess the PFC concentration in groundwater from downgradient and upgradient locations.
- EPA provisional health advisories for PFOS and PFOA of 0.2 µg/L and 0.4 µg/L, respectively. The proposed analytical method must produce results at a minimum 10 times below these limits (see Worksheet # 17).
- For data validation and general QC use default method performance criteria and proposed laboratory SOPs including laboratory statistically derived limits (see Worksheet # 18).

10.3 SITE BOUNDARIES

Two shallow (to 20 feet below ground surface (bgs)) groundwater populations are of interest:

- Upgradient groundwater that reflects groundwater conditions unaffected by use, spills and/or releases of AFFF at the Hangar 1 and FFTA areas.
- Downgradient groundwater that reflects groundwater potentially affected by target analytes released during operations at the Hangar 1 and FFTA areas.
- Field work must begin by April 2010 to accommodate property transfer and redevelopment schedules.

10.4 DECISION RULES

If the groundwater data indicate detections of PFC target analytes, a notification will be included in property transfer documents.

The data may be used in the future in five-year review evaluations if regulatory limits and risk-based criteria become established.

10.5 PERFORMANCE CRITERIA

The sampling design is based on a need to establish groundwater concentrations in known groundwater flow paths into which the target PFC analytes may have been released. The number of samples was selected to ensure that good spatial coverage is achieved, especially in the downgradient areas where contaminant concentrations are expected to be the greatest. After data are collected, the Project Team will ensure that all intended data have been collected and that they are of acceptable quality. The data quality will be evaluated during the data verification and validation processes, the data usability assessment and general data use. Data quality review items are described in Worksheets #19 through #22.

SAP Worksheet #11 -- Secondary Data Criteria and Limitations Table

(UFP-QAPP Manual Section 2.7)

Secondary Data	**Data Source** (originating organization, report title and date)	**Data Generator(s)** (originating organization, data types, data generation / collection dates)	**How Data Will Be Used**	**Limitations on Data Use**
None				

SAP Worksheet #12 -- Sampling Design and Rationale
(UFP-QAPP Manual Section 3.1.1)

The sampling design for this project is based on a need to determine whether PFCs are present in groundwater downgradient of locations where AFFF was used, spilled, and/or released. Since there are no regulatory limits for PFCs, groundwater will also be collected from upgradient and background wells to provide data on groundwater conditions unaffected by the use of AFFF. Groundwater has been selected as the medium of concern as an indicator of potential human health impacts due to the presence of contamination which infiltrated through soil to groundwater. Surface water, soil, and sediments are not considered to represent exposure pathways for this project.

Because PFCs are ubiquitous and there are no risk-based criteria or regulatory standards, upgradient concentrations will be compared to downgradient concentrations to determine the extent of contamination.

The Project Team chose a biased sampling design for this project. The design requires collection of shallow groundwater samples from existing monitoring wells downgradient of known spill/release areas at two locations on the Base, Hangar 1 and FFTA. Shallow groundwater samples will also be collected from existing wells at locations upgradient of the two potential source areas for data comparison purposes. Groundwater flow direction was determined during other field activities at the Base (see Appendix G). Field work must begin in April 2010.

Eighteen groundwater samples (one sample per well) x (18 wells) will be collected, two of which represent upgradient locations. Whether a well is considered to represent upgradient or downgradient conditions is identified in Worksheet #14.

Field QC samples are discussed in Worksheet #16.

The sampling methods are listed in Worksheet #14. Project-specific sampling procedures are presented in Appendix C.

Groundwater samples will be analyzed for PFOA and PFOS by a fixed laboratory, Test America in West Sacramento, California. The target PFOA/PFOS compounds are presented in Worksheets #17. The analytical methods are listed in Worksheet #16. The rationale for the selection of target analytes and analytical methods is discussed in Worksheet #10. The use of each type of field measurement is discussed in Worksheet #15.

SAP Worksheet #13 – Field Task Descriptions and Plan for Data Collection, Reporting and Review

(UFP-QAPP Manual Sections 2.8.1, 3.1.1, 3.1.2, 3.2.1 to 3.2.3, Appendix A, 3.3.3, 3.5.1, and 3.5.2.3)

The following project tasks are summarized below:

- Field Tasks
- Analytical Tasks
- Data Management and Review
- Project Report

The SOPs referenced below are included in Appendix A (Tetra Tech and EPA SOPs) and Appendix E (Laboratory SOPs). Project-specific procedures also are provided in Appendix C-1 for monitoring well development, water level measurement, and groundwater sampling. The field team will follow the project-specific field procedures unless these procedures do not provide guidance on a specific field task issue. In that case, the procedures in the cited SOPs will be followed.

The following table summarizes the field SOPs to be used in the groundwater PFC investigation:

Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Modified for Project Work? (Y/N)	Comments
GH-1.2	GH-1.2 - Evaluation of Existing Monitoring Wells and Water Level Measurement; Revision 2, September 2003	Tetra Tech	Y	SOP is included in Appendix A. Also see Appendix C-1 for project-specific procedures.
GH-2.8	GH-2.8 – Groundwater Monitoring Well Installation; Revision 3, September 2003	Tetra Tech	Y	SOP is included in Appendix A. Also see Appendix C-1 for project-specific procedures.
SA-6.1	SA-6.1 - Non-Radiological Sample Handling ; Revision 3, February 2004	Tetra Tech	N	SOP is included in Appendix A.
SA-6.3	SA-6.3 - Field Documentation; Revision 3, March 2009	Tetra Tech	N	SOP is included in Appendix A.
SA-7.1	SA-7.1 - Decontamination of Field Equipment; Revision 6, January 2009	Tetra Tech	N	SOP is included in Appendix A.
GW-0001	GW-0001 - Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells; Revision 3, January 2010	EPA Region 1/GW-0001	N	SOP is included in Appendix A. Also see Appendix C-1 for project-specific procedures.

13.1 FIELD TASKS

Mobilization/Demobilization – Mobilization includes procurement of field equipment and supplies; a site walkover; mobilization of field staff, equipment, and supplies to the Site; and site set-up. The Navy, EPA and MassDEP will be notified of Tetra Tech mobilizations a minimum of 1 week before start of the field activities.

A field team orientation meeting will be conducted prior to start the fieldwork to familiarize the team personnel with the Site's health and safety requirements, the objectives and scope of the field activities, and chain-of-command. This meeting will be attended by the field staff, FOL, project manager, project chemist, and health and safety officer.

A site walkover will be conducted prior to mobilization. The field team will identify and mark the monitoring wells to be sampled.

Demobilization includes removing field equipment and supplies from the Site, returning rented equipment, managing IDW, performing general site cleanup, organizing and finalizing field paperwork, and entering field records/data into the Site database.

The sampling locations are presented on Figure 2 and in Worksheet #14.

Monitoring Well Development – All wells to be sampled for the PFC study will be inspected prior to use to determine their condition. Wells to be sampled and the sampling rationale are presented in Worksheet #14. Prior to water level measurement and groundwater sampling, each of the selected monitoring wells will be re-developed according to SOP GH-2.8 using the project-specific procedures in Appendix C.

Water Level Measurement – Prior to groundwater sampling water levels will be measured at each of the selected monitoring wells, in accordance with SOP GH-1.2 using the project-specific procedures in Appendix C.

Groundwater Sampling – Groundwater samples will be collected from selected existing monitoring wells listed in Worksheet #14. A minimum of 1 week shall elapse after well development before collecting groundwater samples.

The groundwater samples (plus QA samples) will be collected according to EPA's low flow (low stress) sampling protocol, SOP GW-0001, using the project-specific procedures presented in Appendix C. Rental peristaltic pumps and disposable sampling tubing will be used at each of the selected monitoring wells.

Water quality parameters will be measured during purging using a YSI Model 600 Series multiparameter water quality meter or equivalent coupled with a flow-through cell. Turbidity will be measured separately using a LaMotte Model 2020 or equivalent nephelometer.

Field Quality Control samples – Field QC samples to be collected include field duplicates and equipment rinsate blanks. These samples will be collected at the rate summarized in Worksheet #16. Triple volume of one sample will be provided for laboratory MS/MSD analysis. One rinsate blank will be collected to check that the disposable sampling tubing does not contribute PFCs.

Calibration Procedures – Rental equipment will be used in the field. The rental firm will be responsible for performing and documenting the proper care, maintenance, and repair of the rental equipment. The FOL or designee will visually inspect the instrumentation before calibration and use. Calibration will be performed daily at the beginning and end of the day in accordance with GW-0001 and manufacture's guidance.

Decontamination – The decontamination procedures described in SOP SA-7.1 will be followed. All non-disposable equipment that comes in contact with the sample medium will be decontaminated to prevent cross-contamination between sampling points. Personnel decontamination is discussed in the HASP. Water level indicators will be sprayed with de-ionized water and wiped with clean paper towels in between use in each monitoring well.

Investigation-Derived Waste – Investigation-Derived Waste (IDW) includes decontamination fluid, used personal protective equipment (PPE), and used sampling equipment. IDW will be managed in accordance with SOP SA-7.1.

- Water generated during well development and groundwater sampling and decontamination rinse water will be collected and transferred for staging in 55-gallon drums or bulk containers. The clearly market drums will be staged pending receipt of analytical results. After the analytical data from the groundwater sampling program have been received and evaluated, a determination will be made as to the proper disposal method for the contained water. If off-site transport is required, TtNUS will arrange with a licensed waste hauler for additional sampling of the water (if required), transportation, and disposal at a licensed receiving facility approved by the Navy and EPA.

- Disposable personal protective equipment and disposable sampling equipment/materials (spent tubing, etc.) will be disposed of as general refuse at the approved disposal location on the NAS Weymouth property.

Sample Designation and Tracking System

The sample identification number, date and time of collection and the sampler's name will be recorded on each sample container, on the chain-of-custody form, and sample collection logs. Each sample collected will be labeled with a unique sample tracking number used to catalog the results. The sample tracking number will consist of alpha-numeric characters identifying the site, sample medium, location, and depth or date. The alpha-numeric (A-N) coding to be used in the sample system is described below.

AAA	-	AA	-	AANNN	-	(NNNN)
(Site ID)	-	(Medium)	-	(Location)	-	(Date)

Site identifier: AFFF

Medium identifier: "GW" for groundwater samples.

The sample location well identifier is the well identification number and the date is displayed as "MMYY". For example: A groundwater sample from well MW05-303 collected in February 2010 will be identified as: AFFF-GW-MW05-303-0210.

Field duplicates samples will be designated such that the location designation will be replaced with "DUP" followed by a sequential value (the nth duplicate sample collected during that sampling event) and the date (MMDDYY). The sample log sheet will note which sample location the duplicate was collected from. For example, the first groundwater field duplicate sample collected February 15, 2010 would be labeled AFFF-GW-DUP01-021510.

Rinsate Blank samples identifiers will consist of the Site, the medium, the label "-RB", a sequential value (the nth rinsate blank collected for that medium during that sampling event), and the date (MMDDYY). Example: AFFF-GW-RB01-021510.

Laboratory QC samples (matrix spike and matrix spike duplicate samples) will have no separate sample identifier codes, but are noted on the chain-of-custody record and sample log sheets.

13.2 ANALYTICAL TASKS

The analysis of PFCs in groundwater samples will be performed by a subcontracted laboratory, Test America, West Sacramento, CA.

Test America/West Sacramento will perform the PFC analysis following SW-846 Methods 3535A/8321 Laboratory SOPs WS-LC-0020 (Appendix E) to meet the requirements of the analytical specification for laboratory services developed by Tetra Tech for this work (Appendix D).

The following table summarizes the analytical SOP that the laboratory will use for the analysis of PFCs:

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?[1] (Y/N)
WS-LC-0020	Perfluorooctanoic Acid (PFOA) and Perfluorooctanoic Sulfonate (PFOS) in Water and Solids by LC/MS/MS (Revision 2.1, Effective 09/04/2009)	D	PFCs	HPLC/MS/MS	Test America, West Sacramento, CA	N

The following table summarizes the HPLC/MS/MS laboratory instrument calibration requirements that will be applied by Test America/West Sacramento in the analysis of PFCs for this project:

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[2]	SOP Reference[1]
HPLC/MS/MS	Initial multi-point Calibration, minimum seven point calibration	Initially and as required.	RSD for each compound ≤ 20% (average response factor), or r ≥ 0.980 (linear regression), or r^2 ≥ 0.980 (quadratic regression)	Evaluate standards and analytical system, correct any issues found, and then repeat calibration.	Lab Manager / Analyst	WS-LC-0020
HPLC/MS/MS	Continuing Calibration	Daily, prior to sample analysis, and following every 10 samples. Alternating low and mid-range standards.	%Difference/%Drift for all target compounds and surrogates: %D ≤ 30%	Evaluate standards and analytical system. Correct any issues found, and then repeat CCV. If still fails, repeat initial calibration. Reanalyze all samples since last successful calibration verification.	Lab Manager / Analyst	WS-LC-0020

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[2]	SOP Reference[1]
HPLC/MS/MS	Second-source calibration verification	Following initial calibration.	%Difference/%Drift for all target compounds and surrogates: %D ≤ 30%	Evaluate standards and correct any issue, then repeat. If still fails, repeat initial calibration	Lab Manager / Analyst	WS-LC-0020

The following table summarizes the HPLC/MS/MS instrument maintenance that will be performed by the Test America, West Sacramento laboratory:

Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for CA[2]	SOP Reference[1]
Replace columns as needed, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Test America Chemist	WS-LC-0020

13.3 DATA MANAGEMENT AND REVIEW

Data management and review tasks are described in other worksheets in this SAP as identified below.

Sample Collection Documentation

A project-specific field logbook will be used to keep daily records of significant events, observations, and measurements during field investigations. The field logbook also will be used to document all sampling activities. Field logbooks will be maintained according to Tetra Tech SOP No. SA-6.3 (see Appendix A). Field sample log sheets and purge data sheets will be used to document sample collection details, while other observations and activities will be recorded in the field logbook. Examples of the field documentation forms can be found in Appendix B.

The field sample collection and measurement records, the laboratory records, and assessment finding records are listed below:

Document	Where Maintained
Field Documents Field Logbook Field Sample Forms Chain of Custody Records Air Bills Sampling Instrument Calibration Logs Sampling Notes FMR Forms This SAP Health and Safety Plan	Field documents will be maintained in the project file located in the Tetra Tech Boston, Massachusetts office.
Laboratory Documents Sample Receipt, Custody, and Tracking Record Standards Traceability Logs Equipment Calibration Logs Sample Preparation Logs Analysis Run Logs Equipment Maintenance, Testing, and Inspection Logs Corrective Action Forms Reported Field Sample Results Reported Results for Standards, QC Checks, and QC Samples Sample Storage and Disposal Records Telephone Logs Extraction/Clean-up Records Raw Data Data Completeness Checklist	Laboratory documents will be included in the hardcopy and PDF deliverables from the laboratory. Laboratory data deliverables will be maintained in the Tetra Tech Boston, Massachusetts project file. Electronic data results will be maintained in a database on a password protected Structured Query Language (SQL) server.
Assessment Findings Field Sampling Audit Checklist (if conducted) Analytical Audit Checklist (if conducted) Data Validation Memoranda (includes tabulated data summary forms)	All assessment documents will be maintained in the Tetra Tech Boston, Massachusetts project file.

Field Sample Handling and Chain-of Custody Procedures

Custody of samples must be maintained and documented at all times from collection through analysis. Chain of custody begins when samples are collected in the field, and is maintained by storing the samples in secure areas until custody can be passed on to the analytical laboratory. Samples will be

delivered to the laboratory with a chain-of-custody form. A copy of the chain-of-custody form is included in Appendix B. Chain of custody procedures are described in further detail in the following Tetra Tech SOPs: SA-6.3, Field Documentation; and SA-6.1, Non-Radiological Sample Handling (Appendix A).

The samples will be shipped to the laboratory in coolers with ice to maintain a temperature below 6°C. A container filled with water and labeled "temperature blank" will be included in each cooler to measure the sample temperature upon laboratory receipt. The coolers will be taped and sealed with a signed custody seal to ensure the chain of custody is maintained. Samples will be shipped to the laboratory by an overnight courier to ensure that maximum sample holding times are not exceeded. The maximum allowable sample holding times for the PFC analysis is presented in Worksheet #16.

Laboratory Custody Procedures

The Test America/West Sacramento sample receipt and chain-of-custody procedure is detailed in SOP WS-QA-0003, revision 11.2, included in Appendix E. The laboratory sample custodian will inspect the integrity of the cooler custody seals and measure the temperature of the samples received using the "Temperature Blank" container included in each cooler. The sample label information will be checked against the chain-of-custody form for identification, and integrity. The samples will be logged into the laboratory management system. Custody of the samples will be maintained and recorded in the laboratory from receipt to analysis and this record will be included with the data package deliverables.

Test America/West Sacramento SOP WS-EHS-0001, revision 4 (Appendix E) describes the laboratory procedures for disposal of the environmental samples.

Data Handling, Management, Tracking and Control

The Tetra Tech PM (or designee) is responsible for the overall tracking and control of the data generated for the project. The Project Chemist (or designee) is responsible for tracking the samples collected and shipped to the contracted laboratory and the laboratory data packages. The laboratory electronic data results will be automatically downloaded into the Tetra Tech database.

Data Storage, Archiving, and Retrieval. The laboratory data packages, the field records, and the assessment finding records are entered into the Tetra Tech CLEAN file tracking system prior to archiving in secure project files.

Data Security. The Tetra Tech project files are restricted to designated personnel only. Records can only be borrowed temporarily from the project file using a sign-out system. The Tetra Tech Data Manager maintains the electronic data files. Access to the data files is restricted to qualified personnel only. File and data backup procedures are routinely performed.

Data Review

- Data verification processes are described in Worksheet #18.
- Data validation processes are described in Worksheets #19 and #20.
- Usability assessment processes are described in Worksheet #22.

13.4 PROJECT REPORT

During the field event, the Tetra Tech PM will keep the Navy RPM informed of the progress of the field investigation.

At the conclusion of the sampling program, Tetra Tech will prepare a project report. The report will include a summary of the field program, analytical results, and tag maps indicating the detected concentrations of PFCs. The report will be prepared in draft format (electronic format) for Navy, EPA, and MassDEP review and then finalized (hardcopy and electronic format) based upon the agreed-upon resolution of reviewer comments.

SAP Worksheet #14 -- Sampling Locations and Methods
(UFP-QAPP Manual Section 3.1.1)

Sampling Location / ID Number	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Rationale for Collection
MW05-303	GW	5-15 ft bgs	PFCs	1 plus Dup	GW quality downgradient of AFFF AST in Hangar 1 (See Figure 2 and Hangar 1 figure in Appendix G).
MW05-304	GW	7-17 ft. bgs	PFCs	1	GW quality downgradient of documented AFFF spills/ leaks in Hangar 1 (See Figure 2 and Hangar 1 figure in Appendix G).
MW05-301	GW	5-10 ft. bgs	PFCs	1	GW quality upgradient of AFFF releases in Hangar 1 (See Figure 2 and Hangar 1 figure in Appendix G showing groundwater contours and flow direction at this site).
MW05-302	GW	5-15 ft. bgs	PFCs	1	GW quality downgradient of AFFF releases in Hangar 1 (See Figure 2 and Hangar 1 figure in Appendix G).
MW05-031	GW	4.5-14.5 ft. bgs	PFCs	1	GW quality downgradient of AFFF releases in Hangar 1 (See Figure 2 and Hangar 1 figure in Appendix G).
FFTA-MW-14	GW	1.8-11.8 ft. bgs	PFCs	1	GW quality adjacent to the FFTA operations area. (See Figure 2 and FFTA figures in Appendix G).
FFTA-MW-46	GW	1.1-11.1 ft. bgs	PFCs	1	GW quality potentially impacted by FFTA operations. (See Figure 2 and FFTA figures in Appendix G).
FFTA-MW-52D2	GW	8-23 ft. bgs	PFCs	1	GW quality southeast of FFTA. (See Figure 2 and the groundwater flow direction shown on the FFTA figures in Appendix G).
MW01-093	GW	2-12 ft. bgs	PFCs	1	GW quality downgradient of Hangar 1 and FFTA. (See Figure 2 and the figures in Appendix G).
MW05-033	GW	4-14 ft. bgs	PFCs	1	GW quality downgradient of Hangar 1. (See Figure 2 and the figures in Appendix G).

MW01-073	GW	2.5 -15.5 ft. bgs	PFCs	1	GW quality on east side of west branch of French Stream. (See Figure 2).
TLF-MW-55D	GW	4-14 ft. bgs	PFCs	1	GW quality near confluence of TACAN ditch and west branch of French Stream. (See Figure 2).
MW01-063	GW	5-15 ft. bgs	PFCs	1	GW quality at south end of Base near west branch of French Stream. (See Figure 2).
FFTA-MW13	GW	1.8-16.8 ft. bgs	PFCs	1	GW quality in center part of FFTA site. (See Figure 2 and the figures in Appendix G).
FFTA-MW12	GW	1.8-16.8 ft. bgs	PFCs	1	GW quality in northern part of FFTA site. (See Figure 2 and the figures in Appendix G).
PZ-11D	GW	12-13 ft. bgs	PFCs	1	GW quality at south end of Base near east branch of French Stream. (See Figure 2).
BW-MW31	GW	3.8-12.3 ft. bgs	PFCs	1	GW quality upgradient of FFTA. (See Figure 2 and the figures in Appendix G).
FFTA-MW11	GW	2-12 ft. bgs	PFCs	1	GW quality downgradient of Hangar 1 and FFTA. (See Figure 2 and the figures in Appendix G).

After the above-listed wells have been inspected and re-developed, as described in Worksheet 13 and Appendix C-1, groundwater samples will be collected according to EPA's low flow (low stress) sampling protocol, SOP GW-0001, using the project-specific procedures presented in Appendix C.

SAP Worksheet #15 – Field Quality Control Measurement Performance Criteria Table

(UFP-QAPP Manual Section 2.6.2)

Measurement Performance Criteria Table – Field QC Samples

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Rinsate Blank	PFCs	One per Sample Delivery Group (SDG of 20 samples)	Accuracy/Bias/ Contamination	No target analytes ≥ ½ QL, unless target analytes in field samples are > 10x those in rinsate blank.	S & A
Field Duplicates	PFCs	Groundwater: One per 10 samples	Precision	Waters: RPD ≤ 30%. If samples results are < 2x QL, professional judgment is used.	S & A
Temperature Indicator	PFCs	One per cooler	Representativeness	Temperature between 2 and 6 degrees Celsius (4 ± 2 °C).	S

SAP Worksheet #16 –Sample Preservation, Holding Time, and Field Quality Control Sample Summary Table

(UFP-QAPP Manual Sections 3.1.1 and 3.5.2.3)

Matrix: Groundwater

Laboratory/Organization/Contact Name and Phone Number: Test America/ West Sacramento, CA/ Nilo Ligi/ 916-373-5600

Backup Laboratory/Organization[1]: NA

Data Package Turnaround Time: 21 Days

Analyte Group	No. of Environ. Samples	No. Field Duplicates	No. of MS/MSDs[1,2]	No .of Field Blanks	No. of Equipment Blanks	No. of PT Samples	Total No. of Samples to Laboratory[3]	Containers	Sample Volume	Preservation Requirements	Maximum Holding Time	Preparation & Analysis Method & SOP Reference
PFCs	18	2	1	0	1	0	21	Two 1-L AGB or HDPE bottles with screw caps	1 liter	cool to 4 ± 2° C	7 days to extraction; 40 days to analysis	SW-846 Methods 3535A/8321 SOPs WS-LC-0020

1- Although the MS/MSD is not typically considered a field QC it is included here because location determination is often established in the field.
2- Extra sample volume will be collected for MS/MSD laboratory sample analyses.
3- Total number of samples does not include MS/MSDs.

SAP Worksheet #17 -- Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Groundwater
Analytical Group; PFCs
Preparation and Analysis Method/SW 846 Methods 3535A/8321/SOP: WS-LC-0020
Method Modified[1] (Yes/No)? N
Data Type (definitive or screening): Definitive

Analyte	CAS Number	Project Action Limit (µg/L)	Project Action Limit Reference[1]	Project Quantitation Limit Goal (µg/L)	Laboratory-specific[2]		
					QL (µg/L)	LOD (µg/L)	MDLs (µg/L)
Perfluorooctanoic acid, PFOA	335-67-1	0.4	EPA	0.02	0.004	0.002	0.001
Perfluorooctane sulfonate, PFOS	1763-23-1	0.2	EPA	0.03	0.004	0.002	0.0015

1 – EPA provisional health advisories, 2008.

2 – Specific QLs and MDLs from Test America West Sacramento laboratory for listed method.

SAP Worksheet #18 -- Laboratory Quality Control Samples Table

(UFP-QAPP Manual Section 3.4)

Matrix	Groundwater
Analytical Group	PFCs
Analytical Method/ SOP Reference	SW-846 methods 3535A/8321 SOP: WS-LC-0020

QC Sample	Frequency / Number	Measurement Performance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Method Blank	One per preparation batch, not to exceed 20 field samples.	No target analytes ≥ ½ QL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Evaluate blank and analytical system. If required, then re-extract and reanalyze method blank and all samples processed with the contaminated blank.	Lab Manager / Analyst	Accuracy/Bias Contamination
LCS	One LCS per analytical/preparation batch	Laboratory control limits 70-130% recovery.	Correct problem, then re-extract and reanalyze the LCS and all associated batch samples.	Lab Manager / Analyst	Precision and Accuracy/Bias
MS/MSD	One MS/MSD per analytical/preparation batch	Laboratory control limits 70-130% recovery. RPD < 20.	Identify problem; if not related to matrix interference, then re-extract and reanalyze MS/MSD	Lab Manager / Analyst	Precision and Accuracy/Bias
Internal Standards	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of the midpoint of the last ICAL for each sample and QC	Inspect LCMS for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning. Sample dilution may be required for field samples.	Lab Manager / Analyst	Accuracy/Bias

SAP Worksheet #19 -- Verification (Step I) Process Table

(UFP-QAPP Manual Section 5.2.1)

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Planning Documents	The Tetra Tech QAM or designee will verify evidence of SAP approval, names and qualifications of project personnel performing the work, and laboratory performing the analysis, use of required sampling and analysis SOPs.	Internal	QAM or designee, PM (P. Call), FOL
Chain-of-Custody Forms	The Tetra Tech FOL or designee will review and sign the Chain-of-Custody forms to verify that all samples listed are included in the shipment to the laboratory and the sample information is accurate. The Chain-of-Custody forms will be signed by the sampler and a copy will be retained for the project file, the PM, and the data validator. See SOP SA-6.3.	Internal	FOL (J. Traut) and Field Crew, Tetra Tech
	The laboratory sample custodian will review the sample shipment for completeness and integrity and will sign accepting the shipment. The data validator will check that the Chain-of-Custody form was signed and dated by the Tetra Tech FOL or designee relinquishing the samples and also by the laboratory sample custodian receiving the samples for analyses.	Internal/ External	1 - Laboratory Sample Custodian, (Cheng Vue) 2 - Data Validator, Tetra Tech
Sample Locations/Coordinates	Planned samples will be verified to have been collected. Sample locations will be verified to be correct and in accordance with the SAP (compare map of proposed locations to map of actual locations).	Internal	PM (P. Call), FOL and Field Crew, Tetra Tech
Sample Log Sheets	Log sheets that are completed as samples are collected in the field will be verified for completeness and will be maintained in the Tetra Tech project file.	Internal	PM (P. Call), FOL, or designee, Tetra Tech
Field QC Samples	Verify that field QC samples listed in Worksheet #17 were collected as required.	Internal	FOL or designee, Tetra Tech

Verification Input	**Description**	**Internal / External**	**Responsible for Verification** (name, organization)
Analytical Data Packages	All analytical data packages will be verified internally for completeness by the laboratory performing the work. The Laboratory QAM will sign the case narrative for each data package.	Internal	Laboratory QAO, Test America/CO
	Tetra Tech will verify that the data package contains all the elements required by the functional guidelines and the scope of work. This occurs as part of the data validation process.	External	Data Validator, Tetra Tech

SAP Worksheet #20 -- Validation (Steps IIa and IIb) Process Table

(UFP-QAPP Manual Section 5.2.2) (Figure 37 UFP-QAPP Manual) (Table 9 UFP-QAPP Manual)

Step IIa/IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Field SOPs/Field Logs/Sample Collection	Ensure that all sampling SOPs were followed. Verify that deviations have been documented and MPCs have been achieved, particularly that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken chain-of-custody from sample collection to report generation. Verify that the SAP was implemented and carried out as written and that any deviations are documented.	PM or designee, Tetra Tech
IIa	Chain-of-Custody Forms	Ensure that the custody and integrity of the samples were maintained from collection to analysis and that custody records are complete and any deviations are recorded.	Data Validator, Tetra Tech
IIa	Holding Times	Verify that the samples were shipped and store at the required temperature. Verify that the PFC analysis was performed within the holding times listed in Worksheet #16.	Data Validator, Tetra Tech
IIa	Data Results	Verify that the summary form results match the raw data.	Data Validator, Tetra Tech
IIa/IIb	Laboratory Data Results	Ensure that the laboratory QC samples were analyzed and that the MPCs listed in Worksheet #18 were met for all field samples and QC analyses. Verify that specified field QC samples were collected and analyzed and that the analytical QC criteria set up for this project were met.	Data Validator, Tetra Tech
IIa/IIb	Field and Laboratory Duplicate Analyses for Precision	Verify the field sampling precision by checking the RPD for field duplicate samples. Verify laboratory precision by checking RPDs or %D values from MS/MSD and LCS/LCSD analyses. Ensure compliance with the methods and project MPC accuracy goals listed in Worksheet #18.	Data Validator, Tetra Tech
IIa/IIb	Sample Results for Representativeness	Verify that the laboratory recorded the temperature of each sample at sample receipt to ensure sample integrity from sample collection to analysis.	Data Validator, Tetra Tech
IIa/IIb	Project Screening Levels	Discuss the impact of matrix interferences or sample dilutions performed, because of the high concentration of one or more contaminants, on the other target compounds reported as not detected. Document this usability issue and inform the PM.	Data Validator, Tetra Tech
	Project Screening Levels	Review and add PSLs to the laboratory electronic data deliverable. Flag samples and notify the PM of samples that exceed the PSLs as listed in Worksheets #17.	PM or designee, Tetra Tech

Step IIa/IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa/IIb	Data Validation Report	Summarize deviations from methods, procedures, or contracts. Qualify data results based on method or QC deviation and explain all data qualifications. Print a copy of the project database, qualified data depicting data qualifiers, and data qualifiers codes that summarize the reason for data qualifications. Determine if the data met the MPCs and determine the impact of any deviations on the technical usability of the data.	Data Validator, Tetra Tech
IIa, IIb	SAP QC Sample Documentation	Verify that all QC samples specified in the SAP were collected and analyzed and that the associated results were within prescribed SAP acceptance limits. Verify that QC samples and standards prescribed in analytical SOPs were analyzed and within the prescribed control limits. If any significant QC deviations occur, the laboratory shall have contacted the Tetra Tech Project Chemist or PM.	Data Validator, Tetra Tech
IIa, IIb	Documentation of Analytical Reports for Completeness	Ensure that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. Validator will verify that elements of the data package required for validation are present, and if not, the laboratory will be contacted and the missing information will be requested. Validation will be performed as per Worksheet #21. Verify all data have been transferred correctly and completely to the final SQL database.	Data Validator, Tetra Tech
IIb	Project Quantitation Limits for Sensitivity	Verify that the QLs listed in Worksheet #17were achieved.	Data Validator, Tetra Tech
IIb	Analytical Data Deviations	Determine the impact of any deviation from sampling or analytical methods, SOP requirements, and matrix interferences on the analytical results.	Data Validator, Tetra Tech

[1] IIa=compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005.]
IIb=comparison with measurement performance criteria in the SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005]

SAP Worksheet #21 –Analytical Data Validation (Steps IIa and IIb) Summary Table

(UFP-QAPP Manual Section 5.2.2.1)

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa and IIb	Groundwater	PFCs	Tier II[1] data validation. Project-specific criteria for PFCs by SW-846 Method 8321 are listed in Worksheets #15, #16, #17 and #18 and laboratory SOPs. Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part II, December 1996 (U.S. EPA, 1996) will be applied using these criteria.	Project Chemist (Lucy Guzman) and staff chemists, Tetra Tech

[1] As specified in the Region 1 Tiered Organic and Inorganic Data Validation Guidelines (July 1, 1993).

SAP Worksheet #22 – Data Usability Assessment

(UFP-QAPP Manual Section 5.2.3)

Data Usability Assessment
The usability of the data directly affects whether project objectives can be achieved. The following characteristics will be evaluated at a minimum. The results of these evaluations will be included in the project report. The characteristics will be evaluated for multiple concentration levels if the evaluator determines that this is necessary. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these data characteristics: **Completeness** o The FOL acting on behalf of the Project Team will determine whether deviations from the scheduled groundwater sample collection or analyses occurred. If they have occurred and the Tetra Tech PM determines that the deviations compromise the ability to meet project objectives the PM will consult with the Navy RPM and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions. **Precision** o The Project Chemist acting on behalf of the Project Team will determine whether precision goals for field duplicates and laboratory duplicates were met. This will be accomplished by comparing duplicate results to precision goals identified in Worksheets #15 and #18. This will also include a comparison of field and laboratory precision with the expectation that field duplicate results will be no less precise than laboratory duplicate results. If the goals are not met, or data have been flagged as estimated (J qualifier), limitations on the use of the data will be described in the project report. **Accuracy** o The Project Chemist acting on behalf of the Project Team will determine whether the accuracy/bias goals were met for project data. This will be accomplished by comparing percent recoveries of LCS, LCSD, MS, MSD, and surrogate compounds to accuracy goals identified in Worksheet #18. This assessment will include an evaluation of field and laboratory contamination; instrument calibration variability; and analyte recoveries for surrogates, matrix spike, matrix spike duplicate, and laboratory control samples. If the goals are not met, limitations on the use of the data will be described in the project report. Bias of the qualified results and a description of the impact of identified non-compliances on a specific data package or on the overall project data will be described in the project report. **Representativeness** o A project scientist identified by the Tetra Tech PM and acting on behalf of the Project Team will determine whether the data are adequately representative of intended populations, both spatially and temporally. This will be accomplished by verifying that samples were collected and analyzed in accordance with this SAP, by reviewing spatial and temporal data variations, and by comparing these characteristics to expectations. The usability report will describe the representativeness of the data for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the project scientist indicates that a quantitative analysis is required. **Comparability** o The Project Chemist acting on behalf of the Project Team will determine whether the data generated under this project are sufficiently comparable to available historical property data generated by different methods and for samples collected using different procedures and under different property conditions. This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction. This will not require quantitative comparisons unless the Project Chemist indicates that such quantitative analysis is required. **Sensitivity** o The Project Chemist acting on behalf of the Project Team will determine whether project sensitivity goals listed in Worksheet #17 are achieved. The overall sensitivity and quantitation limits from multiple data sets for each matrix and analysis will be compared. If sensitivity goals are not achieved, the limitations on the data will be described.

SAP Worksheet #23 -- Planned Project Assessments Table

(UFP-QAPP Manual Section 4.1.1)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA)	Person(s) Responsible for Monitoring Effectiveness of CA
Field Quality Assurance[1]	1 per contract year	Internal	Tetra Tech	Tetra Tech Field Auditor	Tetra Tech PM	Tetra Tech Field Auditor and QAM	Tetra Tech QAM
Laboratory System Audit[2]	Every 18 months	External	Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP)	DoD Accrediting Body	Test America/West Sacramento/ Quality Assurance Manager (QAM)	Test America/CA QAO	Test America QAM, Doug Weir

[1] Projects selected for audit are selected at a rate of one per contract year at the program level.
[2] Test America/West Sacramento, CA is DOD certified for the analysis of the PFCs target compounds.

SAP Worksheet #24 -- Assessment Findings and Corrective Action Responses

(UFP-QAPP Manual Section 4.1.2)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Supervision	Site log book and sample collection logs	Tetra Tech PM (Phoebe Call) and FOL (Johanna Traut)	Immediately	Entry in site log book	PM (Phoebe Call), Tetra Tech, FOL (Johanna Traut), Tetra Tech	24 hours
Project Supervision	Written report	Program Manager (John Trepanowski), Tetra Tech Deputy Program Manager (Garth Glenn), Tetra Tech	Monthly	Written memo	Program Manager (John Trepanowski), Tetra Tech Deputy Program Manager (Garth Glenn), Tetra Tech	Within a week of notification
Field Sampling System Audit	Audit checklist and written audit finding summary	PM (P. Call), Tetra Tech; FOL (Johanna Traut), Tetra Tech; Program Manager (John Trepanowski) and Deputy Program Manager (Garth Glenn), Tetra Tech	Dependant on the finding; if major, a stop work may be issue immediately; however, if minor, within 1 week of audit	Written memo	QAM (Tom Johnston),Tetra Tech Field Auditor (Designee), Tetra Tech Program Manager (John Trepanowski) and Deputy Program Manager (Garth Glenn), Tetra Tech	Within 48 hours of notification
Laboratory System Audit	Written audit report	QAM, Test America/West Sacramento/ Doug Weir	Not specified by ELAP	Letter	ELAP	Specified by ELAP

SAP Worksheet #25 -- QA Management Reports Table

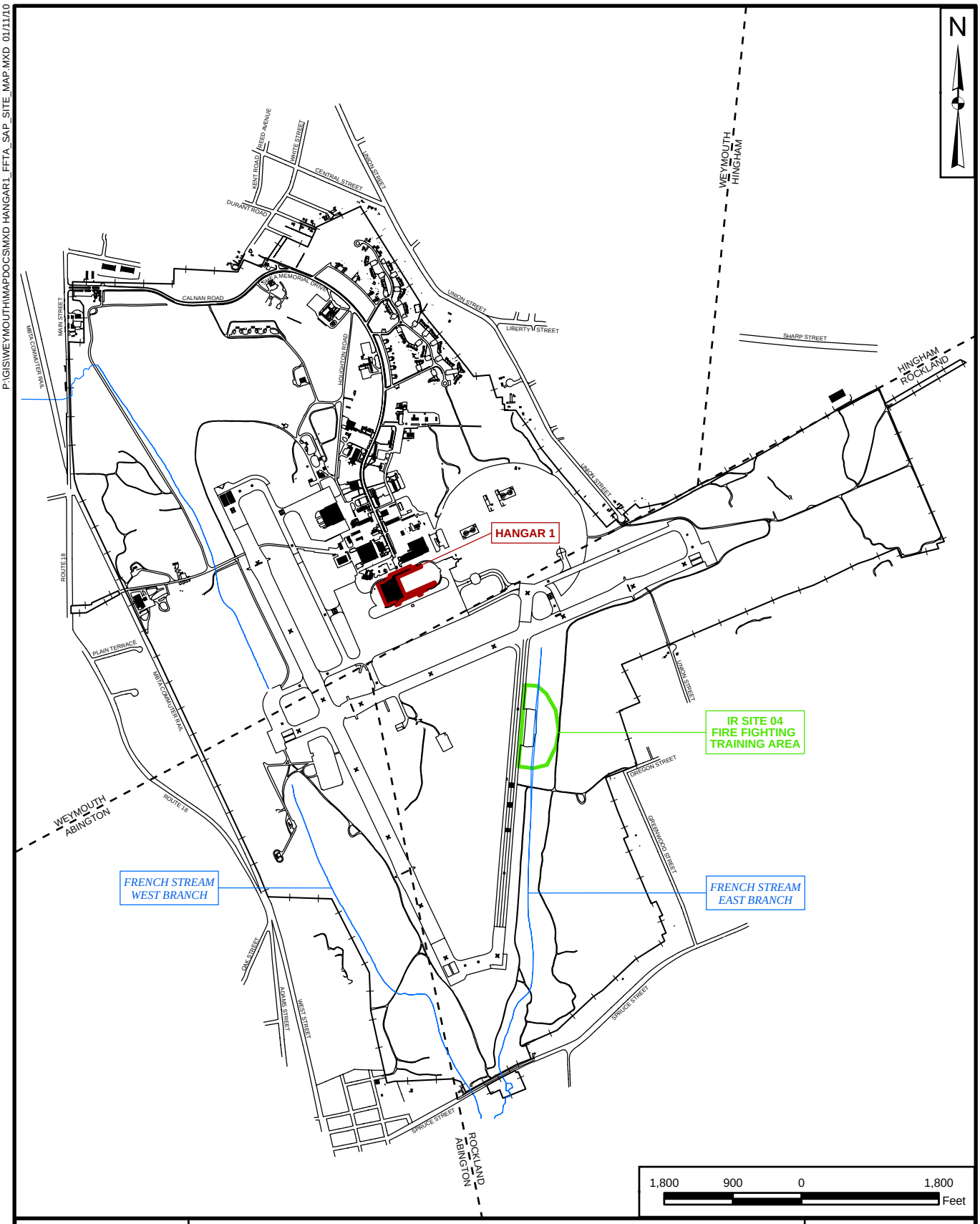
(UFP QAPP Manual Section 4.2)

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Data validation report	Per sample data package	Within 3 weeks	Project Chemist (Lucy Guzman), Tetra Tech	PM (Phoebe Call), Tetra Tech, project file
Major analysis problem identification (internal memorandum)	When persistent analytical problems are detected	Immediately	QAM (Tom Johnston), Tetra Tech	PM (Tetra Tech), QAM (Tetra Tech), Program Manager (Tetra Tech), project file
Project monthly progress report[1]	Monthly for the duration of the project	Monthly	PM (P. Call), Tetra Tech	Navy, project file
Field progress report	Daily, oral, during the course of the sampling	Every day that field sampling is occurring	FOL (J. Traut), Tetra Tech	PM (Phoebe Call), Tetra Tech
Laboratory QA report	When significant plan deviations result from unanticipated circumstances	Immediately upon detection	Laboratory QAM (Doug Weir)	Tetra Tech, project file

[1] The monthly progress report is an update for the Navy RPM and contract office. The report includes information such as activities completed, an updated schedule, identification of outstanding issues, plans for the next period, and a financial narrative.

FIGURES

P:\GIS\WEYMOUTH\MAPDOCS\MXD HANGAR1_FFTA_SAP_SITE_MAP.MXD 01/11/10



Tetra Tech NUS, Inc.

SITE LOCATION MAP
SAMPLING AND ANALYSIS PLAN
NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

SCALE	AS NOTED
FILE	HANGAR1_FFTA_SAP_SITE_MAP.MXD
REV	0
DATE	01/11/10
FIGURE NUMBER	FIGURE NO. 1

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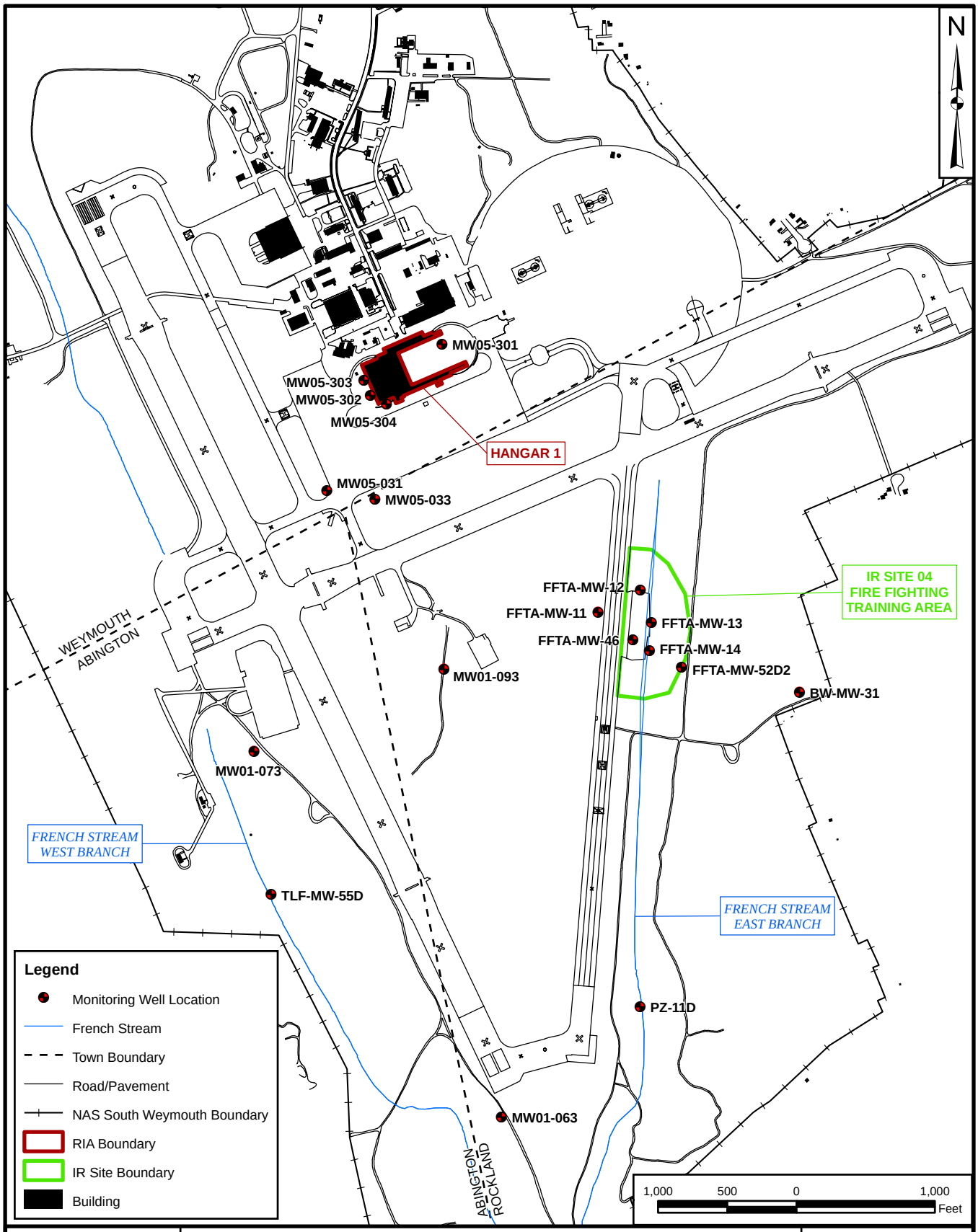

Tetra Tech NUS, Inc.

MONITORING WELL LOCATIONS
SAMPLING AND ANALYSIS PLAN
NAVAL AIR STATION SOUTH WEYMOUTH
WEYMOUTH, MASSACHUSETTS

SCALE	AS NOTED
FILE	SAP_MW_LOCATIONS_LETTER.MXD
REV	0
DATE	04/12/10
FIGURE NUMBER	FIGURE NO. 2

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REFERENCES

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APPENDIX A

APPLICABLE TETRA TECH AND USEPA STANDARD OPERATING PROCEDURES

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUNDWATER SAMPLES FROM MONITORING WELLS

Quality Assurance Unit
U.S. Environmental Protection Agency – Region 1
11 Technology Drive
North Chelmsford, MA 01863

The controlled version of this document is the electronic version viewed on-line only. If this is a printed copy of the document, it is an uncontrolled version and may or may not be the version currently in use.

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Prepared by: Charles Porfert 1/19/10
(Charles Porfert, Quality Assurance Unit) Date

Approved by: Gerard Sotolongo 1-19-10
(Gerard Sotolongo, Quality Assurance Unit) Date

Revision Page

Date	Rev #	Summary of changes	Sections
7/30/96	2	Finalized	
01/19/10	3	Updated	All sections

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USE OF TERMS

Equipment blank: The equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank needs only to include the pump in subsequent sampling rounds. If the pump and tubing are dedicated to the well, the equipment blank is collected prior to its placement in the well. If the pump and tubing will be used to sample multiple wells, the equipment blank is normally collected after sampling from contaminated wells and not after background wells.

Field duplicates: Field duplicates are collected to determine precision of the sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

Indicator field parameters: This SOP uses field measurements of turbidity, dissolved oxygen, specific conductance, temperature, pH, and oxidation/reduction potential (ORP) as indicators of when purging operations are sufficient and sample collection may begin.

Matrix Spike/Matrix Spike Duplicates: Used by the laboratory in its quality assurance program. Consult the laboratory for the sample volume to be collected.

Poteniometric Surface: The level to which water rises in a tightly cased well constructed in a confined aquifer. In an unconfined aquifer, the potentiometric surface is the water table.

QAPP: Quality Assurance Project Plan

SAP: Sampling and Analysis Plan

SOP: Standard operating procedure

Stabilization: A condition that is achieved when all indicator field parameter measurements are sufficiently stable (as described in the "Monitoring Indicator Field Parameters" section) to allow sample collection to begin.

Temperature blank: A temperature blank is added to each sample cooler. The blank is measured upon receipt at the laboratory to assess whether the samples were properly cooled during transit.

Trip blank (VOCs): Trip blank is a sample of analyte-free water taken to the sampling site and returned to the laboratory. The trip blanks (one pair) are added to each sample cooler that contains VOC samples.

SCOPE & APPLICATION

The goal of this groundwater sampling procedure is to collect water samples that reflect the total mobile organic and inorganic loads (dissolved and colloidal sized fractions) transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. This standard operating procedure (SOP) for collecting groundwater samples will help ensure that the project's data quality objectives (DQOs) are met under certain low-flow conditions.

The SOP emphasizes the need to minimize hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations. Indicator field parameters (e.g., dissolved oxygen, pH, etc.) are monitored during purging in order to determine when sample collection may begin. Samples properly collected using this SOP are suitable for analysis of groundwater contaminants (volatile and semi-volatile organic analytes, dissolved gases, pesticides, PCBs, metals and other inorganics), or naturally occurring analytes. This SOP is based on Puls, and Barcelona (1996).

This procedure is designed for monitoring wells with an inside diameter (1.5-inches or greater) that can accommodate a positive lift pump with a screen length or open interval ten feet or less and with a water level above the top of the screen or open interval (Hereafter, the "screen or open interval" will be referred to only as "screen interval"). This SOP is not applicable to other well-sampling conditions.

While the use of dedicated sampling equipment is not mandatory, dedicated pumps and tubing can reduce sampling costs significantly by streamlining sampling activities and thereby reducing the overall field costs.

The goal of this procedure is to emphasize the need for consistency in deploying and operating equipment while purging and sampling monitoring wells during each sampling event. This will help to minimize sampling variability.

This procedure describes a general framework for groundwater sampling. Other site specific information (hydrogeological context, conceptual site model (CSM), DQOs, etc.) coupled with systematic planning must be added to the procedure in order to develop an appropriate site specific SAP/QAPP. In addition, the site specific SAP/QAPP must identify the specific equipment that will be used to collect the groundwater samples.

This procedure does not address the collection of water or free product samples from wells containing free phase LNAPLs and/or DNAPLs (light or dense non-aqueous phase

liquids). For this type of situation, the reader may wish to check: Cohen, and Mercer (1993) or other pertinent documents.

This SOP is to be used when collecting groundwater samples from monitoring wells at all Superfund, Federal Facility and RCRA sites in Region 1 under the conditions described herein. Request for modification of this SOP, in order to better address specific situations at individual wells, must include adequate technical justification for proposed changes. All changes and modifications must be approved and included in a revised SAP/QAPP before implementation in field.

BACKGROUND FOR IMPLEMENTATION

It is expected that the monitoring well screen has been properly located (both laterally and vertically) to intercept existing contaminant plume(s) or along flow paths of potential contaminant migration. Problems with inappropriate monitoring well placement or faulty/improper well installation cannot be overcome by even the best water sampling procedures. This SOP presumes that the analytes of interest are moving (or will potentially move) primarily through the more permeable zones intercepted by the screen interval.

Proper well construction, development, and operation and maintenance cannot be overemphasized. The use of installation techniques that are appropriate to the hydrogeologic setting of the site often prevent "problem well" situations from occurring. During well development, or redevelopment, tests should be conducted to determine the hydraulic characteristics of the monitoring well. The data can then be used to set the purging/sampling rate, and provide a baseline for evaluating changes in well performance and the potential need for well rehabilitation. Note: if this installation data or well history (construction and sampling) is not available or discoverable, for all wells to be sampled, efforts to build a sampling history should commence with the next sampling event.

The pump intake should be located within the screen interval and at a depth that will remain under water at all times. It is recommended that the intake depth and pumping rate remain the same for all sampling events. The mid-point or the lowest historical midpoint of the saturated screen length is often used as the location of the pump intake. For new wells, or for wells without pump intake depth information, the site's SAP/QAPP must provide clear reasons and instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected. If the depths to top and bottom of the well screen are not known, the SAP/QAPP will need to describe how the sampling depth will be determined and how the data can be used.

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 indicator field parameter criteria in this procedure are met. If after 2 hours of purging indicator field parameters have not stabilized, one of three optional courses of action may be taken: a) continue purging until stabilization is achieved, b) 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), c) 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 reflect a sampling bias and therefore, the data may not meet the data quality objectives of the sampling event).

It is recommended that low-flow sampling be conducted when the air temperature is above 32°F (0°C). If the procedure is used below 32°F, special precautions will need to be taken to prevent the groundwater from freezing in the equipment. Because sampling during freezing temperatures may adversely impact the data quality objectives, the need for water sample collection during months when these conditions are likely to occur should be evaluated during site planning and special sampling measures may need to be developed. Ice formation in the flow-through-cell will cause the monitoring probes to act erratically. A transparent flow-through-cell needs to be used to observe if ice is forming in the cell. If ice starts to form on the other pieces of the sampling equipment, additional problems may occur.

HEALTH & SAFETY

When working on-site, comply with all applicable OSHA requirements and the site's health/safety procedures. All proper personal protection clothing and equipment are to be worn. Some samples may contain biological and chemical hazards. These samples should be handled with suitable protection to skin, eyes, etc.

CAUTIONS

The following cautions need to be considered when planning to collect groundwater samples when the below conditions occur.

If the groundwater degasses during purging of the monitoring well, dissolved gases and VOCs will be lost. When this happens, the groundwater data for dissolved gases (e.g., methane, ethene, ethane, dissolved oxygen, etc.) and VOCs will need to be qualified. Some conditions that can promote degassing are the use of a vacuum pump (e.g., peristaltic pumps), changes in aperture along the sampling tubing, and squeezing/pinching the pump's tubing which results in a pressure change.

When collecting the samples for dissolved gases and VOCs analyses, avoid aerating the groundwater in the pump's tubing. This can cause loss of the dissolved gases and VOCs in

the groundwater. Having the pump's tubing completely filled prior to sampling will avoid this problem when using a centrifugal pump or peristaltic pump.

Direct sun light and hot ambient air temperatures may cause the groundwater in the tubing and flow-through-cell to heat up. This may cause the groundwater to degas which will result in loss of VOCs and dissolved gases. When sampling under these conditions, the sampler will need to shade the equipment from the sunlight (e.g., umbrella, tent, etc.). If possible, sampling on hot days, or during the hottest time of the day, should be avoided. The tubing exiting the monitoring well should be kept as short as possible to avoid the sun light or ambient air from heating up the groundwater.

Thermal currents in the monitoring well may cause vertical mixing of water in the well bore. When the air temperature is colder than the groundwater temperature, it can cool the top of the water column. Colder water which is denser than warm water sinks to the bottom of the well and the warmer water at the bottom of the well rises, setting up a convention cell. "During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indication of redox state, and can provide biological data that are not representative of the aquifer conditions" (Vroblesky 2007).

Failure to calibrate or perform proper maintenance on the sampling equipment and measurement instruments (e.g., dissolved oxygen meter, etc.) can result in faulty data being collected.

Interferences may result from using contaminated equipment, cleaning materials, sample containers, or uncontrolled ambient/surrounding air conditions (e.g., truck/vehicle exhaust nearby).

Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment and/or proper planning to avoid ambient air interferences. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

Clean and decontaminate all sampling equipment prior to use. All sampling equipment needs to be routinely checked to be free from contaminants and equipment blanks collected to ensure that the equipment is free of contaminants. Check the previous equipment blank data for the site (if they exist) to determine if the previous cleaning procedure removed the contaminants. If contaminants were detected and they are a concern, then a more vigorous cleaning procedure will be needed.

PERSONNEL QUALIFICATIONS

All field samplers working at sites containing hazardous waste must meet the requirements of the OSHA regulations. OSHA regulations may require the sampler to take the 40 hour OSHA health and safety training course and a refresher course prior to engaging in any field activities, depending upon the site and field conditions.

The field samplers must be trained prior to the use of the sampling equipment, field instruments, and procedures. Training is to be conducted by an experienced sampler before initiating any sampling procedure.

The entire sampling team needs to read, and be familiar with, the site Health and Safety Plan, all relevant SOPs, and SAP/QAPP (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

EQUIPMENT AND SUPPLIES

A. Informational materials for sampling event

A copy of the current Health and Safety Plan, SAP/QAPP, monitoring well construction data, location map(s), field data from last sampling event, manuals for sampling, and the monitoring instruments' operation, maintenance, and calibration manuals should be brought to the site.

B. Well keys.

C. Extraction device

Adjustable rate, submersible pumps (e.g., centrifugal, bladder, etc.) which are constructed of stainless steel or Teflon are preferred. Note: if extraction devices constructed of other materials are to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

If bladder pumps are selected for the collection of VOCs and dissolved gases, the pump setting should be set so that one pulse will deliver a water volume that is sufficient to fill a 40 mL VOC vial. This is not mandatory, but is considered a "best practice". For the proper operation, the bladder pump will need a minimum amount of water above the pump; consult the manufacturer for the recommended submergence. The pump's recommended submergence value should be determined during the planning stage, since it may influence well construction and placement of dedicated pumps where water-level fluctuations are significant.

Adjustable rate, peristaltic pumps (suction) are to be used with caution when collecting samples for VOCs and dissolved gases (e.g., methane, carbon dioxide, etc.) analyses. Additional information on the use of peristaltic pumps can be found in Appendix A. If peristaltic pumps are used, the inside diameter of the rotor head tubing needs to match the inside diameter of the tubing installed in the monitoring well.

Inertial pumping devices (motor driven or manual) are not recommended. These devices frequently cause greater disturbance during purging and sampling, and are less easily controlled than submersible pumps (potentially increasing turbidity and sampling variability, etc.). This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

D. Tubing

Teflon or Teflon-lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics. Note: if tubing constructed of other materials is to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for metal and other inorganics analyses.

The use of 1/4 inch or 3/8 inch (inside diameter) tubing is recommended. This will help ensure that the tubing remains liquid filled when operating at very low pumping rates when using centrifugal and peristaltic pumps.

Silastic tubing should be used for the section around the rotor head of a peristaltic pump. It should be less than a foot in length. The inside diameter of the tubing used at the pump rotor head must be the same as the inside diameter of tubing placed in the well. A tubing connector is used to connect the pump rotor head tubing to the well tubing. Alternatively, the two pieces of tubing can be connected to each other by placing the one end of the tubing inside the end of the other tubing. The tubing must not be reused.

E. The water level measuring device

Electronic "tape", pressure transducer, water level sounder/level indicator, etc. should be capable of measuring to 0.01 foot accuracy. 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 sampling event.

F. Flow measurement supplies

Graduated cylinder (size according to flow rate) and stopwatch usually will suffice.

Large graduated bucket used to record total water purged from the well.

G. Interface probe

To be used to check on the presence of free phase liquids (LNAPL, or DNAPL) before purging begins (as needed).

H. Power source (generator, nitrogen tank, battery, etc.)

When a gasoline generator is used, locate it downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate samples.

I. Indicator field parameter monitoring instruments

Use of a multi-parameter instrument capable of measuring pH, oxidation/reduction potential (ORP), dissolved oxygen (DO), specific conductance, temperature, and coupled with a flow-through-cell is required when measuring all indicator field parameters, except turbidity. Turbidity is collected using a separate instrument. Record equipment/instrument identification (manufacturer, and model number).

Transparent, small volume flow-through-cells (e.g., 250 mLs or less) are preferred. This allows observation of air bubbles and sediment buildup in the cell, which can interfere with the operation of the monitoring instrument probes, to be easily detected. A small volume cell facilitates rapid turnover of water in the cell between measurements of the indicator field parameters.

It is recommended to use a flow-through-cell and monitoring probes from the same manufacturer and model to avoid incompatibility between the probes and flow-through-cell.

Turbidity samples are collected before the flow-through-cell. A "T" connector coupled with a valve is connected between the pump's tubing and flow-through-cell. When a turbidity measurement is required, the valve is opened to allow the groundwater to flow into a container. The valve is closed and the container sample is then placed in the turbidimeter.

Standards are necessary to perform field calibration of instruments. A minimum of two standards are needed to bracket the instrument measurement range for all parameters except ORP which use a Zobell solution as a standard. For dissolved oxygen, a wet sponge used for the 100% saturation and a zero dissolved oxygen solution are used for the calibration.

Barometer (used in the calibration of the Dissolved Oxygen probe) and the conversion formula to convert the barometric pressure into the units of measure used by the Dissolved Oxygen meter are needed.

J. Decontamination supplies

Includes (for example) non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.

K. Record keeping supplies

Logbook(s), well purging forms, chain-of-custody forms, field instrument calibration forms, etc.

L. Sample bottles

M. Sample preservation supplies (as required by the analytical methods)

N. Sample tags or labels

O. PID or FID instrument

If appropriate, to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

P. Miscellaneous Equipment

Equipment to keep the sampling apparatus shaded in the summer (e.g., umbrella) and from freezing in the winter. If the pump's tubing is allowed to heat up in the warm weather, the cold groundwater may degas as it is warmed in the tubing.

EQUIPMENT/INSTRUMENT CALIBRATION

Prior to the sampling event, perform maintenance checks on the equipment and instruments according to the manufacturer's manual and/or applicable SOP. This will ensure that the equipment/instruments are working properly before they are used in the field.

Prior to sampling, the monitoring instruments must be calibrated and the calibration documented. The instruments are calibrated using U.S Environmental Protection Agency Region 1 *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity),* January 19, 2010, or latest version or from one of the methods listed in 40CFR136, 40CFR141 and SW-846.

The instruments shall be calibrated at the beginning of each day. If the field measurement falls outside the calibration range, the instrument must be re-calibrated so that all measurements fall within the calibration range. At the end of each day, a calibration check is performed to verify that instruments remained in calibration throughout the day. This check is performed while the instrument is in measurement mode, not calibration mode. If the field instruments are being used to monitor the natural attenuation parameters, then a calibration check at mid-day is highly recommended to ensure that the instruments did not drift out of calibration. Note: during the day if the instrument reads zero or a negative number for dissolved oxygen, pH, specific conductance, or turbidity (negative value only), this indicates that the instrument drifted out of calibration or the instrument is malfunctioning. If this situation occurs the data from this instrument will need to be qualified or rejected.

PRELIMINARY SITE ACTIVITIES (as applicable)

Check the well for security (damage, evidence of tampering, missing lock, etc.) and record pertinent observations (include photograph as warranted).

If needed lay out sheet of clean polyethylene for monitoring and sampling equipment, unless equipment is elevated above the ground (e.g., on a table, etc.).

Remove well cap and if appropriate measure VOCs at the rim of the well with a PID or FID instrument and record reading in field logbook or on the well purge form.

If the well casing does not have an established 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 (consider a photographic record as well). All water level measurements must be recorded relative to this reference point (and the altitude of this point should be determined using techniques that are appropriate to site's DQOs.

If water-table or potentiometric surface map(s) are to be constructed for the sampling event, perform synoptic water level measurement round (in the shortest possible time) before any purging and sampling activities begin. If possible, measure water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) the day before sampling begins, in order to allow for re-settlement of any particulates in the water column. This is especially important for those wells that have not been recently sampled because sediment buildup in the well may require the well to be redeveloped. If measurement of total well depth is not made the day before, it should be measured 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 may not be necessary unless analytical data or field analysis signal a worsening situation. This SOP cannot be used in the presence of LNAPLs or DNAPLs. If NAPLs are present, the project team must decide upon an alternate sampling method. All project modifications must be approved and documented prior to implementation.

If available 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). If changes are made in the intake depth or extraction rate(s) used during previous sampling event(s), for either portable or dedicated extraction devices, record new values, and explain reasons for the changes in the field logbook.

PURGING AND SAMPLING PROCEDURE

Purging and sampling wells in order of increasing chemical concentrations (known or anticipated) are preferred.

The use of dedicated pumps is recommended to minimize artificial mobilization and entrainment of particulates each time the well is sampled. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each

sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

A. Initial Water Level

Measure the water level in the well before installing the pump if a non-dedicated pump is being used. The initial water level is recorded on the purge form or in the field logbook.

B. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the appropriate depth (may not be the mid-point of the screen/open interval). The Sampling and Analysis Plan/Quality Assurance Project Plan should specify the sampling depth (used previously), or provide criteria for selection of intake depth for each new 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.

Pump tubing lengths, above the top of well casing should be kept as short as possible to minimize heating the groundwater in the tubing by exposure to sun light and ambient air temperatures. Heating may cause the groundwater to degas, which is unacceptable for the collection of samples for VOC and dissolved gases analyses.

C. Measure Water Level

Before starting pump, measure water level. Install recording pressure transducer, if used to track drawdowns, to initialize starting condition.

D. Purge Well

From the time the pump starts purging and until the time the samples are collected, the purged water is discharged into a graduated bucket to determine the total volume of groundwater purged. This information is recorded on the purge form or in the field logbook.

Start the pump at low speed and slowly increase the speed until discharge occurs. Check water level. Check equipment for water leaks and if present fix or replace the affected equipment. Try to match pumping rate used during previous sampling event(s). Otherwise, adjust pump speed until there is little or no water level drawdown. If the minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, continue purging.

Monitor and record the water level and pumping rate every five 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 to ensure stabilization of the water level. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" somewhat as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. If the initial water level is above the top of the screen do not allow the water level to fall into the well screen. The final purge volume must be greater than the stabilized drawdown volume plus the pump's tubing volume. If the drawdown has exceeded 0.3 feet and stabilizes, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are collected.

Avoid the use of constriction devices on the tubing to decrease the flow rate because the constrictor will cause a pressure difference in the water column. This will cause the groundwater to degas and result in a loss of VOCs and dissolved gasses in the groundwater samples.

Note: the flow rate used to achieve a stable pumping level should remain constant while monitoring the indicator parameters for stabilization and while collecting the samples.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (e.g., bladder, peristaltic), and/or the use of dedicated equipment. For new monitoring wells, or wells where the following situation has not occurred before, if the recovery rate to the well is less than 50 mL/min., or the well is being essentially dewatered during purging, the well should be sampled as soon as the water level has recovered sufficiently to collect the volume needed for all anticipated samples. The project manager or field team leader will need to make the decision when samples should be collected, how the sample is to be collected, and the reasons recorded on the purge form or in the field logbook. A water level measurement needs to be performed and recorded before samples are collected. If the project manager decides to collect the samples using the pump, it is best during this recovery period that the pump intake tubing not be removed, since this will aggravate any turbidity problems. Samples in this specific situation may be collected without stabilization of indicator field parameters. Note that field conditions and efforts to overcome problematic situations must be recorded in order to support field decisions to deviate from normal procedures described in this SOP. If this type of problematic situation persists in a well, then water sample collection should be changed to a passive or no-purge method, if consistent with the site's DQOs, or have a new well installed.

E. Monitor Indicator Field Parameters

After the water level has stabilized, connect the "T" connector with a valve and the flow-through-cell to monitor the indicator field parameters. If excessive turbidity is anticipated or encountered with the pump startup, the well may be purged for a while without connecting up the flow-through-cell, in order to minimize particulate buildup in the cell (This is a judgment call made by the sampler). Water level drawdown measurements should be made as usual. If possible, the pump may be installed the day before purging to allow particulates that were disturbed during pump insertion to settle.

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, ORP, DO) at a frequency of five minute intervals or greater. The pump's flow rate must be able to "turn over" at least one flow-through-cell volume between measurements (for a 250 mL flow-through-cell with a flow rate of 50 mLs/min., the monitoring frequency would be every five minutes; for a 500 mL flow-through-cell it would be every ten minutes). If the cell volume cannot be replaced in the five minute interval, then the time between measurements must be increased accordingly. Note: during the early phase of purging emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments followed by stabilization of indicator parameters. 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 are within the following limits:

Turbidity (10% for values greater than 5 NTU; if three Turbidity values are less than 5 NTU, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Samples for turbidity measurements are obtained before water enters the flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within 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. Record start and stop times and give a brief description of cleaning activities.

The flow-through-cell must be designed in a way that prevents gas bubble entrapment in the cell. Placing the flow-through-cell at a 45 degree angle with the port facing upward can help remove bubbles from the flow-through-cell (see Appendix B Low-Flow Setup Diagram). All during the measurement process, the flow-through-cell must remain free of any gas bubbles. Otherwise, the monitoring probes may act erratically. 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 remain submerged in water at all times.

F. Collect Water Samples

When samples are collected for laboratory analyses, the pump's tubing is disconnected from the "T" connector with a valve and the flow-through-cell. The samples are collected directly from the pump's tubing. Samples must not be collected from the flow-through-cell or from the "T" connector with a valve.

VOC samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

If the pump's flow rate is too high to collect the VOC/dissolved gases samples, collect the other samples first. Lower the pump's flow rate to a reasonable rate and collect the VOC/dissolved gases samples and record the new flow rate.

During purging and sampling, the centrifugal/peristaltic pump tubing must remain filled with water to avoid aeration of the groundwater. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use the following procedure to collect samples: collect non-VOC/dissolved gases samples first, then increase flow rate slightly until the water completely fills the tubing, collect the VOC/dissolved gases samples, and record new drawdown depth and flow rate.

For bladder pumps that will be used to collect VOC or dissolved gas samples, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 mL VOC vial.

Use pre-preserved sample containers or add preservative, as required by analytical methods, to the samples immediately after they are collected. Check the analytical methods (e.g. EPA SW-846, 40 CFR 136, water supply, etc.) for additional information on preservation.

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 (transparent housing preferred) is required, and the filter size (0.45 μm is commonly used) should be based on the sampling objective. Pre-rinse the filter with groundwater prior to sample collection. Make sure the filter is free of air bubbles before samples are collected. Preserve the 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 or ecological risk calculations.

Label each sample as collected. Samples requiring cooling 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.

G. Post Sampling Activities

If a recording pressure transducer is used to track drawdown, re-measure water level with tape.

After collection of samples, the pump tubing may be dedicated to the well for re-sampling (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 annually is usually sufficient after the initial low stress sampling event. However, a greater frequency may be needed if the well has a "silting" problem or if confirmation of well identity is needed.

Secure the well.

DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well and then following sampling of each well. Pumps should not be removed between purging and sampling operations. The pump, tubing, support cable and electrical wires which were in contact with the well should be decontaminated by one of the procedures listed below.

The use of dedicated pumps and tubing will reduce the amount of time spent on decontamination of the equipment. If dedicated pumps and tubing are used, only the initial sampling event will require decontamination of the pump and tubing.

Note if the previous equipment blank data showed that contaminant(s) were present after using the below procedure or the one described in the SAP/QAPP, a more vigorous procedure may be needed.

Procedure 1

Decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump and tubing. The pump may be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and alcohol 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:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

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.

Optional - flush with isopropyl alcohol (pesticide grade; must be free of ketones {e.g., acetone}) or with methanol. This step may be required if the well is highly contaminated or if the equipment blank data from the previous sampling event show that the level of contaminants is significant.

Flush with distilled/deionized water. This step must remove all traces of alcohol (if used) from the equipment. The final water rinse must not be recycled.

Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four 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.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

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.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

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. Quality control samples include field duplicates, equipment blanks, matrix spike/matrix spike duplicates, trip blanks (VOCs), and temperature blanks.

FIELD LOGBOOK

A field log shall be kept to document all groundwater field monitoring activities (see Appendix C, example table), and record the following for each well:

Site name, municipality, state.

Well identifier, latitude-longitude or state grid coordinates.

Measuring point description (e.g., north side of PVC pipe).

Well depth, and measurement technique.

Well screen length.

Pump depth.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and detection method.

Pumping rate, drawdown, indicator parameters values, calculated or measured total volume pumped, and clock time of each set of measurements.

Type of tubing used and its length.

Type of pump used.

Clock time of start and end of purging and sampling activity.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analyses.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions, including approximate ambient air temperature.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling/monitoring equipment used, including trade names, model number, instrument identification number, diameters, material composition, etc.

DATA REPORT

Data reports are to include laboratory analytical results, QA/QC information, field indicator parameters measured during purging, field instrument calibration information, and whatever other field logbook information is needed to allow for a full evaluation of data usability.

Note: the use of trade, product, or firm names in this sampling procedure is for descriptive purposes only and does not constitute endorsement by the U.S. EPA.

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U.S Environmental Protection Agency, EPA SW-846.

U.S Environmental Protection Agency, 40 CFR 136.

U.S Environmental Protection Agency, 40 CFR 141.

Vroblesky, Don A., Clifton C. Casey, and Mark A. Lowery, Summer 2007, Influence of Dissolved Oxygen Convection on Well Sampling, *Ground Water Monitoring & Remediation* 27, no. 3: 49-58.

APPENDIX A
PERISTALTIC PUMPS

Before selecting a peristaltic pump to collect groundwater samples for VOCs and/or dissolved gases (e.g., methane, carbon dioxide, etc.) consideration should be given to the following:

- The decision of whether or not to use a peristaltic pump is dependent on the intended use of the data.
- If the additional sampling error that may be introduced by this device is NOT of concern for the VOC/dissolved gases data's intended use, then this device may be acceptable.
- If minor differences in the groundwater concentrations could effect the decision, such as to continue or terminate groundwater cleanup or whether the cleanup goals have been reached, then this device should NOT be used for VOC/dissolved gases sampling. In these cases, centrifugal or bladder pumps are a better choice for more accurate results.

EPA and USGS have documented their concerns with the use of the peristaltic pumps to collect water sample in the below documents.

- "Suction Pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.
- "The agency does not recommend the use of peristaltic pumps to sample ground water particularly for volatile organic analytes" *RCRA Ground-Water Monitoring Draft Technical Guidance*, EPA Office of Solid Waste, November 1992.
- "The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and volatiles loss", *Low-flow (Minimal drawdown) Ground-Water Sampling Procedures*, by Robert Puls & Michael Barcelona, April 1996, EPA/540/S-95/504.
- "Suction-lift pumps, such as peristaltic pumps, can operate at a very low pumping rate; however, using negative pressure to lift the sample can result in the loss of volatile analytes", USGS Book 9 Techniques of Water-Resources Investigation, Chapter A4. (Version 2.0, 9/2006).

APPENDIX B

SUMMARY OF SAMPLING INSTRUCTIONS

These instructions are for using an adjustable rate, submersible pump or a peristaltic pump with the pump's intake placed at the midpoint of a 10 foot or less well screen or an open interval. The water level in the monitoring well is above the top of the well screen or open interval, the ambient temperature is above 32°F, and the equipment is not dedicated. Field instruments are already calibrated. The equipment is setup according to the diagram at the end of these instructions.

1. Review well installation information. Record well depth, length of screen or open interval, and depth to top of the well screen. Determine the pump's intake depth (e.g., mid-point of screen/open interval).

2. On the day of sampling, check security of the well casing, perform any safety checks needed for the site, lay out a sheet of polyethylene around the well (if necessary), and setup the equipment. If necessary a canopy or an equivalent item can be setup to shade the pump's tubing and flow-through-cell from the sun light to prevent the sun light from heating the groundwater.

3. Check well casing for a reference mark. If missing, make a reference mark. Measure the water level (initial) to 0.01 ft. and record this information.

4. Install the pump's intake to the appropriate depth (e.g., midpoint) of the well screen or open interval. Do not turn-on the pump at this time.

5. Measure water level and record this information.

6. Turn-on the pump and discharge the groundwater into a graduated waste bucket. Slowly increase the flow rate until the water level starts to drop. Reduce the flow rate slightly so the water level stabilizes. Record the pump's settings. Calculate the flow rate using a graduated container and a stop watch. Record the flow rate. Do not let the water level drop below the top of the well screen.

If the groundwater is highly turbid or colored, continue to discharge the water into the bucket until the water clears (visual observation); this usually takes a few minutes. The turbid or colored water is usually from the well being disturbed during the pump installation. If the water does not clear, then you need to make a choice whether to continue purging the well (hoping that it will clear after a reasonable time) or continue to

the next step. Note, it is sometimes helpful to install the pump the day before the sampling event so that the disturbed materials in the well can settle out.

If the water level drops to the top of the well screen during the purging of the well, stop purging the well, and do the following:

> Wait for the well to recharge to a sufficient volume so samples can be collected. This may take awhile (pump maybe removed from well, if turbidity is not a problem). The project manager will need to make the decision when samples should be collected and the reasons recorded in the site's log book. A water level measurement needs to be performed and recorded before samples are collected. When samples are being collected, the water level must not drop below the top of the screen or open interval. Collect the samples from the pump's tubing. Always collect the VOCs and dissolved gases samples first. Normally, the samples requiring a small volume are collected before the large volume samples are collected just in case there is not sufficient water in the well to fill all the sample containers. All samples must be collected, preserved, and stored according to the analytical method. Remove the pump from the well and decontaminate the sampling equipment.

If the water level has dropped 0.3 feet or less from the initial water level (water level measure before the pump was installed); proceed to Step 7. If the water level has dropped more than 0.3 feet, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are be collected.

7. Attach the pump's tubing to the "T" connector with a valve (or a three-way stop cock). The pump's tubing from the well casing to the "T" connector must be as short as possible to prevent the groundwater in the tubing from heating up from the sun light or from the ambient air. Attach a short piece of tubing to the other end of the end of the "T" connector to serve as a sampling port for the turbidity samples. Attach the remaining end of the "T" connector to a short piece of tubing and connect the tubing to the flow-through-cell bottom port. To the top port, attach a small piece of tubing to direct the water into a calibrated waste bucket. Fill the cell with the groundwater and remove all gas bubbles from the cell. Position the flow-through-cell in such a way that if gas bubbles enter the cell they can easily exit the cell. If the ports are on the same side of the cell and the cell is cylindrical shape, the cell can be placed at a 45-degree angle with the ports facing upwards; this position should keep any gas bubbles entering the cell away from the monitoring probes and allow the gas bubbles to exit the cell easily (see Low-Flow Setup Diagram). Note,

make sure there are no gas bubbles caught in the probes' protective guard; you may need to shake the cell to remove these bubbles.

8. Turn-on the monitoring probes and turbidity meter.

9. Record the temperature, pH, dissolved oxygen, specific conductance, and oxidation/reduction potential measurements. Open the valve on the "T" connector to collect a sample for the turbidity measurement, close the valve, do the measurement, and record this measurement. Calculate the pump's flow rate from the water exiting the flow-through-cell using a graduated container and a stop watch, and record the measurement. Measure and record the water level. Check flow-through-cell for gas bubbles and sediment; if present, remove them.

10. Repeat Step 9 every 5 minutes or as appropriate until monitoring parameters stabilized. Note at least one flow-through-cell volume must be exchanged between readings. If not, the time interval between readings will need to be increased. Stabilization is achieved when three consecutive measurements are within the following limits:

Turbidity (10% for values greater than 5 NTUs; if three Turbidity values are less than 5 NTUs, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

If these stabilization requirements do not stabilize in a reasonable time, the probes may have been coated from the materials in the groundwater, from a buildup of sediment in the flow-through-cell, or a gas bubble is lodged in the probe. The cell and the probes will need to be cleaned. Turn-off the probes (not the pump), disconnect the cell from the "T" connector and continue to purge the well. Disassemble the cell, remove the sediment, and clean the probes according to the manufacturer's instructions. Reassemble the cell and connect the cell to the "T" connector. Remove all gas bubbles from the cell, turn-on the probes, and continue the measurements. Record that the time the cell was cleaned.

11. When it is time to collect the groundwater samples, turn-off the monitoring probes, and disconnect the pump's tubing from the "T" connector. If you are using a centrifugal or peristaltic pump check the pump's tubing to determine if the tubing is completely filled with water (no air space).

All samples must be collected and preserved according to the analytical method. VOCs and dissolved gases samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

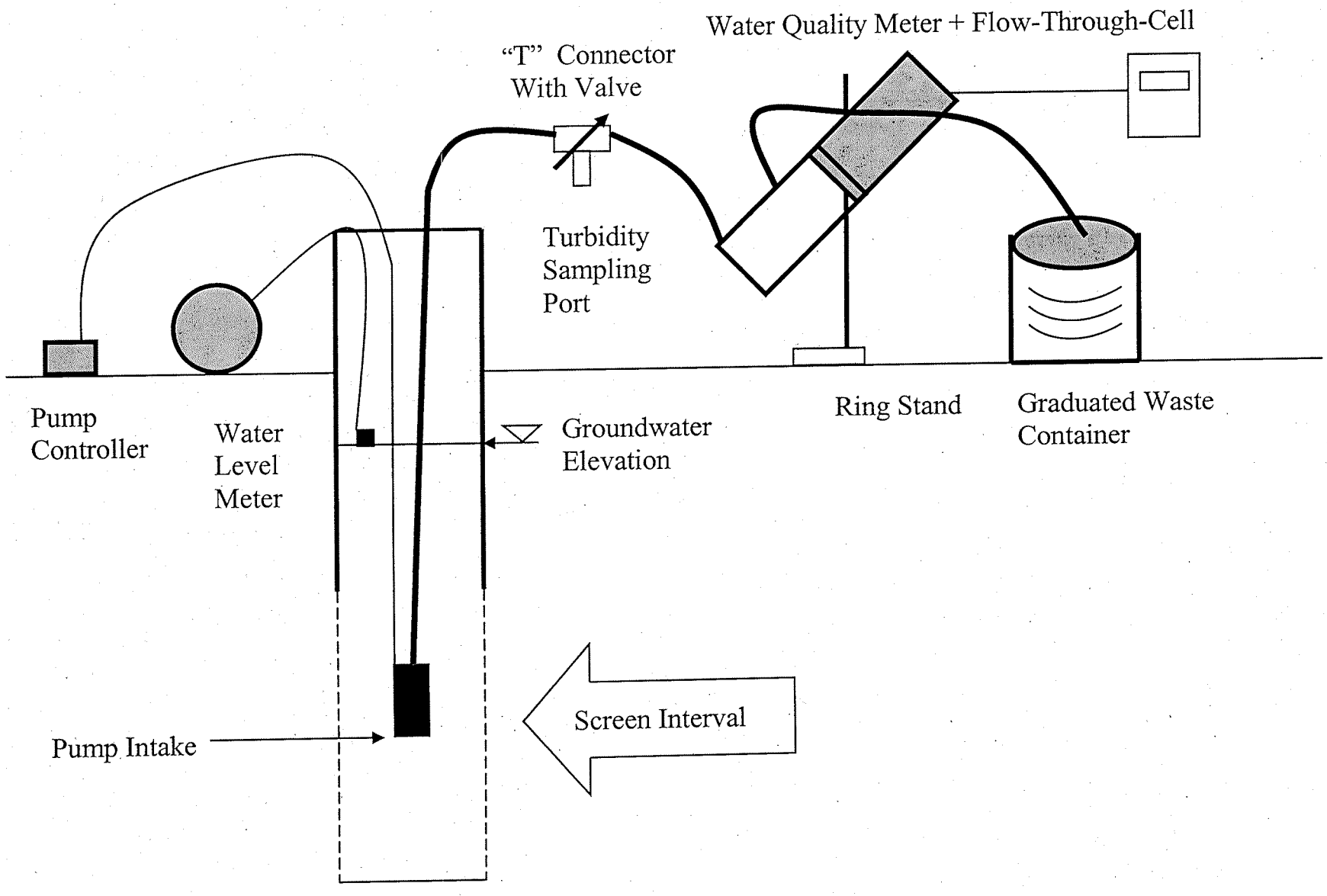
If the pump's tubing is not completely filled with water and the samples are being collected for VOCs and/or dissolved gases analyses using a centrifugal or peristaltic pump, do the following:

> All samples must be collected and preserved according to the analytical method. The VOCs and the dissolved gases (e.g., methane, ethane, ethene, and carbon dioxide) samples are collected last. When it becomes time to collect these samples increase the pump's flow rate until the tubing is completely filled. Collect the samples and record the new flow rate.

12. Store the samples according to the analytical method.

13. Record the total purged volume (graduated waste bucket). Remove the pump from the well and decontaminate the sampling equipment.

Low-Flow Setup Diagram



APPENDIX C
EXAMPLE (Minimum Requirements)
WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Location (Site/Facility Name)_____
Well Number_____ Date_____
Field Personnel_____
Sampling Organization_____
Identify MP_____

Depth to _____/_____ of screen
(below MP) top bottom
Pump Intake at (ft. below MP)_____
Purging Device; (pump type)_____
Total Volume Purged _____

Clock Time 24 HR	Water Depth below MP ft	Pump Dial[1]	Purge Rate ml/min	Cum. Volume Purged liters	Temp. °C	Spec. Cond.[2] µS/cm	pH	ORP[3] mv	DO mg/L	Turb-idity NTU	Comments
Stabilization Criteria					3%	3%	±0.1	± 10 mv	10%	10%	

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. µSiemens per cm(same as µmhos/cm)at 25 °C.
3. Oxidation reduction potential (ORP)

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1.0 PURPOSE

The purpose of this procedure is to provide reference information regarding the proper methods for evaluating the physical condition and project utility of existing monitoring wells and determining water levels.

2.0 SCOPE

The procedures described herein are applicable to all existing monitoring wells and, for the most part, are independent of construction materials and methods.

3.0 GLOSSARY

Hydraulic Head - The height to which water will rise in a well.

Water Table - A surface in an unconfined aquifer where groundwater pressure is equal to atmospheric pressure (i.e., the pressure head is zero).

4.0 RESPONSIBILITIES

Site Geologist/Hydrogeologist - Has overall responsibility for the evaluation of existing wells, obtaining water level measurements and developing groundwater contour maps. The site geologist/hydrogeologist (in concurrence with the Project Manager) shall specify the reference point from which water levels are measured (usually a specific point on the upper edge of the inner well casing), the number and location of data points which shall be used for constructing a contour map, and how many complete sets of water levels are required to adequately define groundwater flow directions (e.g., if there are seasonal variations).

Field Personnel - Must have a basic familiarity with the equipment and procedures involved in obtaining water levels and must be aware of any project-specific requirements or objectives.

5.0 PROCEDURES

Accurate, valid and useful groundwater monitoring requires that four important conditions be met:

- Proper characterization of site hydrogeology.
- Proper design of the groundwater monitoring program, including adequate numbers of wells installed at appropriate locations and depths.
- Satisfactory methods of groundwater sampling and analysis to meet the project data quality objectives (DQOs).
- The assurance that specific monitoring well samples are representative of water quality conditions in the monitored interval.

To insure that these conditions are met, adequate descriptions of subsurface geology, well construction methods and well testing results must be available. The following steps will help to insure that the required data are available to permit an evaluation of the utility of existing monitoring wells for collecting additional samples.

5.1 Preliminary Evaluation

A necessary first step in evaluating existing monitoring well data is the study and review of the original work plan for monitoring well installation (if available). This helps to familiarize the site geologist/hydrogeologist with site-specific condition, and will promote an understanding of the original purpose of the monitoring wells.

The next step of the evaluation should involve a review of all available information concerning borehole drilling and well construction. This will allow interpretation of groundwater flow conditions and area geology, and will help to establish consistency between hydraulic properties of the well and physical features of the well or formation. The physical features which should be identified and detailed, if available, include:

- The well identification number, permit number and location by referenced coordinates, the distance from prominent site features, or the location of the well on a map.
- The installation dates, drilling methods, well development methods, past sampling dates, and drilling contractors.
- The depth to bedrock -- where rock cores were not taken, auger refusal, drive casing refusal or penetration test results (blow counts for split-barrel sampling) may be used to estimate bedrock interface.
- The soil profile and stratigraphy.
- The borehole depth and diameter.
- The elevation of the top of the protective casing, the top of the well riser, and the ground surface.
- The total depth of the well.
- The type of well materials, screen type, slot size, and length, and the elevation/depths of the screen, interval, and/or monitored interval.
- The elevation/depths of the tops and bottom of the filter pack and well seals and the type and size.

5.2 Field Inspection

During the onsite inspection of existing monitoring wells, features to be noted include:

- The condition of the protective casing, cap and lock.
- The condition of the cement seal surrounding the protective casing.
- The presence of depressions or standing water around the casing.
- The presence of and condition of dedicated sampling equipment.
- The presence of a survey mark on the inner well casing.

If the protective casing, cap and lock have been damaged or the cement collar appears deteriorated, or if there are any depressions around the well casing capable of holding water, surface water may have infiltrated into the well. This may invalidate previous sampling results unless the time when leakage started can be precisely determined.

The routine physical inspection must be followed by a more detailed investigation to identify other potential routes of contamination or sampling equipment malfunction. Any of these occurrences may invalidate

previously-collected water quality data. If the monitoring well is to be used in the future, considerations shown in the steps described above should be rectified to rehabilitate the well.

After disconnecting any wires, cables or electrical sources, remove the lock and open the cap. Check for the presence of organic vapors with a photoionization detector (PID) or flame-ionization detector (FID) to determine the appropriate worker safety level. The following information should be noted:

- Cap function.
- Physical characteristics and composition of the inner casing or riser, including inner diameter and annular space.
- Presence of grout between the riser and outer protective casing and the existence of drain holes in the protective casing.
- Presence of a riser cap, method of attachment to casing, and venting of the riser.
- Presence of dedicated sampling equipment; if possible, remove such equipment and inspect size, materials of construction and condition.

The final step of the field inspection is to confirm previous hydraulic or physical property data and to obtain data not previously available. This includes the determination of static water levels, total well depth and well obstruction. This may be accomplished using a weighted tape measure which can also be used to check for sediment (the weight will advance slowly if sediment is present, and the presence of sediment on the weight upon removal should be noted). If sediment is present and/or the well has not been sampled in 12 or more months, it should be redeveloped before sampling.

Lastly, as a final step, the location, condition and expected water quality of the wells should be reviewed in light of their usefulness for the intended purpose of the investigation.

See Attachment A, Monitoring Well Inspection Sheet.

5.3 Water Level (Hydraulic Head) Measurements

5.3.1 General

Groundwater level measurements can be made in monitoring wells, private or public water wells, piezometers, open boreholes, or test pits (after stabilization). Groundwater measurements should generally not be made in boreholes with drilling rods or auger flights present. If groundwater sampling activities are to occur, groundwater level measurements shall take place prior to well purging or sampling.

All groundwater level measurements shall be made to the nearest 0.01 foot, and recorded in the site geologist/hydrogeologist's field notebook or on the Groundwater Level Measurement Sheet (Attachment B), along with the date and time of the reading. The total depth of the well shall be measured and recorded, if not already known. Weather changes that occur over the period of time during which water levels are being taken, such as precipitation and barometric pressure changes, should be noted.

In measuring groundwater levels, there shall be a clearly-established reference point of known elevation, which is normally identified by a mark on the upper edge of the inner well casing. To be useful, the reference point should be tied in with an established USGS benchmark or other properly surveyed elevation datum. An arbitrary datum could be used for an isolated group of wells, if necessary.

Cascading water within a borehole or steel well casings can cause false readings with some types of sounding devices (chalked line, electrical). Oil layers may also cause problems in determining the true water level in a well. Special devices (interface probes) are available for measuring the thickness of oil layers and true depth to groundwater, if required.

Water level readings shall be taken regularly, as required by the site geologist/hydrogeologist. Monitoring wells or open-cased boreholes that are subject to tidal fluctuations should be read in conjunction with a tidal chart (or preferably in conjunction with readings of a tide staff or tide level recorder installed in the adjacent water body); the frequency of such readings shall be established by the site hydrogeologist. All water level measurements at a site used to develop a groundwater contour map shall be made in the shortest practical time to minimize affects due to weather changes.

5.3.2 Water Level Measuring Techniques

There are several methods for determining standing or changing water levels in boreholes and monitoring wells. Certain methods have particular advantages and disadvantages depending upon well conditions. A general description of these methods is presented, along with a listing of various advantages and disadvantages of each technique. An effective technique shall be selected for the particular site conditions by the site geologist/hydrogeologist.

In most instances, preparation of accurate potentiometric surface maps require that static water level measurements be obtained to a precision of 0.01 feet. To obtain such measurements in individual accessible wells, electrical water level indicator methods have been found to be best, and thus should be utilized. Other, less precise methods, such as the popper or bell sound, or bailer line methods, should be avoided. When a large number of (or continuous) readings are required, time-consuming individual readings are not usually feasible. In such cases, it is best to use a pressure transducer.

5.3.3 Methods

Water levels can be measured by several different techniques, but the same steps shall be followed in each case. The proper sequence is as follows:

1. Check operation of recording equipment above ground. Prior to opening the well, don personal protective equipment, as required. Never remove an air-tight lock (such as a J-plug) with your face over the well. Pressure changes within the well may explosively force the cap off once loosened.

2. Record all information specified below in the geologist/hydrogeologist's field notebook or on the Groundwater Level Measurement Sheet (Attachment B):

   - Well number.
   - Water level (to the nearest 0.01 foot). Water levels shall be taken from the surveyed reference mark on the top edge of the inner well casing. If the J-plug was on the well very tightly, it may take several minutes for the water level to stabilize.
   - Time and day of the measurement.
   - Thickness of free product if present.

Water level measuring devices with permanently marked intervals shall be used. The devices shall be free of kinks or folds which will affect the ability of the equipment to hang straight in the well pipe.

5.3.4 Water Level Measuring Devices

Electric Water Level Indicators

These are the most commonly used devices and consist of a spool of small-diameter cable and a weighted probe attached to the end. When the probe comes in contact with the water, an electrical circuit is closed and a meter, light, and/or buzzer attached to the spool will signal the contact.

There are a number of commercial electric sounders available, none of which is entirely reliable under all conditions likely to occur in a contaminated monitoring well. In conditions where there is oil on the water, groundwater with high specific conductance, water cascading into the well, steel well casing, or a turbulent water surface in the well, measuring with an electric sounder may be difficult.

For accurate readings, the probe shall be lowered slowly into the well adjacent to the survey mark on the inner well casing. The electric tape is read (to the nearest 0.01 ft.) at the measuring point and recorded where contact with the water surface was indicated.

Popper or Bell Sounder

A bell- or cup-shaped weight that is hollow on the bottom is attached to a measuring tape and lowered into the well. A "plopping" or "popping" sound is made when the weight strikes the surface of the water. An accurate reading can be determined by lifting and lowering the weight in short strokes, and reading the tape when the weight strikes the water. This method is not sufficiently accurate to obtain water levels to 0.01 feet, and thus is more appropriate for obtaining only approximate water levels quickly.

Pressure Transducer

Pressure transducers can be lowered into a well or borehole to measure the pressure of water and therefore the water elevation above the transducer. The transducer is wired into a recorder at the surface to record changes in water level with time. The recorder digitizes the information and can provide a printout or transfer the information to a computer for evaluation (using a well drawdown/recovery model). The pressure transducer should be initially calibrated with another water level measurement technique to ensure accuracy. This technique is very useful for hydraulic conductivity testing in highly permeable material where repeated, accurate water level measurements are required in a very short period of time. A sensitive transducer element is required to measure water levels to 0.01 foot accuracy.

Borehole Geophysics

Approximate water levels can be determined during geophysical logging of the borehole (although this is not the primary purpose for geophysical logging and such logging is not cost effective if used only for this purpose). Several logging techniques will indicate water level. Commonly-used logs which will indicate saturated/unsaturated conditions include the spontaneous potential (SP) log and the neutron log.

5.3.5 Data Recording

Water level measurements, time, data, and weather conditions shall be recorded in the geologist/hydrogeologist's field notebook or on the Groundwater Level Measurement Sheet. All water level measurements shall be measured from a known reference point. The reference point is generally a marked point on the upper edge of the inner well casing that has been surveyed for an elevation. The exact reference point shall be marked with permanent ink on the casing since the top of the casing may not be entirely level. It is important to note changes in weather conditions because changes in the barometric pressure may affect the water level within the well.

5.3.6 Specific Quality Control Procedures for Water Level Measuring Devices

All groundwater level measurement devices must be cleaned before and after each use to prevent cross contamination of wells. Manufacturer's instructions for cleaning the device shall be strictly followed. Some devices used to measure groundwater levels may need to be calibrated. These devices shall be calibrated to 0.01 foot accuracy and any adjustments/corrections shall be recorded in the field logbook/notebook. After the corrections/adjustments are made to the measuring device and entered in the field logbook/notebook, the corrected readings shall be entered onto the Groundwater Level Measurement Sheet (Attachment B). Elevations will be entered on the sheet when they become available.

5.4 Equipment Decontamination

Equipment used for water level measurements provide a mechanism for potentially cross contaminating wells. Therefore, all portions of a device which project down the well casing must be decontaminated prior to advancing to the next well. Decontamination procedures vary based on the project objectives but must be defined prior to conducting any field activities including the collection of water level data. Consult the project planning documents and SA-7.1 Decontamination of Field Equipment.

5.5 Health and Safety Considerations

Groundwater contaminated by volatile organic compounds may release toxic vapors into the air space inside the well pipe. The release of this air when the well is initially opened is a health/safety hazard which must be considered. Initial monitoring of the well headspace and breathing zone concentrations using a PID or FID shall be performed to determine required levels of protection. Under certain conditions, air-tight well caps may explosively fly off the well when the pressure is relieved. Never stand directly over a well when uncapping it.

6.0 RECORDS

A record of all field procedures, tests and observations must be recorded in the site logbook or designated field notebook. Entries in the log/notebook should include the individuals participating in the field effort, and the date and time. The use of annotated sketches may help to supplement the evaluation.

ATTACHMENT A
MONITORING WELL INSPECTION SHEET

Monitoring Well Inspection Sheet

Project Name: _____ Date: _____

Location: _____ Time: _____

Tidally Influenced: Y / N Personnel: _____

Field Measurements				
Well ID	PID Reading PPM	Depth to Water *	Total Depth *	Flush Mt./ Stick-up

Well Construction Details (Taken from construction logs)		
Total Depth *	Ground Elev.	Top/Btm Screen *

Check List:

Riser Pipe Material:
Riser Notched for Surveyors:
Well ID Tag In-place:
Well security:
Photo taken:

Condition of Well:

Protective Case:
Riser:
Well Pad:
Other:

Presence/Evidence of:

Standing Water Around Well:
Existing Sampling Equipment:
Sediment build-up in Well Btm:

Comments:

** = Measurements are from the top of the inner case to the nearest 0.01'*

ATTACHMENT B
GROUNDWATER LEVEL MESUREMENT SHEET

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: _____ **Project No.:** _____
Location: _____ **Personnel:** _____
Weather Conditions: _____ **Measuring Device:** _____
Tidally Influenced: Yes ____ No ____ **Remarks:** _____

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Comments

* All measurements to the nearest 0.01 foot, from surveyed mark (unless noted)

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1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper monitoring well design, installation, and development.

2.0 SCOPE

This procedure is applicable to the construction of monitoring wells. The methods described herein may be modified by project-specific requirements for monitoring well construction. In addition, many regulatory agencies have specific regulations pertaining to monitoring well construction and permitting. These requirements must be determined during the project planning phases of the investigation, and any required permits must be obtained before field work begins. Innovative monitoring well installation techniques, which typically are not used, will be discussed only generally in this procedure.

3.0 GLOSSARY

Monitoring Well - A well which is screened, cased, and sealed which is capable of providing a groundwater level and groundwater sample representative of the zone being monitored. Some monitoring wells may be constructed as open boreholes.

Piezometer - A pipe or tube inserted into the water bearing zone, typically open to water flow at the bottom and to the atmosphere at the top, and used to measure water level elevations. Piezometers may range in size from 1/2-inch-diameter plastic tubes to well points or monitoring wells.

Potentiometric Surface - The surface representative of the level to which water will rise in a well cased to the screened aquifer.

Well Point (Drive Point) - A screened or perforated tube (Typically 1-1/4 or 2 inches in diameter) with a solid, conical, hardened point at one end, which is attached to a riser pipe and driven into the ground with a sledge hammer, drop weight, or mechanical vibrator. Well points may be used for groundwater injection and recovery, as piezometers (i.e., to measure water levels) or to provide groundwater samples for water quality data.

4.0 RESPONSIBILITIES

Driller - The driller provides adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of performing all phases of proper monitoring well installation and construction. The driller may also be responsible for obtaining, in advance, any required permits for monitoring well installation and construction.

Field Geologist - The field geologist supervises and documents well installation and construction performed by the driller, and insures that well construction is adequate to provide representative groundwater data from the monitored interval. Geotechnical engineers, field technicians, or other suitable trained personnel may also serve in this capacity.

5.0 PROCEDURES

5.1 Equipment/Items Needed

Below is a list of items that may be needed when installing a monitoring well or piezometer:

- Health and safety equipment (hard hats, safety glasses, etc.) as required by the Site Safety Officer.
- Well drilling and installation equipment with associated materials (typically supplied by the driller).
- Hydrogeologic equipment (weighted engineer's tape, water level indicator, retractable engineers rule, electronic calculator, clipboard, mirror and flashlight - for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, and a field notebook).
- Drive point installation tools (sledge hammer, drop hammer, or mechanical vibrator; tripod, pipe wrenches, drive points, riser pipe, and end caps).

5.2 Well Design

The objectives and intended use for each monitoring well must be clearly defined before the monitoring system is designed. Within the monitoring system, different monitoring wells may serve different purposes and, therefore, require different types of construction. During all phases of the well design, attention must be given to clearly documenting the basis for design decisions, the details of well construction, and the materials used. The objectives for installing the monitoring wells may include:

- Determining groundwater flow directions and velocities.
- Sampling or monitoring for trace contaminants.
- Determining aquifer characteristics (e.g., hydraulic conductivity).

Siting of monitoring wells shall be performed after a preliminary estimation of the groundwater flow direction. In most cases, groundwater flow directions and potential well locations can be determined by an experienced hydrogeologist through the review of geologic data and the site terrain. In addition, data from production wells or other monitoring wells in the area may be used to determine the groundwater flow direction. If these methods cannot be used, piezometers, which are relatively inexpensive to install, may have to be installed in a preliminary investigative phase to determine groundwater flow direction.

5.2.1 Well Depth, Diameter, and Monitored Interval

The well depth, diameter, and monitored interval must be tailored to the specific monitoring needs of each investigation. Specification of these items generally depends on the purpose of the monitoring system and the characteristics of the hydrogeologic system being monitored. Wells of different depth, diameter, and monitored interval can be employed in the same groundwater monitoring system. For instance, varying the monitored interval in several wells, at the same location (cluster wells) can help to determine the vertical gradient and the depths at which contaminants are present. Conversely, a fully penetrating well is usually not used to quantify or vertically locate a contaminant plume, since groundwater samples collected in wells that are screened over the full thickness of the water-bearing zone will be representative of average conditions across the entire monitored interval. However, fully penetrating wells can be used to establish the existence of contamination in the water-bearing zone. The well diameter desired depends upon the hydraulic characteristics of the water-bearing zone, sampling requirements, drilling method and cost.

The decision concerning the monitored interval and well depth is based on the following (and possibly other) information:

- The vertical location of the contaminant source in relation to the water-bearing zone.
- The depth, thickness and uniformity of the water-bearing zone.
- The anticipated depth, thickness, and characteristics (e.g., density relative to water) of the contaminant plume.
- Fluctuation in groundwater levels (due to pumping, tidal influences, or natural recharge/discharge events).
- The presence and location of contaminants encountered during drilling.
- Whether the purpose of the installation is for determining existence or non-existence of contamination or if a particular stratigraphic zone is being investigated.
- The analysis of borehole geophysical logs.

In most situations where groundwater flow lines are horizontal, depending on the purpose of the well and the site conditions, monitored intervals are 20 feet or less. Shorter screen lengths (5 feet or less) are usually required where flow lines are not horizontal, (i.e., if the wells are to be used for accurate measurement of the potentiometric head at a specific point).

Many factors influence the diameter of a monitoring well. The diameter of the monitoring well depends on the application. In determining well diameter, the following needs must be considered:

- Adequate water volume for sampling.
- Drilling methodology.
- Type of sampling device to be used.
- Costs.

Standard monitoring well diameters are 2, 4, 6, or 8 inches. Drive points are typically 1-1/4 or 2 inches in diameter. For monitoring programs which require screened monitoring wells, either a 2-inch or 4-inch-diameter well is preferred. Typically, well diameters greater than 4 inches are used in monitoring programs in which open-hole bedrock monitoring wells are used. With smaller diameter wells, the volume of stagnant water in the well is minimized, and well construction costs are reduced; however, the sampling devices that can be used are limited.

In specifying well diameter, sampling requirements must be considered (up to a total of 4 gallons of water may be required for a single sample to account for full organic and inorganic analyses, and split samples), particularly if the monitored formation is known to be a low-yielding formation. The unit volume of water contained within a monitoring well is dependent on the well diameter as follows:

Casing Inside Diameter (Inch)	Standing Water Length to Obtain 1 Gallon Water (Feet)
2	6.13
4	1.53
6	0.68

If a well recharges quickly after purging, then well diameter may not be an important factor regarding sample volume requirements.

Pumping tests for determining aquifer characteristics may require larger diameter wells (for installation of high capacity pumps); however, in small-diameter wells in-situ permeability tests can be performed during drilling or after well installation is completed.

5.2.2 Riser Pipe and Screen Materials

Well materials are specified by diameter, type of material, and thickness of pipe. Well screens require an additional specification of slot size. Thickness of pipe is referred to as "Schedule" for polyvinyl chloride (PVC) casing and is usually Schedule 40 (thinner wall) or 80 (thicker wall). Steel pipe thickness is often referred to as "Strength". Standard Strength is usually adequate for monitoring well purposes. With larger diameter pipe, the wall thickness must be greater to maintain adequate strength. The required thickness is also dependent on the method of installation; risers for drive points require greater strength than wells installed inside drilled borings.

The selection of well screen and riser materials depends on the method of drilling, the type of subsurface materials the well penetrates, the type of contamination expected, and natural water quality and depth. Cost and the level of accuracy required are also important. The materials generally available are Teflon, stainless steel, PVC galvanized steel, and carbon steel. Each has advantages and limitations (see Attachment A of this guideline for an extensive presentation on this topic). The two most commonly used materials are PVC and stainless steel. Properties of these two materials are compared in Attachment B. Stainless steel is a good choice where trace metals or organic sampling is required; however, costs are high. Teflon materials are extremely expensive, but are relatively inert and provide the least opportunity for water contamination due to well materials. PVC has many advantages, including low cost, excellent availability, light weight, ease of manipulation, and widespread acceptance. The crushing strength of PVC may limit the depth of installation, but the use of Schedule 80 materials may overcome some of the problems associated with depth. However, the smaller inside diameter of Schedule 80 pipe may be an important factor when considering the size of bailers or pumps required for sampling or testing. Due to this problem, the minimum well pipe size recommended for Schedule 80 wells is 4-inch I.D.

Screens and risers may have to be decontaminated before use because oil-based preservatives and oil used during thread cutting and screen manufacturing may contaminate samples. Metal pipe may corrode and release metal ions or chemically react with organic constituents, but this is considered a minor issue. Galvanized steel is not recommended where samples may be collected for metals analyses, as zinc and cadmium levels in groundwater samples may become elevated from leaching of the zinc coating.

Threaded, flush-joint casing is most often preferred for monitoring well applications. PVC, Teflon, and steel can all be obtained with threaded joints. Welded-joint steel casing is also acceptable. Glued PVC may release organic contaminants into the well, and therefore, should not be used if the well is to be sampled for organic constituents.

When the water-bearing zone is in consolidated bedrock, such as limestone or fractured granite, a well screen is often not necessary (the well is simply an open hole in bedrock). Unconsolidated materials, such as sands, clay, and silts require a screen. A screen slot size of 0.010 or 0.020 inch is generally used when a screen is necessary, and the annular borehole space around the screened interval is artificially packed with an appropriately sized sand, selected based on formation grain size. The slot size controls the quantity of water entering the well and prevents entry of natural materials or sand pack. The screen shall pass no more than 10 percent of the pack material, or in-situ aquifer material. The site geologist shall specify the combination of screen slot size and sand pack which will be compatible with the water-bearing zone, to maximize groundwater inflow and minimize head losses and movement of fines into the wells. For example, as a standard procedure, a Morie No. 1 or No. 10 to No. 20 U.S. Standard Sieve size filter pack is typically appropriate for a 0.020-inch slot screen; however, a No. 20 to No. 40 U.S. Standard Sieve size filter pack is typically appropriate for a 0.010-inch slot screen.

5.2.3 Annular Materials

Materials placed in the annular space between the borehole and riser pipe and screen include a sand pack when necessary, a bentonite seal, and cement-bentonite grout. The sand pack is usually a medium- to coarse-grained poorly graded, silica sand and should relate to the grain size of the aquifer sediments. The quantity of sand placed in the annular space is dependent upon the length of the screened interval, but should always extend at least 1 foot above the top of the screen. At least 1 to 3 feet of bentonite pellets or equivalent shall be placed above the sand pack. Cement-bentonite grout (or equivalent) is then placed to extent from the top of the bentonite pellets to the ground surface.

On occasion, and with the concurrence of the involved regulatory agencies, monitoring wells may be packed naturally (i.e., no artificial sand pack installed). In this case, the natural formation material is allowed to collapse around the well screen after the well is installed. This method has been used where the formation material itself is a relatively uniform grain size, or when artificial sand packing is not possible due to borehole collapse.

Bentonite expands by absorbing water and provides a seal between the screened interval and the overlying portion of the annular space and formation. Cement-bentonite grout is placed on top of the bentonite pellets, extending to the surface. The grout effectively seals the remaining borehole annulus and eliminates the possibility for surface infiltration reaching the screened interval. Grouting also replaces material removed during drilling and prevents hole collapse and subsidence around the well. A tremie pipe should be used to introduce grout from the bottom upward, to prevent bridging, and to provide a better seal. In shallow boreholes that don't collapse, it may be more practical to pour the grout from the surface without a tremie pipe.

Grout is a general term which has several different connotations. For all practical purposes within the monitoring well installation industry, grout refers to the solidified material which is installed and occupies the annular space above the bentonite pellet seal. Grout, most of the time, is made up of one or two assemblages of material, (e.g., cement and/or bentonite). A cement-bentonite grout, which is the most common type of grout used in monitoring well completions, normally is a mixture of cement, bentonite, and water at a ratio of one 90-pound bag of Portland Type I cement, plus 3 to 5 pounds of granular or flake-type bentonite, and 6-7 gallons of water. A neat cement consists of one ninety-pound bag of Portland Type I cement and 6-7 gallons of water. A bentonite slurry (bentonite and water mixed to a thick but pumpable mixture) is sometimes used instead of grout for deep well installations where placement of bentonite pellets is difficult. Bentonite chips are also occasionally used for annular backfill in place of grout.

In certain cases, the borehole may be drilled to a depth greater than the anticipated well installation depth. For these cases, the well shall be backfilled to the desired depth with bentonite pellets/chips or sand. A short (1- to 2-foot) section of capped riser pipe sump is sometimes installed immediately below the screen, as a silt reservoir, when significant post-development silting is anticipated. This will ensure that the entire screen surface remains unobstructed.

5.2.4 Protective Casing

When the well is completed and grouted to the surface, a protective steel casing is typically placed over the top of the well. This casing generally has a hinged cap and can be locked to prevent vandalism. The protective casing has a larger diameter than the well and is set into the wet cement grout over the well upon completion. In addition, one hole is drilled just above the cement collar through the protective casing which acts as a weep hole for the flow of water which may enter the annulus during well development, purging, or sampling.

A protective casing which is level with the ground surface (flush-mounted) is used in roadway or parking lot applications where the top of a monitoring well must be below the pavement. The top of the riser pipe is placed 4 to 5 inches below the pavement, and a locking protective casing is cemented in place to 3 inches below the pavement. A large diameter, manhole-type protective collar is set into the wet cement around the well with the top set level with or slightly above the pavement. An appropriately-sized id is placed over the protective sleeve. The cement should be slightly mounded to direct pooled water away from the well head.

5.3 Monitoring Well Installation

Pertinent data regarding monitoring well installation shall be recorded on log sheets as depicted and discussed in SOP SA-6.3. Attachments to this referenced SOP illustrate terms and physical construction of various types of monitoring wells.

5.3.1 Monitoring Wells in Unconsolidated Sediments

After the borehole is drilled to the desired depth, well installation can begin. The procedure for well installation will partially be dictated by the stability of the formation in which the well is being placed. If the borehole collapses immediately after the drilling tools are withdrawn, then a temporary casing must be installed and well installation will proceed through the center of the temporary casing, and continue as the temporary casing is withdrawn from the borehole. In the case of hollow-stem auger drilling, the augers will act to stabilize the borehole during well installation.

Before the screen and riser pipe are lowered into the borehole, all pipe and screen sections should be measured with an engineer's rule to ensure proper placement. When measuring sections, the threads on one end of the pipe or screen must be excluded while measuring, since the pipe and screen sections are screwed flush together.

After the screen and riser pipe are lowered through the temporary casing, the sand pack can be installed. A weighted tape measure must be used during the installation procedure to carefully monitor installation progress. The sand is slowly poured into the annulus between the riser pipe and temporary casing, as the casing is withdrawn. Sand should always be kept within the temporary casing during withdrawal in order to ensure an adequate sand pack. However, if too much sand is within the temporary casing (greater than 1 foot above the bottom of the casing) bridging between the temporary casing and riser pipe may occur. Centralizers may be used at the geologist's discretion, one above and one below the screen, to assure enough annular space for sand pack placement.

After the sand pack is installed to the desired depth (at least 1 foot above the top of the screen), then the bentonite pellet seal (or equivalent), can be installed in the same manner as the sand pack. At least 1 to 3 feet of bentonite pellets should be installed above the sand pack. Pellets should be added slowly and their fall monitored closely to ensure that bridging does not occur.

The cement-bentonite grout is then mixed and tremied into the annulus as the temporary casing or augers are withdrawn. Finally, the protective casing can be installed as detailed in Section 5.2.4.

5.3.2 Confining Layer Monitoring Wells

When drilling and installing a well in a confined aquifer, proper well installation techniques must be applied to avoid cross contamination between aquifers. Under most conditions, this can be accomplished by installing double-cased wells. This is accomplished by drilling a large-diameter boring through the upper aquifer, 1 to 5 feet into the underlying confining layer, and setting and pressure grouting or tremie grouting a large-diameter casing into the confining layer. The grout material must fill the space between the native material and the outer casing. A smaller diameter boring is then continued through the confining layer for

installation of the monitoring well as detailed for overburden monitoring wells. Sufficient time (determined by the field geologist), must be allowed for setting of the grout prior to drilling through the confined layer.

5.3.3 Bedrock Monitoring Wells

When installing bedrock monitoring wells, a large diameter boring is drilled through the overburden and approximately 5 –10 feet into bedrock. A casing (typically steel) is installed and either pressure grouted or tremie grouted in place. After the grout has cured, a smaller diameter boring is continued into bedrock to the desired depth. If the boring does not collapse, the well can be left open, and a screen is not necessary. If the boring collapses, then a screen is required and can be installed as detailed for overburden monitoring wells. If a screen is to be used, then the casing which is installed through the overburden and into the bedrock does not require grouting and can be removed when the final well installation is completed.

5.3.4 Drive Points

Drive points can be installed with either a sledge hammer, drop hammer, or a mechanical vibrator. The screen section is threaded and tightened onto the riser pipe with pipe wrenches. The drive point is simply pounded into the subsurface to the desired depth. If a heavy drop hammer is used, then a tripod and pulley setup is required to lift the hammer. Drive points typically cannot be manually driven to depths exceeding 10 feet.

Direct push sampling/monitoring point installation methods, using a direct push rig or drilling rig, are described in SOP SA-2.5.

5.3.5 Innovative Monitoring Well Installation Techniques

Certain innovative sampling devices have proven advantageous. These devices are essentially screened samplers installed in a borehole with only small-diameter tubes extending to the surface. This reduces drilling costs, decreases the volume of stagnant water, and provides a sampling system that minimizes cross-contamination from sampling equipment. Four manufacturers of these samplers include Timco Manufacturing Company, Inc., of Prairie du Sac, Wisconsin, BARCAD Systems, Inc., of Concord, Massachusetts, Westbay Instruments Ltd. of Vancouver, British Columbia, Canada and the University of Waterloo at Waterloo, Ontario, Canada.. Each manufacturer offers various construction materials.

5.4 Well Development Methods

The purpose of well development is to stabilize and increase the permeability of the gravel pack around the well screen, and to restore the permeability of the formation which may have been reduced by drilling operations. Wells are typically developed until all fine material and drilling water is removed from the well. Sequential measurements of pH, conductivity, turbidity, and temperature taken during development may yield information (stabilized values) regarding whether sufficient development has been performed. The selection of the well development method shall be made by the field geologist and is based on the drilling methods, well construction and installation details, and the characteristics of the formation that the well is screened in. The primary methods of well development are summarized below. A more detailed discussion may be found in Driscoll (1986).

5.4.1 Overpumping and Backwashing

Wells may be developed by alternatively drawing the water level down at a high rate (by pumping or bailing) and then reversing the flow direction (backwashing) so that water is passing from the well into the formation. This back and forth movement of water through the well screen and gravel pack serves to

remove fines from the formation immediately adjacent to the well, while preventing bridging (wedging) of sand grains. Backwashing can be accomplished by several methods, including pouring water into the well and then bailing, starting and stopping a pump intermittently to change water levels, or forcing water into the well under pressure through a water-tight fitting ("rawhiding"). Care should be taken when backwashing not to apply too much pressure, which could damage or destroy the well screen.

5.4.2 Surging with a Surge Plunger

A surge plunger (also called a surge block) is approximately the same diameter as the well casing and is aggressively moved up and down within the well to agitate the water, causing it to move in and out of the screens. This movement of water pulls fine materials into the well, where they may be removed by any of several methods, and prevents bridging of sand particles in the gravel pack. There are two basic types of surge plungers; solid and valved surge plungers. In formations with low yields, a valved surge plunger may be preferred, as solid plungers tend to force water out of the well at a greater rate than it will flow back in. Valved plungers are designed to produce a greater inflow than outflow of water during surging.

5.4.3 Compressed Air

Compressed air can be used to develop a well by either of two methods: backwashing or surging. Backwashing is done by forcing water out through the screens, using increasing air pressure inside a sealed well, then releasing the pressurized air to allow the water to flow back into the well. Care should be taken when using this method so that the water level does not drop below the top of the screen, thus introducing air into the formation and reducing well yield. Surging, or the "open well" method, consists of alternately releasing large volumes of air suddenly into an open well below the water level to produce a strong surge by virtue of the resistance of water head, friction, and inertia. Pumping of the well is subsequently done using the air lift method.

5.4.4 High Velocity Jetting

In the high velocity jetting method, water is forced at high velocities from a plunger-type device and through the well screen to loosen fine particles from the sand pack and surrounding formation. The jetting tool is slowly rotated and raised and lowered along the length of the well screen to develop the entire screened area. Jetting using a hose lowered into the well may also be effective. The fines washed into the screen during this process can then be bailed or pumped from the well.

6.0 RECORDS

A critical part of monitoring well installation is recording of all significant details and events in the site logbook or field notebook. The geologist must record the exact depths of significant hydrogeological features, screen placement, gravel pack placement, and bentonite placement.

A Monitoring Well Sheet (see Attachments to SOP SA-6.3) shall be completed, ensuring the uniform recording of data for each installation and rapid identification of missing information. Well depth, length, materials of construction, length and openings of screen, length and type of riser, and depth and type of all backfill materials shall be recorded. Additional information shall include location, installation date, problems encountered, water levels before and after well installation, cross-reference to the geologic boring log, and methods used during the installation and development process. Documentation is very important to prevent problems involving questionable sample validity. Somewhat different information will need to be recorded, depending on whether the well is completed in overburden (single- or double-cased), as a cased well in bedrock, or as an open hole in bedrock.

The quantities of sand, bentonite, and grout placed in the well are also important. The geologist shall calculate the annular space volume and have an idea of the quantity of material needed to fill the annular

space. Volumes of backfill significantly higher than the calculated volume may indicate a problem such as a large cavity, while a smaller backfill volume may indicate a cave-in or bridging of the backfill materials. Any problems with rig operation or down-time shall be recorded and may affect the driller's final fee.

7.0 REFERENCES

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ATTACHMENT A

RELATIVE COMPATIBILITY OF RIGID WELL CASING MATERIAL (PERCENT)

Potentially-Deteriorating Substance	Type of Casing Material						
	PVC 1	Galvanized Steel	Carbon Steel	Lo-carbon Steel	Stainless Steel 304	Stainless Steel 316	Teflon*
Buffered Weak Acid	100	56	51	59	97	100	100
Weak Acid	98	59	43	47	96	100	100
Mineral Acid/ High Solids Content	100	48	57	60	80	82	100
Aqueous/Organic Mixtures	64	69	73	73	98	100	100
Percent Overall Rating	91	58	56	59	93	96	100

Preliminary Ranking of Rigid Materials:

1 Teflon®
2 Stainless Steel 316
3. Stainless Steel 304
4 PVC 1
5 Lo-Carbon Steel
6 Galvanized Steel
7 Carbon Steel

* Trademark of DuPont

RELATIVE COMPATIBILITY OF SEMI-RIGID OR ELASTOMERIC MATERIALS (PERCENT)

Potentially-Deteriorating Substance	Type of Casing Material								
	PVC Flexible	PP	PE Conv.	PE Linear	PMM	Viton®*	Silicone	Neoprene	Teflon®*
Buffered Weak Acid	97	97	100	97	90	92	87	85	100
Weak Acid	92	90	94	96	78	78	75	75	100
Mineral Acid/ High Solids Content	100	100	100	100	95	100	78	82	100
Aqueous/Organic Mixtures	62	71	40	60	49	78	49	44	100
Percent Overall Rating	88	90	84	88	78	87	72	72	100

Preliminary Ranking of Semi-Rigid or Elastomeric Materials:

1 Teflon®
2 Polypropylene (PP)
3. PVC Flexible/PE Linear
4 Viton®
5 PE Conventional
6 Plexiglas/Lucite (PMM)
7 Silicone/Neoprene

* Trademark of DuPont

Source: Barcelona et al., 1983

ATTACHMENT B

COMPARISON OF STAINLESS STEEL AND PVC FOR MONITORING WELL CONSTRUCTION

Characteristic	Stainless Steel	PVC
Strength	Use in deep wells to prevent compression and closing of screen/riser.	Use when shear and compressive strength are not critical.
Weight	Relatively heavier.	Light-weight; floats in water.
Cost	Relatively expensive.	Relatively inexpensive.
Corrosivity	Deteriorates more rapidly in corrosive water.	Non-corrosive -- may deteriorate in presence of ketones, aromatics, alkyl sulfides, or some chlorinated hydrocarbons.
Ease of Use	Difficult to adjust size or length in the field.	Easy to handle and work with in the field.
Preparation for Use	Should be steam cleaned if organics will be subsequently sampled.	Never use glue fittings -- pipes should be threaded or pressure fitted. Should be steam cleaned when used for monitoring wells.
Interaction with Contaminants*	May sorb organic or inorganic substances when oxidized.	May sorb or release organic substances.

* See also Attachment A.

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

2.0 SCOPE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.

3.0 GLOSSARY

Hazardous Material - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

Hazardous Waste - Any substance listed in 40 CFR, Subpart D (~~y~~261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (~~y~~261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

Marking - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

n.o.i - Not otherwise indicated (may be used interchangeably with n.o.s.).

n.o.s. - Not otherwise specified.

Packaging - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

Placard - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H_2SO_4
- Nitric Acid - HNO_3
- Sodium Hydroxide - NaOH

Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate - $Na_2S_2O_3$

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

4.0 RESPONSIBILITIES

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

5.0 PROCEDURES

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

5.1 Sample Containers

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

5.2 Sample Preservation

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological

changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4°C. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO_3, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4°C, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

The FOL is responsible for ensuring that an accurate Chemical Inventory is created and maintained for all hazardous chemicals brought to the work site (see Section 5 of the TtNUS Health and Safety Guidance Manual). Furthermore, the FOL must ensure that a corresponding Material Safety Data Sheet (MSDS) is collected for every substance entered on the site Chemical Inventory, and that all persons using/handling/ disposing of these substances review the appropriate MSDS for substances they will work with. The Chemical Inventory and the MSDSs must be maintained at each work site in a location and manner where they are readily-accessible to all personnel.

5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H_2SO_4)	1 part concentrated H_2SO_4: 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO_3)	Undiluted concentrated HNO_3	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.

- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).

- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

  If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

  Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

  The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

  The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

  If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

  Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory before sampling begins.

5.3 Field Filtration

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed prior to the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).

- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter and discard prior to sample collection.

- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

5.4 Sample Packaging and Shipping

Only employees who have successfully completed the TtNUS "Shipping Hazardous Materials" training course are authorized to package and ship hazardous substances. These trained individuals are responsible for performing shipping duties in accordance with this training.

Samples collected for shipment from a site shall be classified as either environmental or hazardous material samples. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)

- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental samples are outlined in the remainder of this section.

5.4.1 Environmental Samples

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.

- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic bag (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.

- Pack with enough cushioning materials such as bubble wrap (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.

- If cooling is required (see Attachments A and B), place ice around sample container shoulders, and on top of packing material (minimum of 8 pounds of ice for a medium-size cooler).

- Seal (i.e., tape or tie top in knot) large liner bag.

- The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing the vials for VOC analysis. The COC form should then state how many coolers are included with that shipment.

- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

6.0 REFERENCES

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

ATTACHMENT A

GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample Type and Concentration			Container[1]	Sample Size	Preservation[2]	Holding Time[2]
WATER						
Organics (GC&GC/MS)	VOC	Low	Borosilicate glass	2 x 40 mL	Cool to 4°C HCl to ≤ 2	14 days[9]
	Extractables SVOCs and pesticide/PCBs)	(Low	Amber glass	2x2 L or 4x1 L	Cool to 4°C	7 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticide/PCBs)	(Medium	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals	Low	High-density polyethylene	1 L	HNO_3 to pH ≤2	6 months (Hg-28 days)
		Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide	Low	High-density polyethylene	1 L	NaOH to pH>12	14 days
	Cyanide	Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	14 days
SOIL						
Organics (GC&GC/MS)	VOC		EnCore Sampler	(3) 5 g Samplers	Cool to 4°C	48 hours to lab preservation
	Extractables SVOCs and pesticides/PCBs)	(Low	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs)	(Medium	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium		Wide-mouth glass	8 oz.	Cool to 4°C	6 months (Hg - 28 days) Cyanide (14 days)
Organic/Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All		Wide-mouth glass	4 oz.	None	35 days until extraction; 40 days after extraction
TCLP	All		Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction
AIR						
Volatile Organics	Low/Medium		Charcoal tube -- 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4°C	5 days recommended

1 All glass containers should have Teflon cap liners or septa.
2 See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

ATTACHMENT B

ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container[1]	Preservation[2][3]	Maximum Holding Time[4]
INORGANIC TESTS:			
Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia - Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4°C; NaOH to pH 12; 0.6 g ascorbic acid[5]	14 days[6]
Fluoride	P	None required	28 days
Hardness	P, G	HNO_3 to pH 2; H_2SO_4 to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4°C	48 hours
Oil & Grease	G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4°C; HCl or H_2SO_4 to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable (TDS)	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days

ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
PAGE TWO

Parameter Number/Name	Container[1]	Preservation[2][3]	Maximum Holding Time[4]
INORGANIC TESTS (Cont'd):			
Sulfide	P, G	Cool, 4°C; add zinc acetate plus sodium hydroxide to pH 9	7 days
Sulfite	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4°C	48 hours
METALS:[7]			
Chromium VI (Hexachrome)	P, G	Cool, 4°C	24 hours
Mercury (Hg)	P, G	HNO_3 to pH 2	28 days
Metals, except Chromium VI and Mercury	P, G	HNO_3 to pH 2	6 months
ORGANIC TESTS:[8]			
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5] HCl to pH 2 [9]	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5] adjust pH to 4-5 [10]	14 days
Phenols[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
Benzidines[11], [12]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction[13]
Phthalate esters[11]	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitrosamines[11], [14]	G, Teflon-lined cap	Cool, 4°C; store in dark; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
PCBs[11]	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitroaromatics & Isophorone[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]; store in dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons (PAHs)[11],[14]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]; store in dark	7 days until extraction; 40 days after extraction
Haloethers[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
Dioxin/Furan (TCDD/TCDF)[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction

ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
PAGE THREE

(1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.
(2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
(3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).
(4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods, and has received a variance from the Regional Administrator.
(5) Should only be used in the presence of residual chlorine.
(6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
(7) Samples should be filtered immediately on site before adding preservative for dissolved metals.
(8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
(9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.
(10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.
(11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
(12) If 1,2-diphenylthydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.
(13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
(14) For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.
(15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs, and reports generally initiated and maintained for documenting Tetra Tech NUS, Inc. (TtNUS) field activities.

2.0 SCOPE

Documents presented within this SOP (or equivalents) shall be used for all TtNUS field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager (PM) - The PM is responsible for obtaining hardbound controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

Field Operations Leader (FOL) - The FOL is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports included in this SOP (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time frame.

General personnel qualifications for field documentation activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for documentation, handling, packaging, and shipping.

5.0 PROCEDURES

5.1 SITE LOGBOOK

5.1.1 General

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. At a minimum, record or reference the following activities/events (daily) in the site logbook:

- All field personnel present
- Arrival/departure times and names of site visitors
- Times and dates of health and safety training
- Arrival/departure times of equipment
- Times and dates of equipment calibration

- Start and/or completion of borehole, trench, monitoring well installation activities, etc.
- Daily on-site activities
- Sample pickup information
- Health and safety issues (level of protection, personal protective equipment [PPE], etc.)
- Weather conditions

Maintain a site logbook for each project and initiate it at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Make entries every day that on-site activities take place involving TtNUS or subcontractor personnel. Upon completion of the fieldwork, provide the site logbook to the PM or designee for inclusion in the project's central file.

Record the following information on the cover of each site logbook:

- Project name
- TtNUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2) but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, either record the measurements and equipment used in the site logbook or reference the field notebook in which the measurements are recorded (see Attachment A).

Make all logbook, notebook, and log sheet entries in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, cross out the entry with a single strike mark, initial, and date it. At the completion of entries by any individual, the logbook pages used must be signed and dated by the person making the entries. The site logbook must also be signed by the FOL at the end of each day.

5.1.2 Photographs

Sequentially number movies, slides, or photographs taken of a site or any monitoring location to correspond to logbook/notebook entries. Enter the name of the photographer, date, time, site location, site description, and weather conditions in the logbook/notebook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook/notebook. If possible, such techniques shall be avoided because they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend on the subject matter, type of camera (digital or film), and the processing it requires. Follow chain-of-custody procedures for film used for aerial photography, confidential information, or criminal investigation. After processed, consecutively number the slides of photographic prints and label them according to the logbook/notebook descriptions. Docket the site photographs and associated negatives and/or digitally saved images to compact disks into the project's central file.

5.2 FIELD NOTEBOOKS

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a

separate field notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a field notebook.

5.3 FIELD FORMS

All TtNUS field forms (see list in Section 6.0 of this SOP) can be found on the company's intranet site (http://intranet.ttnus.com) under Field Log Sheets. Forms may be altered or revised for project-specific needs, subject to client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOPs.

5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results

5.3.1.1 Sample Log Sheet

Sample log sheets are used to record specified types of data while sampling. The data recorded on these sheets are useful in describing the sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. Complete a sample log sheet for each sample obtained, including field quality control (QC) samples.

5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B. Complete the required information on the adhesive labels and apply them to every sample container. Obtain sample labels from the appropriate program/project source, request that they be electronically generated in house, or request them the laboratory subcontractor.

5.3.1.3 Chain-of-Custody Record

The chain-of-custody record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used as follows for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site:

- Retain one carbonless copy of the completed chain-of custody form in the field.
- Send one copy is sent to the PM (or designee)
- Send the original to the laboratory with the associated samples. Place the original (top, signed copy) of the chain-of custody form inside a large Ziploc®-type bag taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one chain-of custody form, send the form with the cooler containing vials for volatile organic compound (VOC) analysis or the cooler with the air bill attached. Indicate on the air bill how many coolers are included with that shipment.

An example of a chain-of-custody form is provided as Attachment C. After the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed chain-of custody form (any discrepancies between the sample labels and chain-of custody form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the TtNUS PM). The chain-of custody form is signed and copied. The laboratory will retain the copy, and the original becomes part of the samples' corresponding analytical data package.

5.3.1.4 Chain-of-Custody Seal

Attachment D is an example of a custody seal. The custody seal is an adhesive-backed label that is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. Sign and date custody seals

and affix them across the lid and body of each cooler (front and back) containing environmental samples (see SOP SA-6.1). Obtain custody seals from the laboratory (if available) or purchase them from a supplier.

5.3.1.5 Geochemical Parameters Log Sheets

Complete Field Analytical Log Sheets to record geochemical and/or natural attenuation field test results.

5.3.2 Hydrogeological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

Complete a Groundwater Level Measurement Sheet for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. Use a Pumping Test Data Sheet to facilitate this task by standardizing the data collection format for the pumping well and observation wells, and allowing the time interval for collection to be established in advance.

5.3.2.3 Packer Test Report Form

Complete a Packer Test Report Form for each well at which a packer test is conducted.

5.3.2.4 Boring Log

Complete a Summary Log of Boring, or Boring Log for each soil boring performed to document the materials encountered, operation and driving of casing, and locations/depths of samples collected. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a photoionization detector [PID] or flame ionization detector [FID]), enter these readings on the boring log at the appropriate depth. When they become available, enter the laboratory sample number, concentrations of key contaminants, or other pertinent information in the "Remarks" column. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

Complete a Monitoring Well Construction Details Form for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock, stick-up or flush mount), different forms are used.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log must be filled out by the responsible field geologist or sampling technician.

5.3.2.7 Miscellaneous Monitoring Well Forms

Miscellaneous monitoring well forms that may be required on a project-specific basis include the Monitoring Well Materials Certificate of Conformance and Monitoring Well Development Record. Use a Monitoring Well Materials Certificate of Conformance to document all materials utilized during each monitoring well installation. Use a Monitoring Well Development Record to document all well development activities.

5.3.2.8 Miscellaneous Field Forms – Quality Assurance and Checklists

Miscellaneous field forms/checklists forms that may be required on a project-specific basis include the following:

- Container Sample and Inspection Sheet – use this form when a container (drum, tank, etc.) is sampled and/or inspected.
- QA Sample Log Sheet – use this form when a QA sample such as an equipment rinsate blank, source blank, etc. is collected.
- Field Task Modification Request (FTMR) – use this form to document deviations from the project planning documents. The FOL is responsible for initiating the FTMRs. Maintain copies of all FTMRs with the on-site planning documents, and place originals in the final evidence file.
- Field Project Daily Activities Checklist and Field Project Pre-Mobilization Checklist – used these during both the planning and field effort to ensure that all necessary tasks are planned for and completed. These two forms are not requirements but are useful tools for most field work.

5.3.3 Equipment Calibration and Maintenance Form

The calibration or standardization of monitoring, measuring, or test equipment is necessary to ensure the proper operation and response of the equipment, to document the accuracy, precision, or sensitivity of the measurements, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log, which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. Maintain an Equipment Calibration Log for each electronic measuring device used in the field; make entries for each day the equipment is used or in accordance with manufacturer recommendations.

5.4 FIELD REPORTS

The primary means of recording on-site activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation but are not easily used for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain on site for extended periods of time and are thus not accessible for timely review by project management. Other reports useful for tracking and reporting the progress of field activities are described below.

5.4.1 Daily Activities Report

To provide timely oversight of on-site contractors, complete and submit Daily Activities Reports (DARs) as described below.

5.4.1.1 Description

The DAR documents the activities and progress for each day's field work. Complete this report on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring that involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors. The DAR form can be found on the TtNUS intranet site.

5.4.1.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.4.1.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the DAR to the FOL for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DARs are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the PM.

5.4.2 Weekly Status Reports

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

In addition to those described herein, other summary reports may also be contractually required.

All TtNUS field forms can be found on the company's intranet site at http://intranet.ttnus.com under Field Log Sheets.

6.0 LISTING OF FIELD FORMS ON THE TtNUS INTRANET SITE

- Boring Log
- Container Sample and Inspection Sheet
- Daily Activities Checklist
- Daily Activities Record
- Equipment Calibration Log
- Field Task Modification Request
- Field Analytical Log sheet - Geochemical Parameters
- Groundwater Level Measurement Sheet
- Groundwater Sample Log Sheet
- Hydraulic Conductivity Test Data Sheet
- Low Flow Purge Data Sheet
- Bedrock Monitoring Well Construction (Stick Up)
- Bedrock Monitoring Well Construction Flush Mount
- Bedrock Monitoring Well Construction Open Hole
- Confining Layer Monitoring Well Construction
- Monitoring Well Development Record

- Monitoring Well Materials Certificate of Conformance
- Overburden Monitoring Well Construction Flush Mount
- Overburden Monitoring Well Construction Stick Up
- Packer Test Report Form
- Pumping Test Data Sheet
- QA Sample Log Sheet
- Soil/Sediment Sample Log Sheet
- Surface Water Sample Log Sheet
- Test Pit Log
- Field Project Pre-Mobilization Checklist

ATTACHMENT A
TYPICAL SITE LOGBOOK ENTRY

START TIME: _____ DATE: _____

SITE LEADER: _____
PERSONNEL:

TtNUS	DRILLER	SITE VISITORS
_____	_____	_____
_____	_____	_____
_____	_____	_____

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenney and fire hoses were set up.
2. Drilling activities at well ____ resumes. Rig geologist was _____. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well _____.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _____.
4. Well _____ drilled. Rig geologist was _____. See Geologist's Notebook, No. 2, page ____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manger arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _____.
8. Test pit _____ dug with cuttings placed in dump truck. Rig geologist was _____. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit ___ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

_____

Field Operations Leader

ATTACHMENT B
SAMPLE LABEL

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	Project: Site: Location:		
Sample No:			Matrix:
Date:	Time:	Preserve:	
Analysis:			
Sampled by:	Laboratory:		

ATTACHMENT C
CHAIN-OF-CUSTODY RECORD FORM

TETRA TECH NUS, INC.

CHAIN OF CUSTODY | NUMBER 3413 | PAGE ___ OF ___

PROJECT NO: | FACILITY: | PROJECT MANAGER | PHONE NUMBER | LABORATORY NAME AND CONTACT:

SAMPLERS (SIGNATURE) | FIELD OPERATIONS LEADER | PHONE NUMBER | ADDRESS

CARRIER/WAYBILL NUMBER | CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAP (G) COMP (C)	No. OF CONTAINERS	CONTAINER TYPE PLASTIC (P) or GLASS (G) / PRESERVATIVE USED / TYPE OF ANALYSIS	COMMENTS

	DATE	TIME
1. RELINQUISHED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME

	DATE	TIME
1. RECEIVED BY	DATE	TIME
2. RECEIVED BY	DATE	TIME
3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

FORM NO. TtNUS-001 4/02R

ATTACHMENT D
CHAIN-OF-CUSTODY SEAL

CUSTODY SEAL	**CUSTODY SEAL**
Date	**Date**
Signature	**Signature**

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1.0 PURPOSE

Decontamination is the process of removing and/or neutralizing site contaminants that have contacted and/or accumulated on equipment. The purpose of this Standard Operating Procedure (SOP) is to protect site personnel, the general public, and the environment while preserving or maintaining sample integrity. It is further intended through this procedure to describe the steps necessary for proper decontamination of drilling equipment, earth-moving equipment , chemical sampling equipment and field operation and analytical equipment.

2.0 SCOPE AND APPLICABILITY

This procedure applies to all equipment used to provide access to/acquire environmental samples that may have become contaminated through direct contact with contaminated media including air, water, and soil. This equipment includes drilling and heavy equipment and chemical sampling and field analytical equipment. Where technologically and economically feasible, single-use sealed disposable equipment will be employed to minimize the potential for cross-contamination. This SOP also provides general reference information on the control of contaminated materials.

Decontamination methods and equipment requirements may differ from one project to another. General equipment items are specified in Section 6.0, but project-specific equipment must be obtained to address the project-specific decontamination procedures presented in Section 7.0 and applicable subsections.

3.0 GLOSSARY

Alconox/Liquinox - A brand of phosphate-free laboratory-grade detergent.

Decontamination Solution - A solution selected/identified in the Health and Safety Plan or Project-Specific Quality Assurance Plan. The solution is selected and employed as directed by the project chemist/health and safety professional.

Deionized Water (DI) - Tap water that has been treated by passing through a standard deionizing resin column. This water may also pass through additional filtering media to attain various levels of analyte-free status. The DI water should meet College of American Pathologists (CAP) and National Committee for Clinical Laboratory Standards (NCCLS) specifications for reagent-grade Type I water.

Potable Water - Tap water from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

Pressure Washing - Process employing a high-pressure pump and nozzle configuration to create a high-pressure spray of potable water. High-pressure spray is employed to remove solids from equipment.

Solvent – A liquid in which solid chemicals or other liquids are dissolved. The solvent of choice is pesticide-grade isopropanol. Use of other solvents (methanol, acetone, or hexane) may be required for particular projects or for a particular purpose (e.g., removal of concentrated waste) and must be justified in the project planning documents. For example, it may be necessary to use hexane when analyzing for trace levels of pesticides, PCBs, or fuels. In addition, because many of these solvents are not miscible in water, the equipment should be air dried prior to use. Solvents should not be used on PVC equipment or well construction materials.

Steam Pressure Washing - A cleaning method employing a high-pressure spray of heated potable water to remove various organic/inorganic chemicals from equipment.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Decontamination Personnel - Individuals assigned the task of decontamination. It is the responsibility of these individuals to understand the use and application of the decontamination process and solutions as well as the monitoring of that process to ensure that it is working properly. This is accomplished through visual evaluation, monitoring instrument scanning of decontaminated items, and/or through the collection of rinsate blanks to verify contaminant removal.

Field Operations Leader (FOL) - Responsible for the implementation of project-specific planning documents. This includes on-site verification that all field activities are performed in compliance with approved SOPs or as otherwise dictated by the approved project plan(s). The FOL is also responsible for the completion and accuracy of all field documentation.

Site Safety Officer (SSO) - Exercises shared responsibility with the FOL concerning decontamination effectiveness. All equipment arriving on site (as part of the equipment inspection), leaving the site, and moving between locations is required to go through a decontamination evaluation. This is accomplished through visual examination and/or instrument screening to determine the effectiveness of the decontamination process. Improper or incomplete decontamination is sufficient to restrict equipment from entering the site, exiting the site, or moving to a new location on the site until the objectives are successfully completed.

General personnel qualifications for decontamination activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate decontamination procedures.

5.0 HEALTH AND SAFETY

In addition to the health and safety issues and reminders specified in subsections of this SOP, the following considerations and requirements must be observed as SOPs for field equipment decontamination activities:

- If any solvents or hazardous chemicals (e.g., isopropyl alcohol) are to be used in equipment decontamination activities, the FOL must first obtain the manufacturer's/supplier's Material Safety Data Sheet (MSDS) and assure that it is reviewed by all users (prior to its use), added to the site Hazardous Chemical Inventory, and maintained on site as part of the project Hazard Communication Program.
- Review and observe specific health and safety requirements (e.g., personal protective equipment [PPE]) specified in the project-specific health and safety plan for this activity.

6.0 EQUIPMENT LIST

- Wood for decontamination pad construction, when applicable (see Section 7.1).

- Tools for constructing decontamination pad frame, when applicable (see Section 7.1).
- Visqueen sheeting or comparable material to cover decontamination pad frame, when applicable (see Section 7.1).
- Wash/drying racks for auger flights and drill/drive rods, when applicable (see Section 7.2).
- PPE as specified in the project health and safety plan.
- Soap and water for washing and rinsing.
- Deionized water for final rinsing.
- Solvents (e.g., pesticide-grade isopropanol) for rinsing (see applicable portions of Section 7.2).
- Tubs, buckets, etc. for containerizing rinse water (see applicable portions of Section 7.2).
- Sample bottles for collecting rinsate blanks (see Section 7.2).
- Calibrated photoionization detector (PID) or flame ionization detector (FID) to monitor decontaminated equipment for organic vapors generated through the existence of residual contamination or the presence of decontamination solvent remaining after the piece was rinsed.
- Aluminum foil or clear clean plastic bag for covering cleaned equipment (see applicable portions of Section 7.2).
- Paper towels or cloths for wiping.
- Brushes, scrapers, or other hand tools useful for removing solid materials from equipment.
- Clear plastic wrap for covering or wrapping large decontaminated equipment items (see Section 7.2.2).
- Drum-moving equipment for moving filled waste drums (optional) (see Section 7.3).
- Drum labels for waste drums (see Attachment A).

7.0 PROCEDURES

The process of decontamination is accomplished through the removal of contaminants, neutralization of contaminants, or isolation of contaminants. To accomplish this activity, preparation is required including site preparation, equipment selection, and evaluation of the decontamination requirements and processes. Site contaminant types, concentrations, and media types are primary drivers in the selection of the types of decontamination and where it will be conducted. For purposes of this SOP, discussion is limited to decontamination procedures for general environmental investigations.

Decontamination processes will be performed at the location(s) specified in project-specific planning documents. Typical decontamination locations include the following:

- Temporary decontamination pads/facilities
- Sample locations
- Centralized decontamination pad/facilities

- Combination of some or all of the above

The following discussion includes general considerations for the decontamination process. Specific construction and implementation procedures will be as specified in the project-specific planning documents and/or may be as dictated by site-specific conditions as long as the intent of the requirements in the planning documents is met. This intent is to contain any residual fluids and solids generated through the decontamination process.

7.1 Decontamination Pad Design/Construction Considerations

7.1.1 Temporary Decontamination Pads

Temporary decontamination pads may be constructed at satellite locations within the site area in support of temporary work areas. These structures are generally constructed to support the decontamination of heavy equipment such as drill rigs and earth-moving equipment but can be employed for smaller articles.

The purpose of the decontamination pad is to contain wash waters and potentially contaminated soil generated during decontamination procedures. Therefore, construction of these pads should take into account the following considerations:

- Site location – The decontamination site selected should be far enough from the work site to maximize decontamination effectiveness while minimizing travel distance. The location of the decontamination site shall be selected to provide, in the judgment of the FOL or FOL designee, compliance with as many of the following characteristics as practicable:

  - Well removed from pedestrian/vehicle thoroughfares.

  - Avoidance of areas where control/custody cannot be maintained.

  - Avoidance of areas where potential releases of contaminated media or decontamination fluids may be compounded through access to storm water transport systems, streams, or other potentially sensitive areas.

  - Avoidance of potentially contaminated areas.

  - Avoidance of areas too close to the ongoing operation, where cross-contamination may occur.

  The selected decontamination site should include the following, where possible:

  - Areas where potable water and electricity are provided.

> ***Safety Reminder***
>
> When utilizing electrical power sources, either hard-wired or portable-generated sources, ensure that:
>
> - All power is routed through a Ground Fault Circuit Interrupter (GFCI).
>
> - All power cords are in good condition (no physical damage), rated for the intended energy load, and designated for outdoor use.
>
> In situations where accomplishing these elements is not possible, it will be necessary to implement a site electrical grounding program.

- Areas where support activities such as removing decontamination waters soil and sediment are possible without entering an active exclusion zone.

- Areas that offer sufficient size to carry out the specific decontamination sequence.

- Decontamination pad (decon pad) – The decon pad shall be constructed to meet the following characteristics:

  - Size – The size of the pad should be sufficient to accept the equipment to be decontaminated as well as permitting free movement around the equipment by the personnel conducting the decontamination. The size should permit these movements utilizing pressure/steam washer wands and hoses and minimizing splash due to work in close quarters.

  - Slope – An adequate slope will be constructed to permit the collection of water and potentially contaminated soil within a trough or sump constructed at one end. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks. Because the pad will be sloped, place a light coating of sand over the plastic to minimize potential slips and falls. See the text about liners below.

  - Sidewalls – The sidewalls shall be at least 6 inches in height (or as high as possible if 6 inches is not achievable) to provide adequate containment for wash waters and soil. If splash represents a potential problem, splash guards should be constructed to control overspray. Sidewalls may be constructed of wood, inflatables, sand bags, etc. to permit containment. Splash guards are typically wood frames with Visqueen coverings to control overspray.

  - Liner – Depending on the types of equipment and decontamination method to be used, the liner should be of sufficient thickness to provide a puncture-resistant barrier between the decontamination operation and the unprotected environment. Care should be taken to examine the surface area prior to placing the liner to remove sharp articles (sticks, stones, debris) that could puncture the liner. Liners are intended to form an impermeable barrier. The thickness may vary from a minimum recommended thickness of 10 mil to 30 mil. The desired thickness may be achieved through layering materials of lighter construction. It should be noted that various materials (rubber, polyethylene sheeting) become slippery when wet. To minimize this potential hazard associated with a sloped liner, a light coating of sand shall be applied to provide traction as necessary.

  - Wash/drying racks – Auger flights, drill/drive rods, and similar equipment require racks positioned off of the ground to permit these articles to be washed, drained, and dried while secured from falling during this process.

For decontamination of direct-push technology (DPT) equipment, the pad may be as simple as a mortar tub containing buckets of soapy water for washing and an empty bucket to capture rinse waters. Decontamination may be conducted at the rear of the rig to permit rapid tool exchange.

- Maintenance – Maintain the decontamination area by:

  - Periodically clearing the work area of standing water, soil, and debris, and coiling hoses to aid in eliminating slip, trip, and fall hazards. In addition, these articles will reduce potential backsplash and cross-contamination.

- Regularly changing the decontamination fluids to ensure proper cleaning and prevent cross-contamination.

- PPE – Periodically evaluate the condition of, and maintain the decontamination equipment, including regular cleaning of face shields and safety glasses. This is critical to ensuring the safety of decontamination personnel and the integrity of the decontamination process, and it will ensure that equipment is functioning properly.

7.1.2 Decontamination Activities at Drill Rigs/DPT Units

During subsurface sampling activities including drilling and DPT activities, decontamination of drive rods, Macro Core Samplers, split spoons, etc. is typically conducted at an area adjacent to the operation. Decontamination is generally accomplished using a soap/water wash and rinse utilizing buckets and brushes. This area requires sufficient preparation to accomplish the decontamination objectives.

Buckets shall be placed within mortar tubs or similar secondary containment tubs to prevent splash and spills from reaching unprotected environmental media. Drying racks shall be employed as directed for temporary pads to permit parts to dry and be evaluated prior to use/reuse. Methodology regarding this activity is provided in Section 7.2.

7.1.3 Decontamination Activities at Remote Sample Locations

When sampling at remote locations, sampling equipment such as trowels and pumps/tubing should be evacuated of potentially contaminated media to the extent possible. This equipment should be wrapped in plastic for transport to the temporary/centralized decontamination location for final cleaning and disposition. Flushing and cleaning of single-use equipment such as disposable trowels, tubing, and surgeon's gloves may allow disposal of this equipment after visible soil and water remnants have been removed.

7.2 Equipment Decontamination Procedures

The following represents procedures to be employed for the decontamination of equipment that may have contacted and/or accumulated contamination through site investigation activities.

7.2.1 Monitoring Well Sampling Equipment

7.2.1.1 Groundwater sampling equipment – This includes pumps inserted into monitoring wells such as bladder pumps, Whale pumps, and Redi-Flo pumps and reusable bailers, etc.

1. Evacuate to the extent possible, any purge water within the pump/bailer.

2. Scrub using soap and water and/or steam clean the outside of the pump/bailer and, if applicable, the pump tubing.

3. Insert the pump and tubing/bailer into a clean container of soapy water. Pump/run a sufficient amount of soapy water through the pump/bailer to flush out any residual well water. After the pump is flushed, circulate soapy water through the pump to ensure that the internal components are thoroughly flushed.

4. Remove the pump and tubing/bailer from the container

5. Rinse external pump components using tap water.

6. Insert the pump and tubing/bailer into a clean container of tap water. Pump/run a sufficient amount of tap water through the pump/bailer to evacuate all of the soapy water (until clear).

> ***CAUTION***
> Do not rinse PE, PVC, and associated tubing with solvents –
> Use the procedures defined in the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 7 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

7. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment to be cleaned with pesticide-grade isopropanol.

8. Pass deionized water through the hose to flush out the tap water and solvent residue as applicable.

9. Drain residual deionized water to the extent possible.

10. Allow components of the equipment to air dry.

11. For bladder pumps, disassemble the pump and wash the internal components with soap and water, then rinse with tap water, isopropanol, and deionized water and allow to dry. After the parts are dry, conduct a visual inspection and a monitoring instrument scan to ensure that potential contaminants and all decontamination solvent have been removed. Collect a rinsate blank in accordance with the project-specific planning documents to ensure that the decontamination process is functioning as intended. The typical frequency of collection for rinsate blanks is 1 per 20 field samples. In addition, wipe samples or field tests such as UV light may be used.

12. Wrap pump/bailer in aluminum foil or a clear clean plastic bag for storage.

> ***SAFETY REMINDER***
> Remember when handling powered equipment to disconnect the power source and render the equipment to a zero energy state (both potential and kinetic) before opening valves, disconnecting lines, etc.

7.2.1.2 Electronic Water Level Indicators/Sounders/Tapes

During water level measurements, rinsing the extracted tape and probe with deionized water and wiping the surface of the extracted tape between locations is acceptable. However, periodic full decontamination should be conducted as follows:

1. Wash with soap and water
2. Rinse with tap water
3. Rinse with deionized water

> ***NOTE***
> In situations where oil, grease, free product, other hard to remove materials are encountered, probes and exposed tapes should be washed in hot soapy water. If probes or tapes cannot be satisfactorily decontaminated (they are still stained, discolored, etc.), they should be removed from service.

7.2.1.3 Miscellaneous Equipment

Miscellaneous equipment including analytical equipment (water quality testing equipment) shall be cleaned per manufacturers' instructions. This generally includes wiping the sensor housing and rinsing with tap and deionized water.

Coolers/shipping containers employed to ship samples are received from the laboratory in a variety of conditions including marginal to extremely poor. Coolers shall be evaluated prior to use for the following:

- Structural integrity – Coolers missing handles or having breaks in the outer housing should be removed and not used. Notify the laboratory that the risk of shipping samples in the cooler(s) provided is too great and request a replacement unit.

- Cleanliness – As per protocol, only volatile organic samples are accompanied by a trip blank. If a cooler's cleanliness is in question (visibly dirty/stained) or if there are noticeable odors, the cooler should be decontaminated prior to use as follows:

  1. Wash with soap and water
  2. Rinse with tap water
  3. Dry

If these measures fail to clean the cooler to an acceptable level, remove the unit from use as a shipping container and ask the cooler provider (e.g., the analytical laboratory) to provide a replacement unit.

7.2.2 Downhole Drilling Equipment

This includes any portion of the drill rig that is over the borehole, including auger flights, drill stems, rods, and associated tooling that would extend over the borehole. The following procedure is to be employed prior to initiating the drilling/sampling activity, then between locations:

> ***CAUTION***
> Exercise care when using scrapers to remove soil and debris from downhole drilling equipment. Inadvertent slips of scrapers have resulted in cuts, scrapes, and injured knuckles, so use scrapers carefully when removing soil from these items.

1. Remove loose soil using shovels, scrapers, etc.

2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment being decontaminated.

> ***CAUTION***
> In Step 3, do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

3. Rinse the equipment with tap water, where applicable (steam cleaning and pressure washing incorporate rinsing as part of the process).

4. If the equipment has directly or indirectly contacted contaminated sample media and is known or suspected of being contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse equipment with pesticide-grade isopropanol

5. To the extent possible, allow components to air dry.

6. If the decontaminated equipment is to be used immediately after decontamination, screen it with a calibrated photoionization detector (PID)/flame ionization detector (FID) to ensure that all contaminants and possible decontamination solvents (if they were used) have been adequately removed.

7. Wrap or cover equipment in clear plastic until it is time to be used.

SAFETY REMINDER

Even when equipment is disconnected from power sources, dangers such as the following may persist:

Falls - An auger flight standing on its end may fall and injure someone. Secure all loose articles to prevent heavy articles from falling onto people or equipment.

Burns - Steam cleaner water is heated to more than 212 ˚F and exhibits thermal energy that can cause burns. Prevent contact of skin with hot water or surfaces.

High water pressure - Pressure washer discharge can have 2,000 to 4,000 psi of water pressure. Water under this amount of pressure can rupture skin and other human tissues. Water at 4,000 psi exiting a 0˚ tip can be dangerous because of its relatively high cutting power. The exit velocity and cutting power of the water are reduced when exiting a 40˚ fan tip, but damage to soft tissues is still possible.

In general, follow the rules below to avoid injury, equipment damage, or incomplete decontamination:

1. Read the operating manual and follow the manufacturers' recommended safety practices before operating pressure washers and steam cleaners.

2. Never point the pressure washer or steam cleaner at another person or use to clean your boots or other parts of your body. Water lacerations and burns may appear to be minor at first but can be life threatening. Do not attempt to hold small parts in your hand while washing them with high-temperature or high-pressure water.

3. Always wear PPE as specified in the HASP such as:

   - Hard hat, safety glasses, splash shield, impermeable apron or splash suit, and hearing protection. Remember that excessive noise is a hazard when operating gas-powered engines and electrically driven pressure washers. PPE will be identified in your project specific planning documents.

4. Inspect each device before use. An inspection checklist will be provided in the project-specific planning documents. If it is a rented device, safety measures are typically provided by the vendor. In all cases, if you are not familiar with the operation of a pressure washer/steam cleaner, do not operate it until you obtain and thoroughly review operating instructions and recommended safety practices.

5. Do not modify equipment unless the manufacturer has approved the modifications.

7.2.3 Soil/Sediment Sampling Equipment

This section applies to soil sampling equipment including but not limited to hand augers, stainless steel trowels/spoons, bowls, dredges, scoops, split spoons, Macro Core samplers, etc.

1. Remove all loose soil from the equipment through manual means.

2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment.

3. Rinse the equipment with tap water.

> ***CAUTION***
> Do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

4. If the equipment is contaminated or suspected to be contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment with pesticide-grade isopropanol.

5. Rinse the equipment with deionized water.

6. To the extent possible, allow components to air dry.

7. If the equipment is to be used immediately after decontamination, screen it with a calibrated PID/FID to ensure that all solvents (if they were used) and trace contaminants have been adequately removed.

8. After the equipment has dried, wrap it in aluminum foil for storage until use.

Dredges employed in sediment sampling are typically decontaminated as follows:

- Remove the sediment sample from the sampling device

- If sufficient associated surface water is available at the sampling site, place the dredge in the water and flush to remove visible sediment.

- Extract the dredge and wash it in soap and water per the project-specific planning documents.

> ***CAUTION***
> When handling dredges, the primary safety concern is trapping fingers or extremities in the larger dredge samplers within the jaws or pinch points of the mechanical jaws. Keep hands, fingers, and extremities away from these pinch and compression points. Either handle the device by the rope or preferably lock the jaws in place to control the potential for closing during maintenance and/or cleaning.

7.3 Contact Waste/Materials

During the course of field investigations, disposable/single-use equipment becomes contaminated. These items include tubing, trowels, PPE (gloves, overboots, splash suits, etc.), and broken sample containers.

With the exception of the broken glass, single-use articles should be cleaned (washed and rinsed) of visible materials and disposed as normal refuse. The exception to this rule is that extremely soiled materials that cannot be cleaned shall be containerized for disposal in accordance with applicable federal, state, and local regulations.

7.3.1 Investigation-Derived Wastes - Decontamination Wash Waters and Sediments

NOTE
Requirements for waste storage may differ from one facility to the next. Facility-specific directions for waste storage areas will be provided in project-specific documents, or separate direction will be provided by the Project Manager.

1. Assume that all investigation-derived waste (IDW) generated from decontamination activities contains the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. Waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.

2. Where possible, use filtering systems to extend the use of water within a closed system wash unit to recycle water and to reduce possible waste amounts.

NOTE
Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility.

3. Label waste storage containers appropriately labeled (see Attachment A).

4. Ensure that the IDW storage area is configured to meet the following specifications to permit access to the containers and to conduct spill/leak monitoring, sampling, and extraction when the disposal route is determined:

   - Enclose areas accessible by the general public using construction fencing and signs.

   - Stored materials in 55-gallon drums on pallets with four (or fewer) drums per pallet.

   - Maintain the retaining bolt and label on the outside of storage containers where readily visible.

   - Provide at least 4 feet of room between each row of pallets to allow access to containers for sampling, drum removal, and spill response.

   - As directed in project-specific planning documents, maintain an IDW Inventory List and provide the list to the site Point of Contact at the termination of each shift.

   - Maintain spill response equipment at the IDW storage area in case it is required for immediate access.

- Where possible, use equipment for moving containers. Where not possible, obtain help to manipulate containers.

CAUTION

Each container of water can weigh up to 490 pounds. Each 55-gallon drum of wet soil can weigh more than 750 pounds. Fill drums and temporary containers to 80 percent capacity to minimize spill and handling difficulties. Use drum carts to move filled drums.

See safe lifting techniques provided in Section 4.4 of the Tetra Tech NUS, Inc. Health and Safety Guidance Manual.

When placing drums, keep your fingers out of pinch and smash points such as between the drums. In some cases such as well development and/or purge water, you can place the drums to be filled on the pallet and transport materials in smaller easier to handle containers.

7.4 Decontamination Evaluation

Upon decontamination of equipment, determine the effectiveness of the decontamination process in the following manner:

- Visual evaluation – A visual evaluation will be conducted to ensure the removal of particulate matter. This shall be done to ensure that the washing/rinsing process is working as intended.

- Instrument Screening – A properly calibrated PID/FID should be used to evaluate the presence of site contaminants and solvents used in the cleaning process. The air intake of the instrument shall be passed over the article to be evaluated. Avoid placing the instrument probe into residual waters. A PID/FID reading greater than the daily established background level requires a repeat of the decontamination process, followed by rescreening with the PID/FID. This sequence must be repeated until no instrument readings greater than the daily established background level are observed. It should be noted that the instrument scan is only viable if the contaminants are detectable within the instrument's capabilities.

NOTE

When required by project-specific planning documents, collection of rinsate blanks (see next step) shall be completed without exception unless approval to not collect these samples is obtained from the Project Manager.

- Collection of Rinsate Blanks – It is recommended that rinsate samples be collected to:

  - Evaluate the decontamination procedure representing different equipment applications (pumps versus drilling equipment) and different decontamination applications.

  - Single-use disposable equipment – The number of samples should represent different types of equipment as well as different lot numbers of single-use articles.

  - The collection and the frequency of collection of rinsate samples are as follows unless specified differently in the project-specific planning documents:

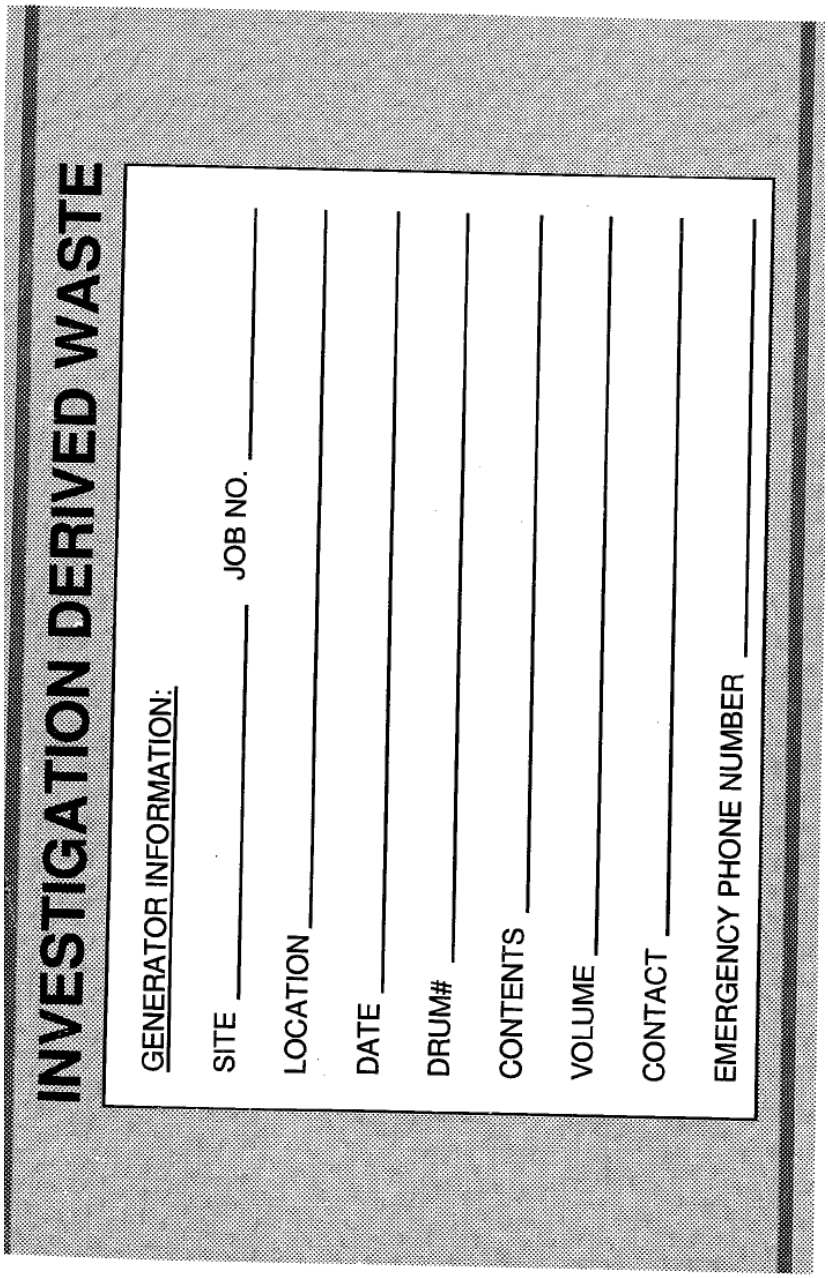
    - Per decontamination method
    - Per disposable article/batch number of disposable articles

NOTE

It is recommended that an initial rinsate sample be collected early in the project to ensure that the decontamination process is functioning properly and to avoid using a contaminated batch of single-use articles. It is recommended that a follow-up sample be collected later during the execution of the project to ensure that those conditions do not change.

Rinsate samples collection may be driven by types of and/or levels of contaminant. Difficult to remove contaminants, oils/greases, some PAHs/PCBs, etc. may also support the collection of additional rinsates due to the obvious challenges to the decontamination process. This is a field consideration to be determined by the FOL.

Attachment A
iDW Label



APPENDIX B

FIELD DOCUMENTATION FORMS

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER 4869 | PAGE ____ OF _____

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
		CARRIER/WAYBILL NUMBER		CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)

PRESERVATIVE USED

TYPE OF ANALYSIS

DATE YEAR ____	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS									COMMENTS

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC.

FIELD INSTRUMENT CALIBRATION LOG

INSTRUMENT NAME: _____ MODEL No.: _____

SERIAL No.: _____ DECAL No.: _____ TETRA TECH NUS CHARGE No. _____

CALIBRATION DATE	INITIAL READING	PROCEDURE	FINAL READING	SIGNATURE	COMMENTS

TtNUS Form 0007

TETRA TECH NUS, INC.

FIELD MODIFICATION RECORD

Site Name: _____ Location: _____

Project Number: _____ Task Assignment: _____

To: _____ Location: _____ Date: _____

Description: _____

_____

_____

_____

Reason for Change: _____

_____

_____

Recommended Action: _____

_____

_____

Field Operations Leader (Signature): _____ Date: _____

Disposition/Action: _____

_____

_____

Project Manager (Signature): _____ Date: _____

Distribution:

Program Manager:	_____	Others as Required:
Project Manager:	_____	_____
Quality Assurance Officer:	_____	_____
Field Operations Leader:	_____	_____
Project File:	_____	_____

TtNUS Form 0003

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: / Time:	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	Other
Method:								

PURGE DATA:

Date:	Volume	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Method:								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type:								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Site: _____ Depth to Bottom (ft.): _____ Project Name: _____
Well: _____ Static Water Level Before (ft.): _____ Project Number: _____
Date Installed: _____ Static Water Level After (ft.): _____ Site Geologist: _____
Date Developed: _____ Screen Length (ft.): _____ Drilling Co.: _____
Dev. Method: _____ Specific Capacity: _____
Pump Type: _____ Casing ID (in.): _____

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)

TETRA TECH NUS, INC.

PHOTOIONIZATION DETECTOR FIELD CALIBRATION LOG

Serial No.: _____ Model No.: _____ Decal No.: _____

Site Name/Location: _____ Tetra Tech NUS Charge No.: _____

CALIBRATION DATE	STANDARD GAS-ISOBUTYLENE	(AM) CALIBRATION READING Isobutylene Equiv. (ppm)	(PM) CALIBRATION CHECK Isobutylene Equiv. (ppm)	SIGNATURE	COMMENTS
	Lot # _____ Conc. = _____ ppm	/		AM: PM:	
	Lot # _____ Conc. = _____ ppm	/		AM: PM:	
	Lot # _____ Conc. = _____ ppm	/		AM: PM:	
	Lot # _____ Conc. = _____ ppm	/		AM: PM:	
	Lot # _____ Conc. = _____ ppm	/		AM: PM:	
	Lot # _____ Conc. = _____ ppm	/		AM: PM:	
	Lot # _____ Conc. = _____ ppm	/		AM: PM:	
	Lot # _____ Conc. = _____ ppm	/		AM: PM:	
	Lot # _____ Conc. = _____ ppm	/		AM: PM:	

TtNUS Form 0006

TETRA TECH NUS, INC.

YSI MULTIPARAMETER WATER QUALITY METER

Site Name: Naval Weapons Industrial Reserve Plant, Bedford, MA; Job No: 112G00893 / Semi-Annual Event

Serial No. _____ Model No. _____ Decal Letter _____;

Instrument is calibrated in accordance with manufacturers instructions

DATE:	Post Calibration Readings	PM Check	Calibration STDs	Signature	Remarks
Cond.= 1 mS/cm			Lot No. Exp.		
Cond. Check (DIUF)			Lot No. Exp.		
pH=4.0			Lot No. Exp.		
pH=7.0			Lot No. Exp.		
pH=10.0			Lot No. Exp.		
D.O. mg/l			% moisture in air		
REDOX mV			Lot No. Exp.		
Temp °C					

DATE:					
Cond.= 1 mS/cm					
Cond. Check (DIUF)					
pH=4.0					
pH=7.0					
pH=10.0					
D.O. mg/l					
REDOX mV					
Temp °C					

Mod. TtNUS Form 0024

TETRA TECH NUS, INC.

PURGE DATA SHEET - "LOW FLOW" GROUNDWATER

Site Name:
Sample ID:

Tetra Tech NUS Charge No. / CTO Page 1 of
QC: _____ (If applicable)

Sample Method: _____
Depth Sampled: _____ ft bgs Screen Int. Depth _____ ft bgs
Sample Date & Time: _/___ /____ _____hours _____(Dup Time)
Sampler(s):
Data Recorded By:_____ Signature: _____ ;
Notes: Water Depth MP = top of riser (TOR); NAPL signal at start (Yes/No); if yes, report depths/describe thickness_____; Visual Evidence of Sheen (Yes/No) _____;
Olfactory Evidence of Odor (Yes/No)_____;
Weather: _____

H&S Survey Meter _____PPM Field Instrument Group A/B/C/D
Pre-tubing insertion WL _____ft btor; Post –tubing insertion WL _____ft btor

Field Analysis:

Sampling Hierarchy and Lab Analyses:

(Also see separate sample logsheet for gw)

Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond. 2 uS/cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments
Acceptance Criteria: <0.3 ft (drawdown)					3%	3%	+/- 0.1 S.U.	+/- 10mV	10%	10%	

TtNUS Form 0009

Saturated Screen Volume (gallons) _____ (2" screen = 0.163 gals/ft of depth; 4" = 0.653 gals/ft; 6" = 1.469gals/ft)

1. Pump dial setting (for example: hertz, cycle/min, etc.)
2. Siemens per cm (same as umhos/cm) at 25 °C.
3. Oxidation reduction potential (stand in for Eh).

TETRA TECH NUS, INC.

PURGE DATA SHEET - "LOW FLOW" GROUNDWATER

Site Name:
Sample ID:

Tetra Tech NUS Charge No.
QC: ______________________________ (If applicable)

Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond. 2 uS/cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments
Acceptance Criteria:	<0.3 ft (drawdown)				3%	3%	+/- 0.1 S.U.	+/- 10mV	10%	10%	

TtNUS Form 0009

Saturated Screen Volume (gallons) ____________ (2" screen = 0.163 gals/ft of depth; 4" = 0.653 gals/ft; 6" = 1.469gals/ft)

1. Pump dial setting (for example: hertz, cycle/min, etc.)
2. Siemens per cm (same as umhos/cm) at 25 °C.
3. Oxidation reduction potential (stand in for Eh).

Tetra Tech NUS, Inc.

QA SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____ Sample ID Number: _____
Project Number: _____ Sampled By: _____
Sample Location: _____ C.O.C. Number: _____
QA Sample Type:

[] Trip Blank [] Rinsate Blank
[] Source Water Blank [] Other Blank _____

SAMPLING DATA:

Date: _____
Time: _____
Method: _____

WATER SOURCE:

[] Laboratory Prepared [] Tap
[] Purchased [] Fire Hydrant
[] Other _____

PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):

Product Name: _____
Supplier: _____
Manufacturer: _____
Order Number: _____
Lot Number: _____
Expiration Date: _____

RINSATE INFORMATION (If Applicable):

Media Type: _____
Equipment Used: _____
Equipment Type:

[] Dedicated
[] Reusable

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
Volatiles	Cool 4°C & HCl		YES / NO
Semivolatiles	Cool 4°C		YES / NO
Pesticide / PCB	Cool 4°C		YES / NO
Metals	Cool 4°C & HNO_3		YES / NO
Cyanide	Cool 4°C & NaOH		YES / NO

OBSERVATIONS / NOTES:

Signature(s):

TETRA TECH NUS, INC.

SITE ENTRY LOG

Site Name: _____ Date: _____

Location: _____ Project Number: _____

NAME	REPRESENTING	TIME IN (HOURS)	TIME OUT (HOURS)	INITIALS

TtNUS Form 0002

TETRA TECH NUS, INC.

WELL DEVELOPMENT DATA SHEET **Well No.:** _____

PROJECT: _____ DATE: _____

PROJECT NO.: _____ WEATHER: _____

SAMPLE ID: _____ PERSONNEL: _____

Well Screen Depth: _____ / _____ ft. bgs

H&S Monitoring Instrument Reading _____

Pump Type/Material: _____

Pump Intake Depth: _____

Total Purge Volume = _____(gal)

Data Recorded By: _____

Time	Water Level ft below top PVC	Volume mL	Flow Rate mL/min	Temp °C	pH	Sp Cond mS/cm	DO mg/L	Turbidity NTU	Comments

TtNUS Form 0013

TETRA TECH NUS, INC.	WELL INSPECTION AND GROUNDWATER LEVEL MEASUREMENT SHEET

WELL NUMBER: _____ PROJECT NAME: _____

DATE/TIME: _____ PROJECT MANAGER: _____

INSPECTED BY: _____

_____

VENT WELL

MONITORING INSTRUMENT READING: _____

LEL/02 READING: _____

WELL INSPECTION/GROUNDWATER LEVEL MEASUREMENT

WELL DEPTH (FEET FROM TOP OF PVC) _____

WATER LEVEL DEPTH (FEET FROM TOP OF PVC) _____

WELL STICK-UP _____

CASING STICK-UP (FEET) _____

WELL DIAMETER (INCHES) _____

WELL CONSTRUCTION (PVC, STEEL, ETC.) _____

LOCKED UPON ARRIVAL?	YES	NO
LOCKED REPLACED?	YES	NO
OBSTRUCTIONS?	YES	NO
WELL RELABELED?	YES	NO
SLUG TEST CONDUCTED?	YES	NO (If YES, refer to "Hydraulic Conductivity Testing Data Sheet")

GENERAL CONDITION/COMMENTS: _____

_____

_____

_____

_____

TtNUS Form 0021

APPENDIX C

PROJECT-SPECIFIC FIELD SAMPLING PROCEDURES

Appendix C-1
Project-Specific Procedures for Well Development, Water Level Measurement and Groundwater Sampling Perfluorinated Compounds in Groundwater Former Naval Air Station South Weymouth Weymouth, Massachusetts

Project-specific procedures for monitoring well development, water level measurement, and groundwater sampling for selected existing wells are presented below. The SOPs referenced below are included in Appendix A. The Field Team will follow these project-specific field procedures unless these procedures do not provide guidance on a specific field task issue. In that case, the procedures in the cited SOPs will be followed.

Worksheet #14 presents the analytical field program summary and lists the selected well locations for sampling. The selected wells can be seen on Figure 2. Worksheet #16 presents the analytical method, sample container types, preservative requirements, and the maximum holding times, and the quality control sample summary.

Monitoring Well Development

Prior to water level measurement and groundwater sampling at the nine existing monitoring wells identified in Worksheet #14 and on Figure 2, each well will be developed according to SOP GH-2.8. Well development will be performed using a bladder pump (or similar) set using gentle agitation until the turbidity level reaches 10 NTU or 2 hours of well development elapses (whichever occurs first). Refer to SOP GH-2.8 for additional information.

Prior to well development, the groundwater monitoring wells will be visually inspected. The condition of the casings, the integrity of the seal surface, and any visual evidence of damage that might impact the accuracy of water level measurement or the quality of groundwater samples will be documented on field log sheets.

Water Level Measurement

Prior to groundwater sampling at the nine identified monitoring wells, water levels will be measured in accordance with SOP GH-1.2 using the following procedures.

Water levels will be measured on the same day in as short a time span as possible, but not during or immediately following a large rain event. Static water levels will be measured using an electronic water level indicator with a weighted cord that is accurate to 0.01 feet relative to the surveyed measurement

point at the top of inner well casing. Groundwater samples will not be collected from any well exhibiting detectable non-aqueous phase liquid (NAPL) and the presence of NAPL will be thoroughly documented in the field notes. The well number, time, date measuring point, depth to water, and observations on the condition of the well will be recorded in the field logbook. If NAPL is present, the depths to the top of product and top of water will be measured and recorded. Detailed procedures are in SOP GH-1.2.

Water level indicators will be sprayed with deionized water and wiped with clean paper towels in between every well.

Groundwater Sampling

Groundwater samples will be collected from the selected existing monitoring wells. The samples will be taken from the midpoint of the saturated well screen. A minimum of 2 weeks shall elapse after well development before collecting groundwater samples.

The groundwater samples will be collected in accordance with EPA's low flow (low stress) sampling protocol, SOP GW-0001, using the project-specific procedures described in this section. The EPA protocol emphasizes the need to minimize water-level drawdown and groundwater pumping rates in order to collect samples with minimal alterations to groundwater chemistry.

A peristaltic pump and polypropylene tubing will be used in each of the wells for purging and sampling purposes. The intake level of the pump will be set in the midpoint of the well screen. The pumps will be started at their lowest settings, and the pumping rates slowly increased until discharge occurs. Water levels will be monitored frequently initially to minimize drawdown and then regularly thereafter. In the event that the water level falls below the top of the pump, the deepest water level will be reported on the sample logsheet and a notation that the level has fallen below the pump will be documented in the Remarks or Comment column. Stable drawdowns of less than 0.3 feet are desired. If drawdown can not be controlled, then the well will be evacuated. Within 24 hours, a grab sample will be collected after the water level in the well has recovered sufficiently to allow collection of an appropriate volume needed for sample analyses.

Water quality parameters (pH, temperature, specific conductance, dissolved oxygen, and oxidation-reduction potential [ORP]) will be measured during purging using a YSI Model 600 Series multi-parameter water level meter or equivalent, coupled with a flow-through cell. Turbidity will be measured separately using a LaMotte Model 2020 or equivalent nephelometer. An aliquot of water will be collected from a T-connection before the flow through cell to measure turbidity.

The water level, pumping rate, turbidity, dissolved oxygen, ORP, specific conductance, temperature, pH, and observations will be recorded every 3 to 5 minutes (or as appropriate). The field instruments will be calibrated according to the manufacturer's specifications. Stabilization will be considered to be achieved when three consecutive readings, taken at 3 to 5-minute intervals, are within the following limits:

- turbidity (10 percent for values greater than 5 NTU),
- dissolved oxygen (± 10 percent),
- specific conductance (± 3 percent),
- temperature (± 3 percent),
- pH (+/- 0.1 unit), and
- ORP (± 10 millivolts).

Groundwater samples will be collected following the stabilization of the measured water quality parameters or after a maximum of 2 hours of purging (the field personnel collecting the sample will make that determination, document it on the sample log sheet, and inform the FOL who will also document it in the field log book). Sampling equipment will be decontaminated before and after each use, according to SOP SA-7.1.

Care should be taken in handling all groundwater samples to ensure that the exterior of the sample containers are clean and free of liquids before shipping. All laboratory analytical samples will be kept on ice in coolers and will be shipped with appropriate QA/QC samples. The sample collection documentation, handling, tracking, and custody procedures are presented in Worksheet #13.

APPENDIX D

ANALYTICAL SPECIFICATION

ATTACHMENT NO. 2

STATEMENT OF WORK/PRICE TABLES

TECHNICAL SPECIFICATION FOR LABORATORY SERVICES – REVISION 1
NAVAL AIR STATION (NAS) SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION - NAVY (CLEAN)
CONTRACT N62470-08-D-1001, CONTRACT TASK ORDER (CTO) NO. WE11

GROUNDWATER PFCs STUDY
CHEMICAL ANALYSIS

1.0 INTRODUCTION

Tetra Tech NUS, Inc. (TtNUS) under CLEAN Contract **N62470-08-D-1001** is procuring a laboratory for NAS South Weymouth in support of a site investigation. Requested analysis includes perfluorinated compounds (PFCs) analysis by HPLC/MS/MS.

The laboratory performing this analysis must submit a copy of its Naval Facilities Engineering Services Center (NFESC) approval letter or Department of Defense (DOD) Environmental Laboratory Accreditation Program (ELAP) accreditation letter.

The responding laboratory must submit method detection limits (MDLs) and quantitation limits (QLs) or limits of detection (LOD) and limits of quantitation (LOQ) for target PFC analysis in water samples by filling out the last columns of the table in Attachment A and including the completed attachment with the bid response. After award, the laboratory will be required to submit SOPs and relevant precision and accuracy limits for the sample extraction and analytical method required under this scope of work. The laboratory will also be asked to complete tables for inclusion in the Sampling and Analysis Plan (SAP). The SAP will be prepared according to the Uniform Federal Policy (UFP) for Quality Assurance Project Plans (QAPPs) (March 2005) and utilize the UFP SAP worksheets 1 through 37.

2.0 SAMPLE INFORMATION

Samples will be shipped to the laboratory in February 2010. The approximate number of samples to be submitted for PFC analysis and the analytical method to be used are summarized in the attached Table 1. The actual number of samples will be provided prior to sample collection.

Field duplicate samples will be submitted with "blinded" identification to the laboratory. The field crew will designate one per 20 samples for matrix spike/matrix spike duplicate analyses; additional volumes of these samples will be provided.

All samples are expected to be of low or moderate contaminant concentration. The field crew will attempt to identify any potentially high concentration samples.

3.0 ANALYSIS/REPORTING INFORMATION

One hardcopy data package deliverable and two portable document format (PDF) compact disk (CD) copies must be submitted, in addition to the electronic data deliverables to be provided in the format described in Attachment C. The original chain-of-custody form received with the samples and signed by the laboratory sample custodian must be returned with the hardcopy data package.

The analytical requirements and approximate number of samples to be submitted for analysis are detailed in Table 1. Analysis and reporting requirements addressed in the DOD Quality Systems Manual (January 2006 or April 2009 depending on current NFESC approval letter or DOD ELAP accreditation

letter) and the requested method must be followed. The laboratory-derived recovery limits for matrix spike, laboratory control samples (LCSs), and surrogates must be met. Additionally, it is a requirement of TtNUS that the hard copy and associated PDF data packages for the PFC analysis must be reported in a Contract Laboratory Program (CLP)-equivalent format and the deliverables are similar to CLP deliverables.

Additionally, each hardcopy and PDF data package must contain a summary data package. This summary data package shall consist of only the summary CLP forms. Attachment B details the required summary forms for CLP-like data packages and requirements for organization/bookmarking of hardcopy/PDF data packages.

Attachment A details the required target compound list and required project quantitation limit (PQL) goals that must be met. The laboratory must submit its QLs and MDLs or LODs and LOQs for PFC analysis of water samples by filling out the last columns of the table in Attachment A and including the completed attachment with the bid response. If no PQL goal is listed for a target compound in Attachment A, the laboratory should propose its lowest QL technically possible for the specified method.

Non-detected PFC results must be reported down to the laboratory MDLs or LODs; positive results above the MDL or LOD but below the laboratory's QL or LOQ must be reported as estimated values qualified with a "J".

The hardcopy/PDF data package deliverable must contain a detailed case narrative for the PFC analytical fraction. This case narrative must also include the Contract Task Order (CTO) number, the site name, and the TtNUS Project Manager's name. Data from all analytical runs (i.e., original, dilution, re-analysis) must be reported in the raw data and on Form Is.

As part of the laboratory case narrative, it is required that the Laboratory Quality Assurance Manager sign an attestation statement verifying that all electronic diskette deliverables exactly match the data summary forms (i.e., Form Is).

As stipulated in the CLEAN Master Services Agreement (MSA), Sample Delivery Group (SDG) and fractionally-specific text (TXT) files containing all environmental sample and field quality control blank analysis results must be generated in accordance with the requirements outlined in Attachment C of this specification.

The maximum holding time allowance, as defined in the following table, is to be strictly observed. Calculation of holding time is in calendar days and is to begin from the time of sample collection. The holding times are as follows:

Analyses	**Preservation**	**Holding Time**
PFCs	Cool to 4° C	7days to extraction; 40 days to analysis

These holding times are based on data validation criteria and method specific requirements, and are measured from date of sample collection. The holding time criteria depicted applies to all analyses necessary to successfully determine the contaminant level contained in the sample. Hence, the holding time criterion applies to any/all subsequent sample dilutions and re-analyses.

The TtNUS Project Manager for this project is Ms. Phoebe Call. She must be contacted in the event of any laboratory problems that could impact project deadlines (i.e., late deliverables, technical problems in the lab that could lead to late deliverables.) To ensure good communication it is required that the laboratory's appointed project manager contact Ms. Call once a week for the entire project duration.

Contact information for Ms. Call is as follows:

Tetra Tech NUS, Inc.
55 Jonspin Road
Wilmington, MA 01887
Phone: 978-474-8403
Fax: 978-474-8499
Email: phoebe.call@tetratech.com

Analytical data turnaround times are to be measured from receipt of each sample shipment. All hardcopy/PDF (2 CDs) analytical data packages and associated electronic (TXT) deliverables are due within the standard MSA turnaround term of 21 calendar days from receipt of the last sample in a Sample Delivery Group (SDG).

The SDGs must contain all the samples, unless enough samples to complete the SDG are not anticipated to be received within a time period that will allow analysis within holding time. All hardcopy/PDF data packages and electronic deliverables must be received at the same time or the deliverable will be considered incomplete and payment deductions may be imposed.

The hardcopy/PDF (2 CDs) analytical data package and the original chain-of-custody form (received with the samples and signed by the laboratory sample custodian) should be sent to Ms. Lucy Guzman. The contact information for Ms. Guzman is the same as noted above for Ms. Call except that her direct phone number is (978) 474-8416 and her email address is lucy.guzman@tetratech.com.

The electronic (TXT) deliverables, in addition to a copy of the chain-of-custody form, should be sent to Ms. Tobrena Skeen. The contact information for Ms. Skeen is as follows:

Tetra Tech NUS, Inc.
661 Andersen Drive, Foster Plaza 7
Pittsburgh, PA 15220-2745
Phone: 412-921-8582
Fax: 412-921-4040
e-mail: tobrena.skeen@tetratech.com

4.0 PERIOD OF PERFORMANCE/BOTTLEWARE INFORMATION

All samples will be shipped to the laboratory via express carrier within 48 hours of collection. **The laboratory must be capable of either picking up samples at the site or receiving samples delivered from Monday to Saturdays.** Please circle the Yes or No at the bottom of Table 1 which will indicate if the laboratory will provide courier service at no extra charge. The laboratory will be notified at least 2 weeks prior to sample collection.

Bottleware shipments will be coordinated by Tetra Tech's Field Operation Leader.

The laboratory is to provide all necessary sample containers **(plus approximately 10% extra for field QC.**. All sample containers must meet ICHEM series 300 cleanliness criteria (or equivalent), and documentation of certified cleanliness must be provided. The bottleware must be shipped to the designated location in Coleman-like coolers. Each cooler must include a "temperature blank" vial. **The laboratory must also provide any extra coolers needed for return shipment of samples to the laboratory for analysis.** The laboratory is also requested to provide sample labels, custody seals, and chain-of-custody forms.

5.0 ADDITIONAL COMMENTS/CONTACTS

Within the laboratory, the internal transfer of samples and extracts must be accomplished and documented as controlled custody transfers. The laboratory must submit the documentation that supports an unbroken chain of custody for samples and extracts from time of receipt or production in the laboratory until disposal.

The laboratory is to provide a minimum of 60 days storage of sample extracts and 60 days storage of intact leftover sample aliquots, as stipulated in the MSA. **Additionally, the laboratory must store PDF data packages for 5 years.**

All analyses conducted under this subcontract assignment are to be performed at the solicited facility only. The laboratory is not permitted to lower-tier subcontract this analysis, or analyze these samples at a corporate facility other than the facility stipulated without prior notification and consent from the CLEAN Subcontracting Officer.

The unit cost for analysis is to include compensation for containers, coolers shipping costs, storage, disposal, and laboratory quality control analyses (such as matrix spike/matrix spike duplicate, and laboratory control sample analyses.) These items are not to be billed as separate line items.

Technical, quality assurance, and data format concerns are to be directed to Ms. Lucy Guzman at 978-474-8416 or via e-mail lucy.guzman@tetratech.com. Ms. Guzman must be contacted and informed of any difficulties encountered during the conduct of the requested analyses.

Contract concerns, and response to this solicitation, are to be directed to:

Ms. Meg Price
CLEAN Subcontracting Officer
Tetra Tech NUS, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, PA 19406-1433
Phone: 610-491-9688
Fax: 610-491-9645
e-mail: meg.price@tetratech.com

Triplicate copies of invoices associated with the analyses contracted herein are to be submitted to the attention of the Accounting Supervisor:

Tetra Tech NUS, Inc.
661 Andersen Drive, Foster Plaza 7
Pittsburgh, PA 15220
Phone: 412-921-8506
Fax: 412-921-4040

Please confirm the laboratory's ability to perform the methodologies requested at the analyte quantitation limits indicated. Also confirm available laboratory capacity, and complete/confirm the costing information indicated in Table 1. All costing information must reflect the terms and conditions established by the 2009 CLEAN MSA.

TABLE 1
NUMBER OF SAMPLES/ANALYTICAL METHODS
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS
CTO WE11, PFC STUDY

Matrix	Parameter	Method	# Samples	Unit Price	Total Cost
Groundwater (and associated field quality control blanks)	PFCs	SW-846 Method 8321	9	$	$

TOTAL COST $

Can the laboratory provide sample pick-up on site? YES or NO (circle one)
If yes is there an additional charge and what is that charge?_____

Name of Laboratory_____

Signature_____

ATTACHMENT A

FIXED LABORATORY PERFLUORINATED COMPOUNDS
GROUNDWATER SAMPLING
NAS SOUTH WEYMOUTH, WEYMOUTH, MASSACHUSETTS

Chemical	CAS Number	Method	PQL (µg/L)	PAL (µg/L	Laboratory		
					QL or LOQ (µg/L	LOD (µg/L	MDL (µg/L
Perfluorooctanoic acid, PFOA	335-67-1	8321	0.02	0.4			
Perfluorooctane sulfonate, PFOS	1763-23-1	8321	0.03	0.2			

PAL - Project Action Limit (EPA provisional health advisories)
PQL – Project Quantitation Limit
LOQ –Limit of Quantitation
µg/L - micrograms per liter
MDL - Method Detection Limit
LOD – limit of detection

Method from SW846 - Test Methods for Evaluating Solid Wastes. EPA Office of Solid Waste.

ATTACHMENT B
Summary Form Requirements for PDF Deliverable and PDF Data Package Deliverables
PDF DATA PACKAGE DELIVERABLE REQUIREMENTS

The laboratory is to provide 2 CDs containing a PDF file in the following format:

1. Table of Contents
2. Case Narrative
3. Chain-of-Custody
4. Data Summary Package (contains summary of all CLP or CLP like Forms 1 through 14 per analytical fraction)
5. Analytical Fractions (PFCs.)
a. Quality Control (QC) Summary (summary of all CLP or CLP like Forms 1 through 14 for the PFC analytical fraction)
b. Raw Sample Data (includes all sample dilutions, sample re-analyses, QC samples, etc.)
c. Calibration Data (includes all initial and continuing calibrations)
d. Miscellaneous (includes extraction forms, MDLs, etc.)

Each of the above sections should be bookmarked in the PDF for easy access.

Summary Forms for SW-846, 8260B and 8270C (i.e., Any SW-846 GC/MS analysis of Volatile and Semivolatile Organic Compounds) should be presented in a CLP-Like format. The following Summary Forms must be included:

Result Summary	One Sample per summary page. Presentation of analytical results for both method blanks and environmental samples, date of collection, preparation, and analysis. Environmental samples should be identified with the field identification numbers on the COCs.
Surrogate Recovery Form	Present all information contained on CLP Form II.
Summary of Matrix Spike/Matrix Spike Duplicate Recovery	Present all information contained on CLP Form III.
Instrument Performance Check Summary Form - Mass Spec Tuning Form	Present all information Contained on CLP Form V.
Initial Calibration Summary	Present all information contained CLP Form VI.
Continuing Calibration Summary	Present All Information contained on CLP Form VII.
Internal Standard Area and Retention Time Summary	Present all information contained CLP Form VIII.

ATTACHMENT C
ELECTRONIC DATA DELIVERABLE REQUIREMENTS

ELECTRONIC DATA FORMAT REQUIREMENTS

1.0 **INTRODUCTION**

The laboratory is to submit text-based tab delimited EDD files for each SDG using Tetra Tech's laboratory data checker explained below. The files must be in the format specified in this Attachment. Additional information such as laboratory name, project name, fractions included, project number, site name/number, laboratory contact person and any specific comments related to the EDD should be included in the comments section of the EDD Submittal page.

The RESULT for non-detects should be populated with the project-specific sample quantitation reporting limits (i.e., either the sample quantitation limit or method detection limit, as specified in Section 3.0 of this scope of work. Any corrections made to the hardcopy data must also be made to the electronic file. Appropriate qualifiers as identified by the analytical protocol must also be designated; laboratory QC non-compliance codes are not to be depicted.

Tetra Tech's electronic EDD format follows the ADAPT structure and requires the A1 and A3 files. The A2 file is only required if the project is using ADAPT; and, for non-ADAPT EDD submittals the A2 file may be omitted. The EDD consists of separate, tab-delimited ASCII text files. Each file corresponds to a database table. The tables are identified as the Analytical Results Table (A1) and Sample Analysis Table (A3). A separate set of text files must be created and submitted for each sample delivery group (SDG). The files must be identified to correspond to the (A1) table and the (A3) table. The file naming convention is: the Sample Delivery Group (SDG) followed by the table identifier (A1 or A3), followed by the ".txt" extension. The file names must not contain spaces or special characters. For example, the EDD file names for a laboratory-reporting batch identified as SDG001 would be as follows:

SDG001A1.txt
SDG001A3.txt

On certain projects Tetra Tech will utilize the ADAPT Electronic Data Validation software, which will require the laboratory to use the ADAPT electronic data deliverable checker software prior to submitting the files through Tetra Tech's laboratory data checker (this will be clearly specified in the Tetra Tech laboratory statement of work). The ADAPT checker software can be downloaded from Laboratory Data Consultants' web site: http://www.lab-data.com. For projects which Tetra Tech is using the ADAPT software, Tetra Tech will provide the laboratory with the project library. The laboratory is not permitted to modify the project library. ADAPT projects will require the laboratory to export all three checked files (A1, A2, and A3) from the ADAPT software and submit them through Tetra Tech's laboratory data checker. **ADAPT error logs generated must be included with the electronic PDF data validation package and cannot be submitted through the laboratory data checker.**

The values reported in the EDD text files must agree exactly with the final values reported on the PDF data package sample result summaries. The details of file naming conventions, data structure and data checker use are discussed below.

Analytical Results Table (A1 File)

The Analytical Results table contains analytical results and related information for target analytes in field samples and associated laboratory quality control samples (excluding calibrations and tunes). Field samples and laboratory method blanks must report a result record for each analyte reported within a method. Laboratory control samples (LCS and LCSD) and matrix spike samples (MS and MSD) must report a result record for every analyte specified as a spiked analyte in the laboratory statement of work. Table A1 in this document lists the field names and data type descriptions for the Analytical Results Table (A1).

Lab Instrument Table (A2 File)

A2 file is only required if the project is using ADAPT. In all other EDD submittals, the A2 file may be omitted. Laboratories should refer to the ADAPT User Guide for populating the A2 Table.

Sample Analysis Table (A3 File)

The Sample Analysis table contains information specific to field environmental samples and laboratory quality control analyses (excluding calibrations and tunes). A sample record must exist for each sample/method/matrix/analysis type combination. Table A3 in this document lists the field names and data type descriptions for the Sample Analysis Table (A3).

All electronic data deliverables are due within the same time established for the associated hardcopy data packages.

In addition, the laboratory QC officer must read and sign a copy of the Quality Assurance Review Form displayed on the next page of this Attachment. Electronic deliverables are not considered to be complete without the accompanying Quality Assurance Review Form.

I _____, as the designated Quality Assurance Officer, hereby attest that all electronic deliverables have been thoroughly reviewed and are in agreement with the associated hardcopy data. The enclosed electronic files have been reviewed for accuracy (including significant figures), completeness and format. The laboratory will be responsible for any labor time necessary to correct enclosed electronic deliverables that have been found to be in error. I can be reached at
(____)_____if there are any questions or problems with the enclosed electronic deliverables.

Signature:_____ Title: _____Date: _____

2.0 EDD Field Properties

Tables A1 and A3 in this document specify the EDD field properties. Laboratories should refer to the ADAPT User Guide for populating the A2 Table. These include the field name, sequence order, field description, data type/length and reporting requirement for each field. Fields in the EDD **must** be sequenced according to the order that they appear below in Tables A1 and A3. For example, in the Analytical Results table (A1), the field "ClientSampleID" will always be the first piece of information to start every new line of data (or database record), followed by the field "LabAnalysisRefMethodID", "AnalysisType", etc.

When creating an EDD as a text file, use the ASCII character set in a file of lines terminated by a carriage return and line feed. No extra characters are allowed at the end of a line, after the carriage return and line feed. Enclose each data value with double quotes (text qualifier) and separate each field value with a **tab** character (tab delimiter). Data fields with no information (null) may be represented by two consecutive tabs. For example, in the Sample Analysis table, since the "Collected", "ShippingBatchID", and "Temperature" fields do not apply to laboratory generated QA/QC samples, the record for a Laboratory Control Sample by Method 8270C would be entered as follows. Note that the first two fields ("ProjectNumber" and "ProjectName") are omitted in this example.

…"LCSW100598" "AQ" "LCSW100598" "LCS" "8270C",…etc.

If a field is populated with less than the maximum allowed number of characters, do not pad the values with leading or trailing spaces. In the above example, although the "MatrixID" field can accommodate up to 10 characters, only 2 characters were entered in this field. **Do not include the delimiter (tab character) within any of the field values.** Example EDD files may be downloaded from the LEDD Checker application.

An example database shall be sent for review prior to the first electronic deliverable in the required .txt format. The example file will be examined for completeness and comments will be sent to the laboratory. Any questions regarding the electronic deliverable should be directed to LabSupport@tetratech.com.

Table A1
Field Descriptions for the Analytical Results Table (Table A1)
Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Required Value
ClientSampleID	Client or contractor's identifier for a field sample If a sample is analyzed as a laboratory duplicate, matrix spike, or matrix spike duplicate, append suffixes DUP, MS and MSD respectively to the Client Sample ID with no intervening spaces or hyphens (i.e. MW01DUP, MW01MS, and MW01MSD). For Method Blanks, LCS, and LCSD enter the unique LaboratorySampleID into this field. Do not append suffixes to the ClientSampleID for dilutions, reanalyses, or re-extracts (the AnalysisType field is used for this distinction). For example, MW01DL and MW01RE are not allowed. Parent sample records must exist for each MS and MSD. If an MS/MSD is shared between two EDDs, records for the MS/MSD and its parent sample must exist in the Analytical Results table for both EDDs.	Text	25	X
LabAnalysisRefMethodID	Laboratory reference method ID. The method ID may be an EPA Method number or a Lab Identifier for a method such as a SOP Number, however; method ID is specified by the project. The method ID must be entered into the standard list.	Text	25	X
AnalysisType	Defines the analysis type (i.e., Dilution, Reanalysis, etc.). This field provides distinction for sample result records when multiple analyses are submitted for the same sample, method, and matrix; for example dilutions, re-analyses, and re-extracts.	Text	10	X
LabSampleID	Laboratory tracking number for field samples and lab generated QC samples such as method blank, LCS, and LCSD. There are no restrictions for the LabSampleID except for field length and that the LabSampleID must be distinct for a given field sample or lab QC sample and method. Suffixes may be applied to the LabSampleID to designate dilutions, reanalysis, etc.	Text	25	X
LabID	Identification of the laboratory performing the analyses.	Text	7	X
ClientAnalyteID	CAS Number or unique client identifier for an analyte or	Text	12	X

Table A1
Field Descriptions for the Analytical Results Table (Table A1)
Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Required Value
	isotope. If a CAS Number is not available, use a unique identifier provided by the client or contractor. The ClientAnalyteID for a particular target analyte or isotope should be specified by the project and must exist in the standard value tables for Analytes. For the LCS, LCSD, MS, and MSD, it is only necessary to report the compounds designated as spikes in the library (and surrogates for organic methods.) For TICs from GC/MS analyses, enter the retention time in decimal minutes as the Client Analyte ID.			
AnalyteName	Chemical name for the analyte or isotope. The project specifies how an analyte or isotope is named. The analyte name must be associated to a ClientAnalyteID in the standard values table for Analytes (excluding compounds designated as TIC's).	Text	60	X
Result	Result value for the analyte or isotope. Entries must be numeric. For non-detects of target analytes or isotopes and spikes, **do not enter "ND" or "0". Do not leave this field blank**. If an analyte or spike was not detected, enter the reporting limit value corrected for dilution and percent moisture as applicable. Do not enter "0"	Numeric (1)	20(6)	X
ResultUnits	The units defining how the values in the Result, DetectionLimit, and ReportingLimit fields are expressed. For radiochemistry this also includes how the value in the Error field is expressed.	Text	10	X
LabQualifiers	A string of single letter result qualifiers assigned by the lab based on client-defined rules and values. <u>The "U" Lab Qualifier must be entered for all non-detects.</u> Other pertinent lab qualifiers may be entered with the "U" qualifier. Order is insignificant. Lab qualifiers other than those listed in the standard values table may be used. If so, these must be	Text	7	Q

Table A1
Field Descriptions for the Analytical Results Table (Table A1)
Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Required Value
	added to the standard value table in the application.			
DetectionLimit	For radiochemistry methods, the minimum detectable activity for the isotope being measured. For all other methods: The minimum detection limit value for the analyte being measured.	Numeric (1)	10(6)	X
DetectionLimitType	Specifies the type of detection limit (i.e., MDA, MDL, IDL, etc.).	Text	10	X
RetentionTime or Error	For radiochemistry methods only, enter the 2 Sigma Counting Errors. The units for error are entered in the ResultUnits field. For GC/MS methods only, enter the time expressed in decimal minutes between injection and detection for GC/MS TICs only For target analytes in all other methods, leave this field blank. Note: GC retention times are not evaluated at this time.	Text	5	T
AnalyteType	Defines the type of result, such as tracer, surrogate, spike, or target compound.	Text	7	X
PercentRecovery	For radiochemistry methods: The tracer yield, if applicable. For all other analytical methods: The percent recovery value of a spiked compound or surrogate. If the spike or surrogate was not recovered because of dilution, enter “DIL”. If a spike or surrogate was not recovered because of matrix interference, enter “INT”. If a spike or surrogate was not recovered because it was not added to the sample, enter “NS”.	Numeric (1)	5(3)	R
RelativePercentDifference	The relative percent difference (RPD) of two QC results, such as MS/MSD, LCS/LCSD, and Laboratory Duplicates. Report RPD in Laboratory Duplicate, LCSD, and MSD records only.	Numeric (1)	5(3)	D
ReportingLimit	Reporting limit value for the measured analyte or isotope Factor in the dilution factor and percent moisture correction, if applicable. The Reporting Limit for each analyte and matrix in a given method is specified in the project library or QAPP.	Numeric (1)	10(6)	X

Table A1
Field Descriptions for the Analytical Results Table (Table A1)
Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Required Value
ReportingLimitType	Specifies the type of reporting limit (i.e., CRQL, PQL, SQL, RDL, etc). The Reporting Limit Type for each method and matrix is specified in the project library or QAPP.	Text	10	X
ReportableResult	This field indicates whether or not the laboratory chooses an individual analyte or isotope result as reportable. Enter "YES" if the result is reportable. Enter "NO" if the result is not reportable. If only one analysis is submitted for a particular sample and method, enter "YES" for all target compounds (where Analyte Type = TRG). For GC/MS methods enter yes for tentatively identified compounds (where Analyte Type = TIC). If two or more analyses are submitted for a particular sample and method (i.e. initial analysis, reanalysis and/or dilutions), enter "YES" from only <u>one</u> of the analyses for each target compound. For example: a sample was run a second time at dilution because benzene exceeded the calibration range in the initial, undiluted analysis. All target analytes are reported in each analysis. For the initial analysis, (Analysis Type = RES), enter "NO" for benzene and enter "YES" for all other compounds. For the diluted analysis (Analysis Type = DL), enter "YES" for benzene and enter "NO" for all other compounds. For TICs (Analyte Type = TIC), if more than one analysis is submitted for a particular sample and method, choose only one of the analyses where Reportable Result = YES for <u>all</u> TICs. For example, a sample was run a second time because one or more target compounds exceeded the calibration range in the undiluted analysis. Choose a particular analysis and enter "YES" for all TICS. In the other analysis enter "NO" for all TICs. Note that it is not necessary to report the full target analyte list for the initial result, dilution, re-analysis, or re-extraction. However, each target analyte must be reported YES once and once only in the case of multiple analyses for a given sample, method, and matrix. In the case of organics, all surrogates must be reported for all analyses submitted for a given sample, method, and, matrix.	Text	3	X
SpkConcnAdded	The spike added. This value must be reported in the	Numeric (1)	10(6)	R

Table A1
Field Descriptions for the Analytical Results Table (Table A1)
Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Required Value
	same units as the result. Where (SA) in the following equation: % Recovery = (SSA-SC)/SA x 100% where : SSA is the spiked sample concentration (amount) after spiking. SC is the sample concentration (amount) before spiking. SA is the the expected increase in sample concentration (amount) as a result of spiking. This value must incorporate all correction factors such as dilution factor and moisture content that are applied to the spiked sample when computing the spiked sample concentration or amount.			
SpkParentSampleID	The sampleID of a sample (often called the original sample) that receives a spike aliquot to form a spiked sample such as a matrix spike. This is not the same as the ID of the spiked sample (such as a matrix spike) after spiking. The result for SpkParentSampleID and the result (i.e., SpkConcnAdded) for the spiked sample are used to compute percent recovery of the analyte.	Text	25	R
SamplePrepInitial	The initial sample preparation volume in liters (L) for aqueous samples or grams (g) for solid samples.	Numeric (1)	20(6)	
SamplePrepFinal	The final sample preparation volume in liters (L) for aqueous samples or grams (g) for solid samples.	Numeric (1)	20(6)	
Comment	Add any comments or additional information specific to the analyte test result data record.	Text	200	

X Required field.

Q Only required if laboratory has qualified the result.

T Only required for tentatively identified compounds by GC/MS.

R Only required if Analyte_Type =”SPK” or “SURR”.

D Only required for spiked compounds in the LCSD and MSD.

(1) Field Length indicates decimal precision in parenthesis. For example, 5(2) = a total width of 5 numbers including a maximum of 2 decimal places.

Table A3
Field Description for the Sample Analysis (Table A3)
This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Required Value
ProjectNumber	Project number assigned by the client.	Text	30	X
ProjectName	Project name assigned by the client.	Text	90	X
ClientSampleID	Client or contractor's identifier for a field sample If a sample is analyzed as a laboratory duplicate, matrix spike, or matrix spike duplicate, append suffixes DUP, MS and MSD respectively to the Client Sample ID with no intervening spaces or hyphens (i.e. MW01DUP, MW01MS, and MW01MSD). For Method Blanks, LCS, and LCSD enter the unique LaboratorySampleID into this field Do not append suffixes to the ClientSampleID for dilutions, reanalyses, or re-extracts (the Analysis_Type field is used for this distinction). For example, MW01DL and MW01RE are not allowed Parent sample records must exist for each MS and MSD. If an MS/MSD is shared between two EDDs, records for the MS/MSD and its parent sample must exist in the Sample Analysis table for both EDDs.	Text	25	X
Collected	Date and Time of sample collection. Refer to the date/time format at the end of this table. Leave this field blank for Method Blank, LCS, and LCSD	Date/ Time	16*	C
MatrixID	Sample matrix (i.e., AQ, SO, etc.)	Text	10	X
LabSampleID	Laboratory tracking number for field samples and lab generated QC samples such as method blank, LCS, and LCSD. There are no restrictions for the LabSampleID except field length and that the LabSampleID must be unique for a given field sample or lab QC sample and method.	Text	25	X
QCType	This record identifies the type of quality control sample QC (i.e., Duplicate, LCS, Method Blank, MS, or MSD). For regular environmental samples, populate this field with "NM".	Text	10	X
ShippingBatchID	Unique identifier assigned to a cooler or shipping container used to transport client or field samples. Links all samples to a cooler or shipping container. No	Text	25	C

Table A3
Field Description for the Sample Analysis (Table A3)
This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Required Value
	value is required for method blanks, LCS, and LCSD.			
Temperature	Temperature (in centigrade degrees) of the sample as received. This field is not required for radiochemistry methods.	Numeric (1)	10(6)	C
LabAnalysisRefMethodID	Laboratory reference method ID. The method ID may be an EPA Method number or laboratory identifier for a method such as a SOP number, however; values used for Laboratory Method IDs are specified by the project and must in the in standard value list for method IDs.	Text	25	X
PreparationType	Preparation Method Number (i.e., 3010A, 3510C, 3550C, 5030B, etc.) For analytical procedures that do not have a specific preparation method number, use “Gen Prep”.	Text	25	X
AnalysisType	Defines the type of analysis such as initial analysis, dilution, re-analysis, etc. This field provides distinction for sample records when multiple analyses are submitted for the same sample, method, and matrix, for example: dilutions, re-analyses, and re-extracts.	Text	10	X
Prepared	For radiochemistry leave this field blank. For all other methods enter the date and time of sample preparation or extraction. Refer to the date/time format at the end of this table.	Date/ Time	16*	X
Analyzed	Date and time of sample analysis. Refer to the date and time format at the end of this table.	Date/ Time	16*	X
LabID	Identification of the laboratory performing the analysis.	Text	7	X
QCLevel	The level of laboratory QC associated with the analysis reported in the EDD. If only the Analytical Results Table (A1) and the Sample Analysis Table (A3) information are submitted for the sample, enter “COA”. If the Laboratory Instrument Table (A2) information is also submitted for the sample, enter “COCAL”	Text	6	X
ResultBasis	Indicates whether results associated with this sample records are reported as wet or percent moisture corrected. This field is only required for soils and sediments. Enter “WET” if results are not corrected for	Text	3	X

Table A3
Field Description for the Sample Analysis (Table A3)
This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Required Value
	percent moisture. Enter "DRY" if percent moisture correction is applied to results.			
TotalOrDissolved	This field indicates if the results related to this sample record are reported as a total or dissolved fraction. This field is only required for metal methods. For all other methods leave this field blank.	Text	3	X
Dilution	Dilution of the sample aliquot. Enter "1" for method blanks, LCS, and LCSD, or if the field samples was analyzed without dilution.	Numeric (1)	10(6)	X
HandlingType	Indicates the type of leaching procedure, if applicable (i.e., SPLP, TCLP, WET). Leave this field blank if the sample analysis was not performed on a leachate.	Text	10	L
HandlingBatch	Unique laboratory identifier for a batch of samples prepared together in a leaching procedure (i.e., SPLP, TCLP, or WET preparation). The HandlingBatch links samples with leaching blanks. Leave this field blank if the sample analysis was not performed on a leachate	Text	12	L
LeachateDate	Date and time of leaching procedure (i.e., date for SPLP, TCLP, or WET preparation). Refer to the date and time format at the end of this table. Leave this field blank if the sample analysis was not performed on a leachate	Date /Time	16*	L
Percent_Moisture	Percent of sample composed of water. Enter for soil and sediment samples only.	Numeric (1)	10(6)	X
MethodBatch	Unique laboratory identifier for a batch of samples of similar matrices analyzed by one method and treated as a group for matrix spike, matrix spike duplicate, or laboratory duplicate association The method batch links the matrix spike and/or matrix spike duplicate or laboratory duplicates to associated samples. Note the MethodBatch association may coincide with the PreparationBatch association. The MethodBatch is specifically used to link the MS/MSD and/or DUP to associated samples.	Text	12	X
PreparationBatch	Unique laboratory identifier for a batch of samples	Text	12	X

Table A3
Field Description for the Sample Analysis (Table A3)
This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Required Value
	prepared together for analysis by one method and treated as a group for method blank, LCS and LCSD association. The PreparationBatch links method blanks and laboratory control samples (blank spikes) to associated samples. Note, the PreparationBatch association may coincide with the MethodBatch association but the PreparationBatch specifically links the Method Blank and LCS to associated samples.			
RunBatch	For radiochemistry methods leave this field blank. For all other methods the RunBatch is the unique identifier for a batch of analyses performed on one instrument under the control of one initial calibration and initial calibration verification. The RunBatch links both the initial calibration and initial calibration verification to subsequently analyzed and associated continuing calibrations, field samples, and QC analyses. For GC/MS methods, the RunBatch also links a BFB or DFTPP tune. A distinct RunBatch must used with every new initial calibration within a method The value entered in this field links a particular sample/method/analysis type record to a set of associated initial calibration and initial calibration verification records from Table A2. This field is only required if the A2 table is included with the EDD.	Text	12	X
AnalysisBatch	For radiochemistry methods leave this field blank. For all other methods the AnalysisBatch is the unique identifier for a batch of analyses performed on one instrument and under the control of a continuing calibration or continuing calibration verification. The AnalysisBatch links the continuing calibration or calibration verification to subsequently analyzed and associated field sample and QC analyses. For GC/MS methods, the AnalysisBatch also links the BFB or DFTPP tune. A distinct AnalysisBatch must be used with every new continuing calibration or continuing calibration verification within a method The value entered in this field links a particular sample/method/analysis type record to a set of associated continuing calibration records in the Laboratory Instrument table.	Text	12	X

Table A3
Field Description for the Sample Analysis (Table A3)
This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Required Value
	This field is only required if the A2 table is included with the EDD.			
LabReportingBatch	Unique laboratory identifier for the EDD. This is equivalent to the sample delivery group, lab work number, login ID, etc. The LabReportingBatch links all records in the EDD reported as one group. The value entered in this field must be the same in all records.	Text	12	X
LabReceipt	Date and time the sample was received in the lab. A time value of 00:00 may be entered. Refer to the date/time format at the end of this table.	Date/ Time	16*	X
LabReported	Date and time hard copy reported delivered by the lab. A time value of 00:00 may be entered. Refer to the date/time format at the end of this table.	Date/ Time	16*	X
Comment	Add any comments or additional information specific to the sample analysis data record.	Text	200	

C Only required for regular samples, duplicates and MS/MSDs.
L Only required if analysis performed is SPLP, TCLP or WET extracts.
X Required field.

(1) Field Length indicates decimal precision in parenthesis. For example, 5(2) = a total width of 5 numbers including a maximum of 2 decimal places.

* Format Date and Time as MM/DD/YYYY hh:mm; where MM = two digit month, DD = two digit day, and YYYY = four digit year, hh = hour in 24 hour format, and mm = minutes.

3.0 Laboratory Data Checker

The Laboratory Data Checker is a web-based application that will review Laboratory Electronic Data Deliverables (LEDDs) for adherence to Tetra Tech's EDD format requirements. EDDs will be reviewed for elements such as missing data and/or columns of data, and compliance of the data within each column to the required data types/lengths. Once an EDD passes through the checker with no errors, it must be submitted to Tetra Tech through the LEDD Checker application.

Access to the LEDD Checker application will be provided by an initial registration/approval process. An Information Systems Group (ISG) Administrator will approve requests for access**.** To access the site or begin the registration process, visit the ISG web site at http://isg.ttnus.com and select the "Laboratory Checker" link on the left of the home page. Registered users may access the checker immediately by logging in to the system using their credentials. New users must select the "Register" button and provide all of the requested information**.**

After completing all fields on the registration form, select the "Submit" button to complete the request process. Upon verification by an ISG Administrator, an email notification will be sent verifying the user ID, password and account status. Forgotten passwords may be retrieved by using the "Forgot password?" link on the login

page. Note that the email address that was provided for registration or password retrieval is the user ID and must be a valid e-mail address.

The general process for submitting EDD files through the LEDD Checker involves a 3-stage process that includes an upload stage, an error checking stage and a submittal stage.

Log into the LEDD Checker by typing your login credentials and select the "Login" button. The LEDD Checker home page provides a general overview of the checker functionality and EDD file format requirements. At the bottom of the home page, example EDDs are provided that may be viewed or downloaded. To download the files, right click on the link and select "Save target as" from the menu. Each LEDD Checker page includes a navigation bar with links to return to the home page or continue the checking and submittal process. Users should **NOT** use the back or forward buttons on the browser, instead use the links provided in the application to navigate through the site.

Detailed information regarding EDD preparation, formatting requirements and text file naming conventions are provided in the Electronic Data Format Requirements Section of the Laboratory SOW.

Begin the upload stage by selecting the "Upload/Check Files" link on the home page. Follow the steps on the upload page starting with the selection of the laboratory name that corresponds to your organization. If your organization is not listed, contact LabSupport@tetratech.com, and provide a full description of your organization name, contact information and include "Laboratory Contractor ID Request" in the subject line. An ISG Administrator will respond to the request via e-mail.

Load the appropriate A1, A2, or A3 target EDD files by clicking the "Browse" button next to each data table input box. A file browser dialog will appear allowing files to be selected from a local or network drive. After the EDD files are loaded, click the "Upload" button to complete the upload stage. Note that each table may be uploaded and checked separately; however, a minimum of the A1 and A3 files are required in order to submit the EDDs.

If the file upload was successful, the checking page will immediately load. Begin the checking stage by selecting the "Check Files" button. The LEDD Checker will begin validating the EDD files for compliance. Depending on file size and network activity the validation process may take several minutes. The progress should be displayed in the information bar at the bottom of the browser window. **Do not** select the "Check Files" button again or otherwise use the browser during this process. Other applications may be used; however, note that the LEDD Checker may not sit idle for more than 30 minutes. If the time is exceeded a new session must be started in a new browser window.

Any errors will be processed and returned on the error page. The following general errors may be returned.

- Column count / table structure errors – due to column header names being included, improper delimiter, extra tabs, extra or missing columns of data, spaces or other characters at the end of a row.
- Row and column value specific errors – may occur for one or more reasons including: data truncation, invalid date / time format, invalid decimal precision or field width exceedance, or if a value is not in a list of valid values or expected range.

If column count / table structure errors are encountered, the LEDD Checker will return an error and stop the checking process.

The EDDs will not be processed any further until the column errors are resolved. Text fields are validated for truncation. Date / Time fields are validated for truncation and format compliance. Numeric decimal fields are validated for truncation, character type compliance and decimal precision. All required fields are validated for null values or empty text strings (i.e. spaces). The LEDD Checker will return a list of all errors in and include a reference to the row number on which the error occurred. Note that consecutive EDD files may be loaded and checked, and submitted while logged in. However, no data may be submitted until all EDD files have passed

through the LEDD Checker without errors. The list of errors may be printed by selecting the “Print this Page” button from the checker error page.

If the EDD files pass with no errors, the submittal page will immediately load. To complete the submittal stage, include the following information in the comment and additional information area of the form: laboratory name, laboratory contact person, project name, project number, site name/number, fractions included and any specific comments related to the EDD. Select the “Submit Files” button to continue the submittal process.

The submittal stage is not considered complete until a unique ticket key reference is returned in the browser window. The ticket key reference must be printed for record of submission and future reference. In addition, a copy of the ticket key reference must be included in the PDF data package.

APPENDIX E

LABORATORY STANDARD OPERATING PROCEDURES AND CERTIFICATIONS

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

TESTAMERICA LABORATORIES
WEST SACRAMENTO

West Sacramento, CA

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (QSM v4.1); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

Presented this 15th day of December 2009.

President & CEO
For the Accreditation Council
Certificate Number 2928.01
Valid to January 31, 2012

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025-2005

TESTAMERICA LABORATORIES WEST SACRAMENTO
880 Riverside Parkway
West Sacramento, CA 95605
Douglas Weir Phone: 916 3744 389

ENVIRONMENTAL

Valid To: January 31, 2012 Certificate Number: 2928.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1)) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Inductively Coupled Plasma (ICP), ICP-Mass Spectroscopy, Atomic Absorption Spectroscopy (flame), Gas Chromatography(GC), GC- Mass Spectroscopy, High Resolution Gas Chromatography/High Resolution Mass Spectroscopy, Liquid Chromatography(LC),LC- Mass Spectroscopy, Ion Chromatography, Spectrophotometry, Misc.- Electronic Probes

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
Metals				
Aluminum	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Antimony	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Arsenic	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Barium	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Beryllium	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Cadmium	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Calcium	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Chromium (Total)	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Chromium (Hexavalent)	EPA 7196A	EPA 7196A	-------	EPA 3005A/3010A/3050A
Cobalt	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Copper	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Iron	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Lead	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Magnesium	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A

5301 Buckeystown Pike, Suite 350 | Frederick, Maryland 21704-8373 | Phone: 301 644 3248 | Fax: 301 662 2974 | www.A2LA.org

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
Manganese	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Mercury	EPA 7470A/6020	EPA 7471A	-------	EPA 3005A/3010A/3050A
Molybdenum	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Nickel	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Potassium	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Selenium	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Silver	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Sodium	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Thallium	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Vanadium	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Zinc	EPA 6010B/6020A	EPA 6010B/6020A	-------	EPA 3005A/3010A/3050A
Nutrients				
Nitrate	EPA 353.2/9056A/300.0	EPA 353.2/9056A/300.0	-------	----------
Nitrate-nitrite	EPA 353.2/ SM4500-NO3 F	EPA 353.2	-------	----------
Nitrite	EPA 353.2/9056A/300.0	EPA 353.2	-------	----------
Orthophosphate	EPA 9056A/300.0	EPA 9056A/300.0	-------	----------
Wet Chemistry				
Oil and Grease	EPA 1664/9070	EPA 1664/9071	-------	----------
Nitrocellulose	WS-WC-0050	WS-WC-0050	-------	----------
Perchlorate	EPA 6850	EPA 6850	-------	----------
Chloride	EPA 9056A/300.0	EPA 9056A/300.0	-------	----------
Fluoride	EPA 9056A/300.0	EPA 9056A/300.0	-------	----------
Sulfate	EPA 9056A/300.0	EPA 9056A/300.0	-------	----------
TOC	EPA 9060	EPA 9060	-------	----------
Hazardous Waste Characteristics				
TCLP Extractables	----------	EPA 1311	-------	----------
TCLP Inorganics	----------	EPA 1311	-------	----------
Purgeable Organics				
(volatiles)				
Acetone	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Acrolein	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Acrylonitrile	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Allyl Chloride	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Benzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Bromochloromethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Bromodichloromethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Bromoform	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Bromomethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Carbon disulfide	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Carbon tetrachloride	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Chlorobenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
Chloroethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
2-Chloroethyl vinyl ether	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Chloroform	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Chloromethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Chloroprene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Dibromochloromethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,2-Dibromo-3-chloropropane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,2-Dibromoethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Dibromomethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,2-Dichlorobenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,3-Dichlorobenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,4-Dichlorobenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
trans-1,4-dichloro-2-butene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Dichlorodifluoromethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,1-Dichloroethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,2-Dichloroethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,1-Dichloroethene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
trans-1,2-Dichloroethene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
cis-1,2-Dichloroethene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,2-Dichloropropane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,3-Dichloropropane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
2,2-Dichloropropane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,1-Dichloropropene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
cis-1,3-Dichloropropene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
trans-1,3-Dichloropropene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,4-Dioxane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Ethylbenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Ethyl methacrylate	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Hexachlorobutadiene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
2-Hexanone (MBK)	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Iodomethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Isobutyl Alcohol	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Methacrylonitrile	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Methyl tert-butyl ether (MTBE)	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Methylene chloride	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Methyl ethyl ketone	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Methyl methacrylate	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
4-Methyl-2-pentanone (MIBK)	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Naphthalene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Propionitrile	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,1,1,2-Tetrachloroethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,1,2,2-Tetrachloroethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Tetrachloroethene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Toluene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,2,3-Trichlorobenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,2,4-Trichlorobenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,1,1-Trichloroethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,1,2-Trichloroethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Trichloroethene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
Trichlorofluoromethane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,2,3-Trichloropropane	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Vinyl acetate	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Vinyl chloride	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
m & p xylene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
o-xylene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Xylenes, Total	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
tert-amyl methyl ether (TAME)	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
tert-butyl alcohol (TBA)	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Ethyl tert-butyl ether (ETBE)	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Bromobenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
n-Butylbenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
sec-Butylbenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
tert-Butylbenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
2-Chlorotoluene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
4-Chlorotoluene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Isopropylbenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
n-Propylbenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Styrene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,2,4-Trimethylbenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
1,3,5-Trimethylbenzene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Oxygenates	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Gasoline Range Organics (GRO)	EPA 8260B/AK101	EPA 8260B/AK101	-------	EPA 5030A/5030B/5035/5035A
p-Isopropyltoluene	EPA 8260B	EPA 8260B	-------	EPA 5030A/5030B/5035/5035A
Extractable Organics				
(semivolatiles)				
Acenaphthene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/3580A Air: 3542/TO-13A
Acenaphthylene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/3580A Air: 3542/TO-13A
Acetophenone	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
2-Acetylaminofluorene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
4-Aminobiphenyl	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Aniline	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Anthracene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/3580A Air: 3542/TO-13A
Aramite	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Benzaldehyde	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Benzidine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
Benzo(a)anthracene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/3580A Air: 3542/TO-13A
Benzo(b)fluoranthene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/3580A Air: 3542/TO-13A
Benzo(k)fluoranthene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/3580A Air: 3542/TO-13A
Benzo(g,h,i)perylene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/3580A Air: 3542/TO-13A
Benzo(a)pyrene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/3580A Air: 3542/TO-13A
Benzo(e)pyrene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/3580A Air: 3542/TO-13A
Benzoic acid	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Benzyl alcohol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Benzyl butyl phthalate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Biphenyl	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Bis(2-chloroethoxy) Methane	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Bis(2-chloroethyl) ether	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Bis(2-chloroisopropyl) ether	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Di(2-ethylhexyl) phthalate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
4-Bromophenyl phenyl ether	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Carbazole	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
4-Chloroaniline	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
4-Chloro-3-methylphenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
1-Chloronaphthalene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
2-Chloronaphthalene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
2-Chlorophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
4-Chlorophenyl phenyl ether	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Chrorobenzilate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/3580A
Chrysene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/3580A

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
Diallate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Dimethoate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Dibenz(a,j)acridine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Dibenz(a,h)anthracene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/ 3580A Air: 3542/TO-13A
Dibenzofuran	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1,2-Dichlorobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1,3-Dichlorobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1,4-Dichlorobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
3,3'-Dichlorobenzidine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2,4-Dichlorophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2,6-Dichlorophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Diethyl Phthalate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
p-Dimethylaminoazobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
7,12-Dimethylbenz(a)anthracene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Dimethoate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
a-Dimethylphenethylamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2,4-Dimethylphenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Dimethyl Phthalate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Di-n-butyl phthalate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Di-n-octyl phthalate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1,3-Dinitrobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1,4-Dinitrobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
4,6-Dinitro-2-methylphenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2,4-Dinitrophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2,4-Dinitrotoluene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2,6-Dinitrotoluene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1,4-Dioxane	WS-MS-0011	WS-MS-0011	-------	EPA 3500B/3510C
Diphenylamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
1,2-Diphenylhydrazine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Ethyl methanesulfonate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Fluoranthene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/ 3580A Air: 3542/TO-13A
Fluorene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/ 3580A Air: 3542/TO-13A
Hexachlorobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Hexachlorobutadiene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Hexachlorocyclopentadiene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Hexachloroethane	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Hexachloropropene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Indeno(1,2,3-c,d)pyrene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/ 3580A Air: 3542/TO-13A
Isophorone	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Isosafrole	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Isodrin	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/
3-Methylcholanthrene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2-Methyl-4,6-dinitrophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Methyl methanesulfonate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2-Methylnaphthalene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/ 3580A Air: 3542/TO-13A
2-Methylphenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
3-Methylphenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/
4-Methylphenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Naphthalene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/ 3580A Air: 3542/TO-13A
1,4-Naphthoquinone	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1-Naphthylamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2-Naphthylamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2-Nitroaniline	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
3-Nitroaniline	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
4-Nitroaniline	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Nitrobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2-Nitrophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
4-Nitrophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
n-Nitrosodi-n-butylamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
n-Nitrosodiethylamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
n-Nitrosodimethylamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
n-Nitrosodi-n-propylamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
n-Nitrosodiphenylamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
n-Nitrosomethylethylamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
n-Nitrosomorpholine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
n-Nitrosopiperidine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
n-Nitrosopyrrolidine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
5-Nitro-o-toluidine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Parathion Ethyl	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Pentachlorobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Pentachloronitrobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Pentachlorophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Phenacetin	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Phenanthrene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/ 3580A Air: 3542/TO-13A
Phenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1,4-Phenylenediamine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Phorate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2-Picoline	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Pyrene	EPA 8270C/WS-MS-006/WS-MS-0008	EPA 8270C/WS-MS-006/WS-MS-0008	WS-MS-0006	EPA 3500B/3510C/3550B/ 3580A Air: 3542/TO-13A
Pyridine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Safrole	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
Sulfotepp	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1,2,4,5-Tetrachlorobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2,3,4,6-Tetrachlorophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
o-Toluidine	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1,2,4-Trichlorobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2,4,5-Trichlorophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
2,4,6-Trichlorophenol	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
1,3,5-Trinitrobenzene	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
o,o,o-triethyl Phosphorothioate	EPA 8270C	EPA 8270C	-------	EPA 3500B/3510C/3550B/ 3580A
Diesel Range Organics (DRO)	EPA 8015B/AK102	EPA 8015B/AK102	-------	EPA 3500B/3510C/3550B/ 3580A
Residual Range Organics	AK103	AK103	-------	EPA 3500B/3510C/3550B/ 3580A
Dioxins				
2,3,7,8-TeCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,7,8-PeCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,4,7,8-HxCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,6,7,8-HxCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,7,8,9-HxCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,4,6,7,8-HpCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
OCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
2,3,7,8-TeCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,7,8-PeCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
2,3,4,7,8-PeCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,4,7,8-HxCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,6,7,8-HxCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,7,8,9-HxCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
2,3,4,6,7,8-HxCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,4,6,7,8-HpCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
1,2,3,4,7,8,9-HpCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
OCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
Total TCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
Total PeCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
Total HxCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
Total HeptaCDD	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
Total TCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
Total PeCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
Total HxCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------
Total HpCDF	EPA 8280A/8290/1613B	EPA 8280A/8290/1613B	-------	----------

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
Chemical Warfare Degradates				
1,4-Dithiane	WS-MS-0003	WS-MS-0003	-------	----------
Benzothiazole	WS-MS-0003	WS-MS-0003	-------	----------
p-Chlorophenyl methylsulfide	WS-MS-0003	WS-MS-0003	-------	----------
p-Chlorophenyl methylsulfoxide	WS-MS-0003	WS-MS-0003	-------	----------
p-Chlorophenyl methylsulfone	WS-MS-0003	WS-MS-0003	-------	----------
Chloropicrin	WS-MS-0003	WS-MS-0003	-------	----------
Acetophenone	WS-MS-0003	WS-MS-0003	-------	----------
2-Chloroacetophenone	WS-MS-0003	WS-MS-0003	-------	----------
1,4-Oxathiane	WS-MS-0003	WS-MS-0003	-------	----------
Dimethyl Disulfide	WS-MS-0003	WS-MS-0003	-------	----------
Diisopropylmethylphosphate (DIMP)	WS-LC-0004	WS-LC-0004	-------	----------
Dimethylmethylphosphonate (DMMP)	WS-LC-0004	WS-LC-0004	-------	----------
Ethyl methylphosphonic acid (EMPA)	WS-LC-0004	WS-LC-0004	-------	----------
Isopropyl methylphosphonic acid (IMPA)	WS-LC-0004	WS-LC-0004	-------	----------
Methylphosphonic acid (MPA)	WS-LC-0004	WS-LC-0004	-------	----------
Thiodiglycol (2,2'-Thiodiethanol) (TDG)	WS-LC-0004	WS-LC-0004	-------	----------
Nitroaromatics				
2-Amino-4,6-dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
4-Amino-2,6-dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
3,5-Dinitroaniline	EPA 8330B	EPA 8330B	-------	----------
1,3-Dinitrobenzene	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
2,4-Dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
2,6-Dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
Ethylene glycol dinitrate	EPA 8330B	EPA 8330B	-------	----------
Glycerol trinitrate (Nitroglycerin)	EPA 8330B	EPA 8330B	-------	----------
Hexahydro-1,3,5-trinitro-1,3,5-triazine (Hexogen)	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
Methyl-2,4,6-trinitrophenylnitramine	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
Nitrobenzene	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
2-Nitrotoluene (o-Nitrotoluene)	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
3-Nitrotoluene (m-Nitrotoluene)	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
4-Nitrotoluene (p-Nitrotoluene)	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
Octahydro-1,3,5,7-tetranitro1,3,5,7-tetracine (Octogen)	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
Picric acid	EPA 8330B	EPA 8330B	-------	----------
Pentaerythritol tetranitrate	EPA 8330B	EPA 8330B	-------	----------
1,3,5-Trinitrobenzene	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
2,4,6-Trinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B	-------	----------
Nitroguanidine	WS-LC-0010	WS-LC-0010	-------	----------
Nitrosamines				
N-Nitrosodimethylamine (NDMA)	WS-MS-0012	WS-MS-0012	-------	----------
Perfluoro Compounds				
Perfluorooctanoic acid	WS-LC-0020	WS-LC-0020	-------	----------
Perfluorooctane sulfonate	WS-LC-0020	WS-LC-0020	-------	----------
Ammonium perfluorooctanate	WS-LC-0020	WS-LC-0020	-------	----------
Pesticides/PCBs				
Aldrin	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
a-BHC	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
b-BHC	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
d-BHC	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
g-BHC (Lindane)	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
a-Chlordane	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
g-Chlordane	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
4,4'-DDD	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
4,4'-DDE	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
4,4'-DDT	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
Dieldrin	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Endosulfan I	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Endosulfan II	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Endosulfan sulfate	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Endrin	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Endrin aldehyde	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Endrin ketone	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Heptachlor	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Heptachlor epoxide	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Methoxychlor	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Toxaphene	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Mirex	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Diallate	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Isodrin	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Chlorobenzillate	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
Chlordane (technical)	EPA 8081A	EPA 8081A	-------	EPA 3500B/3510C/3550B/3620B/ 3660A
<u>PCB (Aroclors)</u>				
PCB-1016	EPA 8082	EPA 8082	-------	EPA 3500B/3510C/3550B/3580A/3620B/3660A/3665A

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
PCB-1221	EPA 8082	EPA 8082	-------	EPA 3500B/3510C/3550B/3580A/ 3620B/3660A/3665A
PCB-1232	EPA 8082	EPA 8082	-------	EPA 3500B/3510C/3550B/3580A/ 3620B/3660A/3665A
PCB-1242	EPA 8082	EPA 8082	-------	EPA 3500B/3510C/3550B/3580A/ 3620B/3660A/3665A
PCB-1248	EPA 8082	EPA 8082	-------	EPA 3500B/3510C/3550B/3580A/ 3620B/3660A/3665A
PCB-1254	EPA 8082	EPA 8082	-------	EPA 3500B/3510C/3550B/3580A/ 3620B/3660A/3665A
PCB-1260	EPA 8082	EPA 8082	-------	EPA 3500B/3510C/3550B/3580A/ 3620B/3660A/3665A
PCB-1262	EPA 8082	EPA 8082	-------	EPA 3500B/3510C/3550B/3580A/ 3620B/3660A/3665A
PCB-1268	EPA 8082	EPA 8082	-------	EPA 3500B/3510C/3550B/3580A/ 3620B/3660A/3665A
PCB (congeners)				
PCB 1 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 2 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 3 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 4 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 5 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 6 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 7 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 8 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 9 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 10 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 11 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 12 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 13 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 14 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 15 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 16 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 17 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 18 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 19 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 20 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 21 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 22 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 23 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 24 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 25 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 26 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
PCB 27 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 28 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 29 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 30 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 32 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 31 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 33 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 34 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 35 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 36 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 37 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 38 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 39 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 40 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 41 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 42 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 43 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 44 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 45 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 46 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 47 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 48 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 49 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 50 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 51 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 52 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 53 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 54 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 55 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 56 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 57 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 58 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 59 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 60 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 61 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 62 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 63 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 64 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 65 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 66 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 67 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 68 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 69 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 70 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 71 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 72 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 73 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 74 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 75 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 76 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 77 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
PCB 78 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 79 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 80 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 81 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 82 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 83 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 84 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 85 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 86 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 87 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 88 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 89 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 90 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 91 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 92 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 93 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 94 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 95 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 96 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 97 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 98 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 99 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 100 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 101 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 102 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 103 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 104 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 105 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 106 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 108 (BZ)/107 (IUPAC)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 109 (BZ)/108 (IUPAC)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 107 (BZ)/109 (IUPAC)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 110 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 111 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 112 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 113 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 114 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 115 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 116 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 117 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 118 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 119 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 120 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 121 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 122 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 123 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 124 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 125 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 126 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 127 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 128 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
PCB 129 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 130 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 131 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 132 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 133 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 134 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 135 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 136 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 137 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 138 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 139 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 140 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 141 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 142 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 143 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 144 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 145 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 146 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 147 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 148 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 149 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 150 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 151 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 152 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 153 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 154 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 155 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 156 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 157 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 158 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 159 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 160 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 161 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 162 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 163 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 164 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 165 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 166 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 167 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 168 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 169 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 170 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 171 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 172 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 173 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 174 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 175 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 176 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 177 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 178 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 179 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------

Parameter/Analyte	Non potable Water	Solid Hazardous Waste	Air	Associated Prep Methods
PCB 180 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 181 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 182 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 183 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 184 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 185 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 186 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 187 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 188 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 189 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 190 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 191 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 192 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 193 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 194 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 195 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 196 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 197 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 198 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 201 (BZ)/199 (IUPAC)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 199 (BZ)/200 (IUPAC)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 200 (BZ)/201 (IUPAC)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 202 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 203 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 204 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 205 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 206 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 207 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 208 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------
PCB 209 (BZ)	EPA 1668A mod	EPA 1668A mod	-------	----------

Title: Waste Disposal

Approvals (Signature/Date):

Richard Kester 1-26-09	1/26/2009
Richard Kester — Date	Joe Schairer — Date
Technical Manager	Health & Safety Manager / Coordinator
Pamela Schemmer 1/27/09	Karla Buechler 1/29/09
Pamela Schemmer — Date	Karla Buechler — Date
Quality Assurance Manager	Laboratory Director

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1. PURPOSE

1.1. The purpose of this procedure is to provide details for waste management procedures established in Corporate Safety Manual (CSM) Section 13 that apply to TestAmerica West Sacramento.

2. SCOPE

2.1. TestAmerica West Sacramento is a Large Quantity Generator (LQG), which creates over 1000 kg/month of hazardous waste (CSM 13.3). Consequently, TestAmerica West Sacramento is required to maintain an Emergency Response Team (ERT) for spills.

2.2. Drums must be shipped within 90 days from the date waste is first placed in them. Only non-hazardous soapy water from glassware cleaning is disposed via laboratory sinks to the sewer (CSM 13.2).

3. SAFETY

3.1. Procedures shall be carried out in a manner that protects the health and safety of all associates. When moving a waste drum, always use a drum dolly, and a ramp for palletizing.

3.2. The sump in the waste processing oven where lab wastewater is collected in a holding tank is a confined space that requires special training equipment and preparation before entry. Contact the EHSC before entering the sump.

3.3. All work must be stopped in the event of a known or potential compromise to the health and safety of an associate. The situation must be reported **immediately** to a laboratory supervisor.

3.4. In addition to lab coat and protective safety glasses, the following personal protective equipment is required for specific tasks:

3.4.1. When moving 55-gallon drums, the waste processor will wear steel toe boots and work gloves.

3.4.2. When adding bottles to glass drums, crushing glass and lab trash, or cleaning the Vyleater, puncture resistant gloves are required.

3.4.3. When operating either the Rampactor or Vyleater, hearing protection is required.

3.4.4. Wear a faceshield when pouring concentrated acids or bases.

3.5. Pollution Prevention

3.5.1. Drain Protectors (magnetized sheets) are used to cover/close all external drains during load out for waste shipment.

3.5.2. The use of sumps and secondary containment throughout the building helps to minimize the potential for contaminants to escape if they are spilled.

3.5.3. Routine testing and monitoring of POTW discharge ensures that we remain in compliance with regulatory limits.

3.5.4. The presence of specially treated hard surfaces in building sumps and work areas prevents leakage of contaminants into the ground.

3.5.5. The use of closed containers and vent bungs minimizes air pollution.

3.5.6. 1 gallon of water is added to all DCM waste drums. This forms a water layer on top of the DCM and reduces evaporation.

3.6. Waste Management

3.6.1. Contaminated tools and materials (that cannot be cleaned) become hazardous waste, and must be disposed of in the same manner as the original contaminant.

4. DEFINITIONS

4.1. ***Waste***: material no longer useful in the laboratory requiring disposal.

4.2. ***Drum:*** Cylindrical container for holding waste. Usually 55 gallon size, although may also be 20 liter or 5 gallon.

4.3. ***Satellite container:*** Smaller container near the point of waste generation that is emptied at least once a year.

4.4. ***H-3 Room***: Purpose built room for bulk waste storage. They feature fire doors, explosion proof wiring/lighting, separate ventilation, waxed sprinkler heads, and a grated sump to contain waste spills.

5. PROCEDURE

Wastes are either excess sample or analytical wastes. Analytical waste may include reagents (excess, expired, off-specification, or spilled), expired standards and curves, sample extracts, extracted solid or liquid samples, and machine fluids such as coolant and vacuum pump oil. Samples may accumulate in laboratories (filters in Air Tox, VOAs and core tubes in VOA

instrument) or may be returned to Sample Control. These last are routinely organized for disposal using dump slips.

5.1. Waste Collection: Waste is collected at multiple locations around the facility, then consolidated at either H-3 Waste Accumulation Rooms or the main waste collection area.

5.1.1. Waste is collected in the lab as outlined in Section 5.3 through 5.7. Labels are applied to all containers to identify the type of waste, hazardous constituents, collection start date or last emptied date, and the relative hazard of the waste. The National Fire Protection Association (NFPA) diamond system is our preferred method. Pre-made labels for satellite collection containers are available through EH&S, and are maintained on the safety drive, in the one of the "labels" folders.

5.1.2. Satellite collection areas and containers are found in all prep and instrument labs. These must be emptied when they are full, or after no more than one year after the first waste is put into the container, whichever comes first.

5.1.2.1. Instrument satellite waste containers are typically 2.5-liter to 20-liter plastic or plastic-coated glass carboys. When emptied, these are either dumped into a 55-gallon drum in an H-3 closet or moved directly to the main waste area, depending on the type of waste. Refer to the specific operations SOP.

5.1.2.2. Lab satellite trash cans are 5-gallon plastic buckets, with lids. When emptied, these are dumped into a 55-gallon drum in an H-3 closet or the main waste area.

5.1.2.3. Glassware satellite collection containers are cardboard boxes that are moved to the main waste area for disposal.

5.1.2.4. Storage cabinets in the main waste area.

5.1.3. 90-day collection areas are the "H-3" closets located between the metals prep lab and the air toxics prep lab; between sample administration and the organic prep lab; and between the organic prep lab and the low-resolution dioxin prep lab.

5.1.3.1. At the air toxics/metals prep H-3, there are drums for the accumulation of flammable solvent, DCM, lab trash and/or aqueous acid waste.

5.1.3.2. At the sample administration/organic prep H-3, there are drums for the accumulation of LLE waste, HPLC waste and lab trash.

5.1.3.3. At the organic prep/low resolution dioxin prep H-3, there are drums for the accumulation of DCM, flammable solvents, lab trash, and/or LLE waste.

5.2. Dump Slips

Dump slips are written authorizations for disposal that also serve as records for the disposition of samples. Dump slips are routinely generated and samples disposed of 30 days after invoicing unless differing instructions are provided to the waste processor and sample administration staff.

5.2.1. The Manager of Customer Service maintains the automated dump slip program on the Sacramento public directory. The Waste Processor keeps a file titled "Sample Disposal" in his desk file drawer tracking the dates when dump slips are generated.

5.2.2. The processor produces the dump slips. The Processor selects invoice dates at least 30 days prior to the current date so that the range should not duplicate previous selections. He then enters the dates on a log sheet.

5.3. Liquids: refer to Section 5.14, waste list.

Laboratory analysts are responsible for disposing liquid waste as listed in the specific operations SOPs. These will provide the following direction:

5.3.1. Dispose waste liquids to the appropriate container in the lab area.

5.3.2. Acid, Liquid-Liquid Extraction (LLE), Methylene Chloride (DCM), Flammable Solvent, and High Performance Liquid Chromatography (HPLC) wastes:

5.3.2.1. When the satellite collection container is ready to dump, transfer the contents to the appropriate drum in the H-3 Room.

5.3.2.2. When the flammable solvent drum is full (one to four inches from the top), bung the drum and transfer it to the waste collection area in the warehouse. When the DCM drum is full (four to six inches from the top), bung the drum and transfer it to the white storage are in the warehouse. Determine "fullness" with a wooden dowel or dipstick.

Note: There is a $5 reward for turning in DCM or flammable solvent drums that are properly filled.

5.3.2.3. Return with an empty drum to H-3, attach and date a proper in-house label. For the DCM drum, add one gallon of tap water to the drum to reduce evaporation.

<u>WARNING</u>: When using a drum dolly to move either a full or empty 55-gallon drum, you should always face the drum.

5.3.3. Deliver other wastes and expired liquids (VOA vials, standards, curves, and extract vials) directly to the main waste room.

5.4. Processing liquid wastes

5.4.1. VOA liquid waste: The VOA analysts collect analytical waste in 4-L plastic jugs. These are transferred to the processor and treated as follows:

5.4.1.1. Add two tablespoons of sodium bicarbonate (baking soda) to each jug to assure pH 6-8.

5.4.1.2. Pour into a blue plastic drum designated for incineration.

5.4.2. VOA vials: VOA analysts collect 40 ml vials of unused sample in cardboard boxes lined with plastic bags. Once they are transferred to the main waste room, the processor performs the following:

5.4.2.1. Place boxes of VOA vials on the narrow table next to the blue Vyleater. Check all fingerscrews on the Vyleater for tightness. Power up by throwing the main power switch to ON. Place a 20-L plastic carboy with 250 g of sodium bicarbonate under the Vyleater with the hose down its throat. Place the rubber mat in front to reduce breakage of fallen VOA vials. Situate a lab trash drum under the right side of the Vyleater. Prepare the drum by powdering the bottom of the drum with sodium bicarbonate to neutralize any hydrochloric acid, followed by a half inch of vermiculite to absorb any liquid.

5.4.2.2. Press the left and right green buttons to start the Vyleater. Pull the adjustment wheel from under the Vyleater and inset just below the hopper. Adjust the rollers to the point where they are almost touching. Load about 10 VOA vials into the hopper and raise it to the top, where it dumps into the Vyleater. Readjust the rollers so that they crush the vials being processed. Pull the adjustment wheel from under the Vyleater and insert below hopper to adjust width between grinder wheels to match vial size. The Vyleater will chew down the vials rapidly when the correct width is achieved. Observe that the liquid flows into the carboy and the broken vials are delivered to the lab trash drum. Use the plastic scoop to add vials to the hopper. This drops fewer on the floor. Repeat process until carboy is full or VOAs are all crushed. Wait until liquid stops flowing before changing carboy. Dump full carboys to the blue plastic drum designated for incineration.

5.4.2.3. When done, clean the Vyleater: Turn on the rinse water tap by the sink. Use the sodium bicarbonate squirt bottle to neutralize any HCL in the hopper and grinder area.

WARNING: DO NOT stick any body parts into the Vyleater. Wear heavy rubber coated gloves when cleaning the Vyleater.

Turn off the rinse water. Stop the Vyleater by pressing the Red button. Then switch OFF the power on the wall. Open the panel on the right end. Open the inner panel. Use the long handle scraper to clear most of the glass off the top screen. Pull out the screen while brushing remaining glass into the Vyleater. Lean the top screen against the Vyleater front and repeat for the lower screen. Scrape glass on the bottom towards yourself with the scraper. Use the wide putty knife to pick up and dispose to lab trash drum. Replace screens, close Vyleater and remove lab trash drum to Rampactor for more waste.

5.4.3. Process solvent vials in the Vyleater observing the following differences: Some extracts are stored cold for up to 90 days in room 419. They are removed on a monthly cycle. A 20-L steel drum is used to collect the vials, then pour the waste solvent into a 4-liter polyethylene jug. The 4-liter jug is then emptied into the flammable waste drum in the Advanced Technology H-3. Five gallon open-top drums delivered by analysts may contain bottles (60-250 mls). These are set aside and poured to the collection drum. Neat materials and standards with hazards other than flammability are set aside for lab packs. Wait overnight for vapors to clear before cleaning the Vyleater.

5.4.4. Enter the drum in logbook using a sequential number for the year. Document the start date, full date, shipping date and manifest number when shipped. Check the LLE and HPLC drums for pH (4-10 is acceptable).

5.4.5. Torque the bungs.

5.4.5.1. For waste packaged in blue poly drums (LLE, HPLC, and Acid), use the yellow preset torque wrench to apply 20 foot-pounds to each bung.

5.4.5.2. For waste packaged in steel drums, (DCM and Flammable solvents), replace the bungs with a 2 inch self-venting bung to prevent pressure buildup until shipped. Ship with the original bun torqued to 60 foot-pounds.

5.4.6. Apply a preprinted yellow RCRA label and write in drum number and start date. Make sure that the label is applied to upper third of the drum.

5.4.7. Next to the RCRA label, apply a 100 mm square DOT diamond indicating hazard class: 3 for flammable solvent and HPLC, 6.1 for DCM, and 8 for Acid drum.

5.4.8. Mark the drum on its top and sides with the drum number (from logbook) and profile number (from waste list or logbook). Place the drum number on the side between RCRA and DOT labels, with the side profile number placed immediately below labels. Write the numbers on the top so that they can be read from the label side. Use a black Sanford "Magnum 44" marker on poly drums and the tops of steel drums. Use a yellow Sanford "Mean Streak" marker to mark steel drum sides.

5.4.9. Strap drums with the same waste profile together on pallets. When less than four drums are shipped, they may be strapped with other compatible drums going to the same TSDF (Treatment Storage Disposal Facility). Flammable solvent drums are kept in the small shed in the warehouse parking lot until shipment.

5.5. Solids: See laboratory trash, soil on waste list, and Section 5.14.

5.5.1. Analysts dispose hazardous lab trash to the appropriate container in the lab area (lab trash bucket, glass box).

5.5.2. When the container is full, the analyst transfers it to the waste collection area in the warehouse or to the lab trash drum located in each H-3. Analyst replaces box or liner in lab trash bucket and marks new start date. Lab trash drums in H-3s are transported to main waste room when full, or not more than 90 days from start date.

5.5.3. The Processor uses orange Rampactor to consolidate lab trash. Rampacting the waste saves on the number of drums used, transport costs, and brings the drums up to the weight listed on the profile.

WARNING: In addition to lab coat and safety glasses, cut and puncture resistant gloves and earmuffs are required when operating the Rampactor. Before operation, read, follow, and replace the instruction sheets located in the blue capped steel tube welded on the right side below the control levers.

5.5.4. Sweep any broken glass out of the Rampactor. Seat drums fully over the bottom metal disk in the chamber. A shard of glass can tilt the drum. When the top disk crushes the edge of the drum, it can become wedged in place. When this happens, unbolt the top disk and place the ruined drum and disk in the 85 gallon salvage drum and buy a new disk.

5.5.5. Mark the position for the bottom of the drum. Place a perfect empty open-top drum in the Rampactor chamber. Center it as well as possible over the bottom disk. Close the chamber door and latch. Turn on the electric power switch on

the wall to the left of the Rampactor. Push both levers back until the top disk lowers to the level of the drum top. Observe through the tiny slit at the top of the door. Use a flashlight to help see. Pull both handles forward (towards yourself) to stop the ram and disk. Turn off the electric power.

Open the chamber door. Center the top of the drum under the top disk. Draw a circle around the drum bottom on the Rampactor using a yellow Sanford Meanstreak marker. Allow to dry. This allows you to place the drum more accurately. Remove the empty drum

5.5.6. Select an open top steel lab trash drum. Drums from lab areas will have a white paper in-house waste label with start date.

5.5.7. Log in the drum. Find the drum logbook and file of yellow RCRA labels under the radio. Turn to the current year and contents page. Turn to the Lab Trash pages. Enter the next drum number in the logbook, on the drum and on the yellow label. The proper label will have the profile number 44-11307. Mark the profile number on the top and side of the drum. Enter the "Start" date from the in-house label. Use the current date when starting a new drum.

Note: Do not apply start dates from glass boxes. They are satellite containers and may accumulate for one year. Lab trash drums must be shipped within 90 days of the start date.

5.5.8. Place the drum in the chamber and center on the disk. Close the chamber door, latching top and bottom. Turn on the electric power. Push both levers away from you and release. Carefully watch the disk descend to make sure it clears the edge of the drum. If it appears that the ram will not clear the edge of the drum properly, jerk back the levers. Then follow the procedures in paragraph 5.5.5 and reposition the drum so that it is centered under the ram and disk. The ram is bottomed when the dial reaches the line at 4 o'clock. Pull the bottom lever towards you, if it does not pop out automatically. The dial will indicate full pressure again when the ram and disk reach the top. Pull both levers towards yourself. Turn off the electric power. Open the chamber door.

5.5.9. Add more bags of lab trash or boxes of glass, and crush until no more can be added, or it is too heavy to move. Mix light plastic with glass to achieve an average weight. Pull bags from drums by the knot. Do not inhale while your head is in or over the drum.

5.5.10. Top off the full drum with vermiculite. It is stored in brown bags under the pallet racks.

5.5.11. Put ring and lid on drum. If the drum top is out of round, open the ring further and drop it 1/3 down the drum. Use the Rampactor carefully to seat the lid,

then bring up the ring and fasten with a 5/8-inch bolt (from the box under the radio).

5.5.12. Torque drum bolt to 60 foot-pounds.

5.5.13. Enter "Full" date in logbook. Mark drum top as in Section 5.4.8.

5.6. Soil: Sample Control Technicians bring excess soil samples to the main room after they receive a dump slip (Section 5.2, above). Standard cold retention is 30 days after mailing data, so those clients have time to review and request additional tests.

Soil must be thermally treated to comply with the California and US Department of Agriculture permits to import soils from quarantine areas.

VOA analysts bring soil samples after testing. Once soil is received, the processor handles the material as follows:

5.6.1. Log, label and mark a drum for soil (profile 44-11310). Line the drum with a 6 mil 55 gallon yellow plastic liner (kept between the poison locker and the flame cabinet).

5.6.2. Place soil samples in the drum. Glass containers and acetate tubes may be placed in whole. Do not open containers marked as high results for lead. Otherwise pour samples of loose, dry consistency over the other containers to fill the space, and reduce the number of waste drums required. Re-cap empty glass containers and place in a lined 20 gallon fiber drum, before adding to hazardous lab trash.

5.6.3. Remove the contents of metal core tubes, and reserve the tubes (segregated by metal) for salvage. Cut the plastic ends of the core tube, cutting away from the body and fingers. Express samples from standard size tubes using the modified arbor press kept on Tank 1. Otherwise, remove soil with a soil sampling gouge furnished with a wooden handle.

5.6.4. Transfer the contents of the drum to labpack segregated by hazard class and physical state. Seal the labpack and ship for disposal.

5.7. Non Hazardous solids: Empty solvent jugs, and sample bottles.

Analysts drain empty solvent bottles to appropriate waste drum and air overnight in hood to vent vapors. Keep bottles inverted so heavier than air vapors fall out.

In the Organic Prep and Dioxin Prep laboratories, place bottles in a drum and transport to the main waste room. Client sample bottles are collected in a separate drum from solvent bottles. In other areas, collect and transport empty bottles on tub carts and place into the open-top drums just to the right of the double yellow doors.

Once the empty solvent jugs and sample bottles are received in the main waste room, the processor handles them as described below:

5.7.1. Remove empty bottles from the glass collection drum(s) until even with the top of the drum. Otherwise they will fall and splinter. Place a metal lid over the glass to discourage jumpers. Using a drum truck, move the full drum to the Rampactor.

5.7.2. Crush the solvent bottles in the Rampactor and dump the glass into the dumpster using the forklift. The brown glass is borosilicate and melts at a higher temperature than soda ash glass, and is not recycled in California. Glass is crushed the same as lab trash (refer to Section 5.5) with the following exceptions:

5.7.2.1. Client sample bottles are crushed with lab trash and disposed with hazardous waste to destroy the label and protect client confidentiality.

5.7.3. Place the glass drum in the chamber over the disk. Remove the metal lid. Close the chamber door, latching top and bottom. Turn on the electric power. Push both levers away from you and release. Carefully observe the disk descend to make sure it clears the edge of the drum. If it does not, jerk back the levers, and adjust as in Section 5.5.5.

5.7.4. The ram is bottomed when the dial reaches the line at 4 o'clock. Pull the bottom lever towards you, if it does not pop out automatically. The dial will indicate full pressure again when the ram and disk reach the top. If plastic bottles have crawled around the edge, lower the disk a tad to release them. Pull both levers towards yourself. Turn off the electric power. Open the chamber door. Cover the drum to contain dust. Remove the drum or add more glass and repeat. When the crushed glass reaches the ring one-third from the bottom, stop and place the drum in the drum carrier.

5.7.5. When the container is one-third full, contents are transferred to a dumpster, and eventually are disposed in the local municipal landfill.

5.8. Dumping glass to the dumpster:

5.8.1. Open the rollup door in the main waste room all the way up. Position the drum carrier a few feet back from the doorway. There is a berm at the door so the forks will bounce up and down as your front forklift tires go over.

5.8.2. Open the warehouse rollup door by hitting the top button. Let it go all the way up. Back out the forklift and close the rollup door.

5.8.3. Adjust the forks to maximum width to fit the drum carrier. Bring the forks up to your middle thigh. Brake on. Neutral gear. Stand between the forks, facing the right fork you will adjust first. Disengage the lock at the top of the fork. Place your left thumb at the top of the fork. Pull up the fork with your right hand just enough to relieve the pressure at the elbow of the fork. Shift

your body weight to your right foot. Shove the fork out with even pressure at top, fork elbow (with left leg), and mid fork with right hand. Shove all the way out. Turn 180° to face the other fork and repeat. Remember to push fork with inside leg, or it will bind.

5.8.4. Drive forklift to main waste door. Raise forks so bottom is at big crossbar (about knee height) to clear bumps. Tilt full forward and lower to meet drum carrier and shove in. Park forklift (neutral & brake). Tighten hand screws on top of drum carrier fork tunnels.

5.8.5. Open both bat wing arms of drum carrier. The small one on the left will stay open if you drape the locking chain back towards the forklift. The tail of the chain should dip into the chain storage cup for the light spinner chain. Roll the drum in with the drum truck. Push in as far as possible. Bring the locking chain around the front of the drum. Turn the long black latch handle counterclockwise as far as you can without dropping the pawl. Pull the chain taut and place a link between the lugs. Turn the latch handle strongly clockwise to pull in the drum and tighten the chain. The ratchet will hold. (Pull the handle tight and lift the pawl to release when done.)

5.8.6. Lift the forks to the crossbar again. Ensure that the top of the mast clears the bottom of the door. Check for traffic and blow horn. Back out. Drive along edge of basketball court until you can see the street entrance of the parking lot. This ensures you are visible to drivers in the parking lot. Raise the bottom of the forks to the big bolts on the mast to clear the dumpster.

5.8.7. Drive in slowly until your side of the drum is just inside the dumpster and a few inches higher.

5.8.8. Park the forklift and dismount to the right.

5.8.9. Pull the tilt-chain with both hands to swing the drum forward 180 degrees and dump the glass. Do not breathe the glass dust. Drop the chain and grab the crowbar kept behind the seat. Beat the bottom of the drum to dislodge plastic bottles that may have wedged. Replace the crowbar. Tilt the drum back so open side is up. Repeat as needed.

WARNING: If the wind is blowing dust from the dumping process back towards you, use a dust filter/nuisance mask, available from the EH&S Coordinator or Hazardous Waste Specialist.

5.8.10. Lower the drum carrier all the way to the floor. Tilt the tips of the forks up a bit to relieve pressure on the hand screws so you can release them. Take the forklift back to the front of the warehouse. Close all the doors.

5.8.11. Leave the last empty drum in the carrier so you can move it from a standing posture.

5.9. Palletizing Drums:

5.9.1. Reserve a parking space next to the main waste room forklift ramp. Place a four-way pallet, in good condition, in the parking space about two inches from the curb. Place the yellow plastic ramp at the other end of the pallet. Using the curb and ramp reduces the strain required to load the drums on the pallets. Use the drum truck to move the pallets and place them so the labels face out at a 45° angle. This orientation allows the labels to be read from the front (in the waste truck) or from the side (in rows awaiting shipment). Place four drums of the same profile together to facilitate counting for the manifest and transfer to treatment facility. Next best is to group drums going to the same treatment facility. Never strap together drums whose contents are not compatible (see Corporate Safety Manual).

5.9.2. Band the drums with half-inch plastic tape so they do not jump off the pallet while loading the waste truck or during shipment. Pull about seventeen feet of tape out of the banding machine and loop clockwise around the four drums on the pallet. The band should be about two thirds up the drum. Fold ten inches of the loose end back along the length of the band. The steel buckle has two prongs that should be located points up and out. Push the loop of tape through the back of the buckle and over the prong on the same side of the buckle. Fold the running end of the tape back on itself and push it through the buckle and over the prong on its side. Position the tensioner about ten inches left of the buckle with the slots facing up. Grip the red and black handles together to lift the foot, and place the drum side band between the frame and the foot. Place the running band through both the front cutting slot and one of the middle winding slots. Lift the red handle away from the black handle to ratchet the winding slots until the band is tight. Squeeze the red and black handles again to cut the running band, and release the tensioner from the band around the drums.

5.9.3. Using the forklift, stack the pallets two high in the main waste collection area, leaving aisles that extend from the roll-up door to the back of the area between the stacked pallets.

5.10. Shipping waste:

5.10.1. Waste material must be shipped before the oldest drum is 90 days from start date. Ship every drum that is older than 14 days, so that shipments are about 75 days apart. Roughly 4 weeks before shipping, estimate the number of drums and cost of the shipment. Copy the yellow tally sheet in the “Xerox Master” file (SacSafe/Waste 2/ Drumtally) and count the number of drums for each profile. Estimate the number to be shipped by dividing current number by weeks since last shipment, and multiplying by total weeks from last shipment to next shipment (usually ten).

5.10.2. Use the Excel spreadsheet at sacsafe/waste/syndi/shipments to estimate weights and disposal costs for the shipment. Request a Purchase Order (PO) through JD Edwards. Use the vendor number 667711 for Clean Harbors from the safety "Purchases" folder. The cost center for waste disposal is 320.23000. Enter item one, one shipment, and the full cost of the shipment on one line. Notify the controller, lab director, and regional manager so the large purchase order may be approved as quickly as possible.

5.10.3. Contact the waste vendor and request a waste pickup for the week preceding the 90 day date. Send your lab pack inventories and list of lab pack drums for approval. Lab packs must be approved for shipment, which requires at least three weeks. Enter the new profile number on the lab pack inventories, tops and sides of drums. Photocopy the lab pack inventories double sided to reduce bulk in records, and place the originals on the drums. Use clear packing list envelopes so the drum number is visible.

5.10.4. Send an e-mail to Sac OA All explaining when the waste truck will block egress by automobile from the back parking lot. On the day of shipment, install the drain mat to prevent the contents of a leaking drum from entering the storm drain. The drain is behind the parking bumper so no one will park right on top of it. The two foot square magnetic mat is kept on the personnel door in the main waste room. Place the spill cart near the drain and familiarize all participants with the blue drum uprighting lever. Reserve the parking slots next to the ramp to use as staging area. Pull the flammable drums from the small shed and place on pallets. Arrange the pallets on the asphalt in a checkerboard so drums may be placed from both sides. Do a final "as shipped" count.

5.10.5. Have the driver back his trailer even with the cryogen fill station closest to the waste ramp. Stand where the driver can see you in the mirror and, when the trailer is within six feet close your hands together to indicate remaining distance, then place palms towards the driver to say "stop here". Give the driver a broom to sweep out any wood chips. Use the forklift to place the pallet jack in the trailer. One fork should be under the handle near the bigger wheels, where the weight is. Pump the pallet jack up a bit so the forks will slide out after delivery. Lift the pallets to the lower crossbar to get them out of the building without hitting the ground. Lift to the second crossbar to fit onto trailer. When only eight feet of trailer remains, take out the pallet jack. Push the remaining pallets in place using the heavy pallet stored by the safety shower. Offer the driver five (5) DOT Placards located in the shelves to the right of the sink, if he does not have his own.

5.10.6. Sign and date the DOT manifest and land ban forms after loading. Check DTSC requirements regularly. Current regulations require only one land ban form per year per profile, but you may get one per shipment. You will have at

least one to sign for PCI, if you are sending lab packs. Have the driver sign. Continuation sheets are not signed. Pull your copies (Generator and state (blue and second yellow if California manifest)). If Arkansas is the receiving state, you must use an Arkansas manifest. If the receiving state does not require its own version of the manifest, you will use the California manifest. Make a photocopy of the front pages so that we have a completely legible copy for TestAmerica records.

5.10.7. Stand at the end of the wall when the waste truck leaves, and flag down any traffic that might run into the truck. Mail the state copies to DTSC; the address is on the blue copies. Update drum logbook and waste shipment logbook. Sweep floor, and mop if needed. Vacuum spider webs from flammable solvent shed. Order steel drums, vent caps, vermiculite, yellow bags, placards, clear envelopes, drum labels, smaller drums/pails and blue drums as needed for the next cycle.

5.11. Soapy Wash Water: Pipes carry soapy water from laboratory sinks to the 500-gallon tank under the grate in the wash water treatment room. A pneumatic pump propels the water through a bag filter, two carbon filters, and a flow meter to plastic tank three (T-3). Daily procedures are posted on the inside door of the treatment room. The logbook is kept on T-2 next to the flow meter. Check that pH in T-3 is between 5 and 11 before discharging.

5.11.1. Fill tank two (T-2) at the beginning of each month. Take VOA and metals samples to Sample Control. Hold the water in T-2 until testing confirms contaminants are within allowed levels. David Alltucker is the TestAmerica West Sacramento Project Manager for quote 27973. Results are kept in the file folder titled “POTW Data” in the waste coordinators desk.

5.11.2. Notify Ray Lucero (facilities) and Joe Schairer (EH&S) when non-conforming materials are found in the wash water sump. Note: organic materials such as latex paint, propylene glycol, or ethylene glycol may clog the carbon filters and require immediate replacement. The slug may be stored in blue drums or tank one (T-1) until a determination is made.

5.11.3. Clean the foot valve and in-line strainer every three months. Replace the bag filter with a new one from the cabinet. Cut a slit in the dirty bag filter and remove the water with a dry/wet vacuum. Force the plastic mouth into an oval to slip off the retention disk. Cut the internal ears off the plastic mouth of the new bag. Follow the directions on the carbon drums when replacing. Attach a plastic standpipe to the outflow stub. Backfill with water overnight. Backflush one day before connecting as final drum. Use the stinger and tap water carboy to re-prime the pneumatic pump. Do not enter the sump.

5.12. Waste Area Inspections: The waste processor inspects the main waste storage area, the H-3 waste storage closets, the soil room and the waste sheds weekly using the standard inspection forms (Sacsafe/Waste/Satellite Checklist and Sacsafe/Waste/Weekly Main Checklist). Results are recorded in the safety logbook for the area.

5.13. Records Retention: Records are retained in accordance with the Quality Assurance Manual (QAM), maintained on the purple Q. Several specific types of records are addressed here for convenience.

5.13.1. Inspection Records: General inspection records are retained for two years. OSHA inspection records, when present, are retained for six years.

5.13.2. Tracking logs, as part of the waste manifest process, are retained indefinitely.

5.13.3. Test data from internal samples is retained per the records retention policy.

5.13.4. Manifests and supporting/associated documentation are retained indefinitely.

5.13.5. Land Disposal Restrictions, as part of the waste manifest process, are filed with and retained with the manifests.

5.13.6. State or Federal reports are retained for seven years.

5.13.7. Other documents. Waste profiles, as part of the manifest process, are retained indefinitely.

5.14. TestAmerica West Sacramento Waste List

5.14.1. Flammable Solvent (Clean Harbors profile AP336072_143, collected in and shipped to in 55-gallon steel drums): toluene, hexane, acetone, methanol, isooctane, cyclohexane, ethyl acetate, and methylene chloride when mixed with flammable solvent before use.

5.14.2. Flammable solvent with less than 15% methylene chloride (Ashland profile 44-11303 collected and shipped in 55 gallon steel drum): A properly filled 55 gallon drum will weigh less than 350 pounds to qualify for this profile/disposal method.

5.14.3. Methylene Chloride (Clean Harbors profile CH94289 collected in and shipped in 55-gallon steel drums): Also known as dichloromethane or DCM.

5.14.4. HPLC Solvents & Water (Ashland profile 44-11304 collected in and shipped in 55-gallon blue plastic drums): Water with acetonitrile, methanol.

5.14.5. Acid Drum (Ashland profile 44-11305) shipped in 55-gallon blue plastic drums): Water with nitric acid, hydrochloric acid and sulfuric acid.

5.14.6. Soil Samples (Clean Harbors profile CH94287 collected and shipped in 55-gallon steel drums): Soil samples, ash, and sludge.

5.14.7. Laboratory Trash (Clean Harbors profile CH94284 collected and shipped in 55-gallon steel drums): Contaminated personal protective equipment, used filters, sodium sulfate, aluminum oxide, calcium silicate, silica gel, absorbed spills, and dirty glassware.

5.14.8. LLE Water and coolant (Ashland profile 44-22167collected and shipped in 55-gallon blue plastic drums): This is clean, unused aqueous samples or aqueous samples that have been extracted with methylene chloride and retain about 2% DCM.

5.14.9. Contaminated unused aqueous samples, black liquor, zinc or sodium thiosulfate, preserved samples and VOA waste water (Clean Harbors profile 94286).

5.14.10. All Lab packs: (PCI issues a profile number for each drum). Packed and shipped in either fiber or steel drums, as appropriate, size depends on volume of waste to be shipped). Required for samples (oil or soil), which contain over 50ppm polychlorinated biphenyls. TestAmerica typically includes PCB standards even though our source standards are less than 50 PPM. TestAmerica also disposes the vials from advanced technology. The TCDD/TCDF spiking standards are used formulations that may be incinerated as PCB waste. Unused formulations carry “F” codes, which would preclude treatment in the United States. PCBs must be incinerated at a higher temperature and longer dwell time than other hazardous wastes to prevent dioxin formation.

5.14.11. Mercury Lab packs: Metallic mercury contaminated with sulfur is packed separately in plastic drums, size depends on volume of waste to be shipped, but typically are 5-gallon pails and sent to PCI, East Chicago for retort/redistillation. TKN waste is low level mercury waste packed in fiber or plastic drums, usually 15 or 20 gallons, and sent to PCI for treatment. COD waste is Hach digestion tubes that are collected in a special 5 gallon prepaid bail by Heritage for recycling. Contact and disposal information is on each pail.

5.14.12. Standard Lab packs are composed of small containers containing process wastes, samples, or excess chemicals not including mercury or PCBs. They are packed in fiber, plastic or steel drums; size depends on the volume, and shipped to Clean Harbors.

5.14.13. Carbon Filters (Clean Harbors profile CH94282) are 55-gallon steel drums filled with activated carbon. They are US Filter ASC-200-2 filters used to

remove acetone and dichloromethane from our soapy wash water. The filter is spent when either contaminant nears 1.0 PPM or the drum bulges. Residual water is drained to an LLE drum before shipment. Place the drum on the heavy pallet reserved as a pusher and rotate the standpipe counterclockwise to collect the water in a bucket or pan. Recap the 2-inch outlet stub for shipment.

5.14.14. Empty steel drums (Clean Harbors profile CH101820). These are drums that were damaged during the rampacting process. State law prohibits discarding empty 55-gallon drums in the dumpster.

5.14.15. Medical waste (Clean Harbors profile MWCH220382). This includes extracted human blood and tissue samples, or first aid supplies contaminated with human blood. These are 30 gallon or smaller fiber drums as specified by Clean Harbors.

6. RESPONSIBILIES

6.1. **Waste Coordinator (CSM 13.4.1):** The waste coordinator performs weekly audits of the 90 day storage areas. The coordinator maintains and provides the correct in-house waste labels for drums, carboys, and all other waste containers. The coordinator reviews the compatibility of waste containers, establishes waste stream profiles, and ships hazardous, and biohazard waste. The waste coordinator prepares the following:

- Waste minimization plan,
- Biennial Report to California Department of Toxic Substances Control,
- Tax return for
  - Environmental Fee,
  - Generator Fee,
  - EPA ID verification and manifest fee,
  - Yolo County hazardous material fee, and
  - West Sacramento city hazardous materials fees,
- Environmental Protection Agency (EPA) generator ID as required, and
- Quarterly reports to the West Sacramento Publicly Owned Treatment Works (POTW).

6.2. **Waste Processor (CSM 13.4.2)**: Responsibilities of the waste processor include:

- Request dump slips from Sample Admin staff for sample lots thirty days after reports are invoiced,
- Pull extract vials for disposal 90 days after reports are invoiced,
- Crush extract and VOA vials in the Vyleater,
- Dump excess samples to the appropriate drum for shipping.

- Use the Rampactor to crush clean glass and hazardous Laboratory Trash,
- Pump the soapy water from laboratory sinks daily, and
- Log, inspect, seal, label, mark and stack the drums on pallets for shipment.

6.3. **Analyst:** Labels and dates waste containers per the operational SOPs. Ensures that waste containers are emptied and the labels are updated appropriately. Follows the procedures in the operational SOPs, and as outlined here.

6.4. **Project Managers:** Notify the waste processor and sample administration staff within 30 days after invoicing the project if samples or extracts are to be retained longer than 30 days.

7. REFERENCES/CROSS REFERENCES

7.1.1. Operational SOP's

7.1.2. TestAmerica Corporate Environmental Health and Safety Manual.

7.1.3. TestAmerica West Sacramento Addendum to the Corporate EHSM.

7.1.4. West Sacramento Quality Assurance Manual, for current facility map

7.1.5. TestAmerica Records Retention Policy, WI-STL-0013 / P-L-001

7.1.6. Manufacturer's instruction manuals for the Rampactor and Vyleater.

8. ATTACHMENTS

8.1. No attachments are present.

9. REVISION HISTORY

9.1. WS-EHS-0001, Revision 4, Effective 2/13/09

9.1.1. The SOP format was updated to TestAmerica format.

9.1.2. Editorial changes.

9.2. SAC-EHS-0001, Revision 3, Effective 12/29/06

9.2.1. Updated Vendor Information.

9.3. SAc-EHS-0001, Revision 2, Effective 08/30/04

9.3.1. Added waste collection information (Section 4.1).

9.3.2. Added records retention information (Section 4.13).

9.3.3. Removed waste vendor contact information (Section 6.2).

9.3.4. Added References (Section 6.2).

9.4. SAC-EHS-0001, Revision 1, Effective 3/23/03

9.4.1. This is the first edition of this SOP.

Title: Perfluorooctanoic Acid (PFOA) and Perfluorooctanoic Sulfonate (PFOS) in Water and Solids by LC/MS/MS

Approvals (Signature/Date):

Michael Flournoy — Date: 8/31/09 Technical Manager	Joe Schairer — Date: 8/31/09 Health & Safety Manager / Coordinator
Douglas Weir — Date: 09/01/09 Quality Assurance Manager	Karla Buechler — Date: 8/31/09 Laboratory Director

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1. SCOPE AND APPLICATION

1.1. This procedure describes the analysis of water and soil samples for the following compounds using liquid chromatography / tandem mass spectrometry (LC/MS/MS).

Compound Name	Abbreviation	CAS #
Perfluorooctanoic Acid	PFOA	335-67-1
Perfluorooctane sulfonate	PFOS	1763-23-1
Ammonium Perfluorooctanate	APFO	3825-26-1

Sample results for PFOA may also be reported as APFO, at the request of the client.

1.2. The working range of the method is listed below. The linear range can be extended by diluting the extracts. Concentration of the extract could yield lower reporting limits but additional MDLs would be required.

Matrix	Reporting Limit	Working Range
Water	4 ng/L	4 to 400 ng/L
Soil	5 ug/kg	1 to 100 ug/kg

1.3. When undertaking projects for Department of Defense (DoD) the relevant criteria in QA Policy WS-PQA-021 “DoD QSM and AFCEE QAPP Implementation” must be checked and incorporated.

2. SUMMARY OF METHOD

2.1. Water samples are adjusted to pH < 2 with hydrochloric acid immediately prior to extraction. PFOA and PFOS are extracted using a C18 solid phase extraction (SPE) cartridge. PFOA and PFOS are eluted from the cartridge with methanol.

2.2. Soil samples are mixed with a sodium hydroxide solution and allowed to sit for 30 minutes to 1 hour. Methanol is then added and the soil/solvent mixture is sonicated for 3 hours and then tumbled for 24 hours. The mixture is centrifuged and the solvent filtered.

2.3. The methanol extracts are analyzed by LC/MS/MS. PFOA and PFOS are separated from other components on an HPLC C18 column with a mobile phase mixture of water containing 0.1% formic acid and methanol. The mass spectrometer detector is operated in the electrospray (ESI) negative ion mode. Sample results are quantitated using the internal standard method.

2.4. The isotope dilution technique is employed with this method. The internal standards consist of carbon-13 labeled analogs of the compounds of interest (PFOA and PFOS), and are spiked at the time of extraction. This technique allows correction for analytical bias encountered when analyzing more chemically complex environmental samples,

because the isotopically labeled compounds are chemically similar to the compounds of concern, and are therefore affected by sample-related interferences to the same extent as the compounds of concern.

3. DEFINITIONS

3.1. PFOA: perfluorooctanoic acid (may also be written PHOA).

3.2. APFO: ammonium perfluorooctanoate.

3.3. PFOS: perfluorooctane sulfonate (may also be written PHOS).

3.4. MPFOA: perfluoro-n-[1,2,3,4-13C4]octanoic acid. Carbon-13 labeled PFOA.

3.5. MPFOS: perfluoro-1-[1,2,3,4-13C4]octanesulfonate. Carbon-13 labeled PFOS.

3.6. PTFE: polytetrafluoroethylene (e.g., Teflon)

3.7. SPE: solid phase extraction.

3.8. Further definitions of terms used in this SOP may be found in the glossary of the Laboratory Quality Assurance Manual (QAM).

4. INTERFERENCES

4.1. PFOA has been used in a wide variety of manufacturing processes, and laboratory supplies should be considered potentially contaminated until they have been tested and shown to be otherwise. The materials and supplies used during the method validation process have been tested and shown to be clean. These items are listed below in Section 6.

4.2. To avoid contamination of samples, standards are prepared in a ventilation hood in an area separate from where samples are extracted.

4.3. PTFE products can be a source of PFOA contamination. The use of PTFE in the procedure should be avoided or at least thoroughly tested before use.

4.4. Volumetric glassware and syringes are difficult to clean after being used for solutions containing high levels of PFOA. These items should be labeled for use only with similarly concentrated solutions or verified clean prior to re-use. To the extent possible, disposable labware is used.

4.5. Commercial sources of PFOS produce two peaks in the PFOS chromatogram. These adjacent peaks are either completely resolved or not resolved but with a profound deflection that can be resolved during peak integration. The later of the two peaks

matches the retention time of the single labeled PFOS peak. It is unclear what the earlier peak is. Literature suggests that it is an isomer of PFOS, rather than a result of peak splitting. Until more information is available, the earlier peak is excluded during peak integration.

5. SAFETY

Employees must abide by the policies and procedures in the Corporate Safety Manual, West Sacramento Supplement to the CSM, and this document. All work must be stopped in the event of a known or potential compromise to the health or safety of an associate. The situation must be reported **immediately** to a supervisor, the EH&S Staff, or a senior manager.

5.1. Specific Safety Concerns

5.1.1. Preliminary toxicity studies indicate that PFOA and PFOS could have significant toxic effects. In the interest of keeping exposure levels as low as reasonably achievable, PFOA and PFOS must be handled in the laboratory as hazardous and toxic chemicals.

5.1.2. Exercise caution when using syringes with attached filter disc assemblies. Application of excessive force has, upon occasion, caused a filter disc to burst during the process.

5.1.3. Laboratory procedures such as repetitive use of pipets, repetitive transferring of extracts and manipulation of filled separatory funnels and other glassware represent a significant potential for repetitive motion or other ergonomic injuries. Laboratory associates performing these procedures are in the best position to realize when they are at risk for these types of injuries. Whenever a situation is found in which an employee is performing the same repetitive motion, the employee shall immediately bring this to the attention of their supervisor, manager, or the EH&S staff. The task will be analyzed to determine a better means of accomplishing it.

5.1.4. Eye protection that satisfies ANSI Z87.1 (as per the STL Corporate Safety Manual), laboratory coat, and nitrile gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated will be removed and discarded; other gloves will be cleaned immediately.

5.1.5. PFOA is an acid and is not compatible with strong bases.

5.1.6. The use of vacuum systems presents the risk of imploding glassware. All glassware used during vacuum operations must be thoroughly inspected prior to each use. Glass that is chipped, scratched, cracked, rubbed or marred in any manner must not be used under vacuum. It must be removed from service

and replaced.

5.1.7. Glass containers are not to be used for "tumbling" soil samples.

5.2. Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. NOTE: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table. A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material(1)	**Hazards**	**Exposure Limit(2)**	**Signs and Symptoms of Exposure**
Hydrochloric Acid	Corrosive Poison	5 ppm (Ceiling)	Can cause pain and severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause deep ulcerations to skin, permanent eye damage, circulatory failure and swallowing may be fatal.
Sodium Hydroxide	Corrosive Poison	2 mg/cm^3 (Ceiling)	Severe irritant. Can cause severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause severe scarring of tissue, blindness, and may be fatal if swallowed.
Formic Acid	Combustible Corrosive Flammable	5 ppm (TWA)	Causes severe burns, toxic by inhalation, harmful if swallowed, possible sensitizer.
Methanol	Flammable Poison Irritant	200 ppm (TWA)	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.

(1) Always add acid to water to prevent violent reactions.
(2) Exposure limit refers to the OSHA regulatory exposure limit.

6. EQUIPMENT AND SUPPLIES

6.1. 8 mL test tubes, screw thread, with caps.

6.2. 50 mL graduated plastic centrifuge tubes.

6.3. 125 mL PPE wide-mouth bottles.

6.4. 8 oz glass or PPE wide mouth bottles.

6.5. Analytical balance capable of accurately weighing to the nearest 0.0001g, and checked for accuracy each day it is used in accordance with SAC-QA-0041.

6.6. Syringe filter, Millipore Millex-HV 0.45um, or equivalent.

6.7. 2.0 mL autosampler vials, Waters PN 186000307, or equivalent.

6.8. Phenomenex Strata SPE C18, 6mL, 500 mg, part number 8B-S001-HCH, Waters Oasis WAX 100 to 200mg, Waters Oasis HLB 60 to 200mg, Waters SepPak tC18 1 to 10g, or equivalent.

6.9. Vacuum manifold for SPE cartridges or Zymark Auto-Trace Workstation automated SPE system or equivalent.

6.10. Miscellaneous laboratory apparatus (beakers, test tubes, volumetric flasks, pipettes, etc.). These should be disposable where possible, or marked and segregated for high-level versus low-level use.

6.11. HPLC or UPLC system connected to an electrospray MS/MS detector such as Waters Micromass Quattro Premier XE.

6.12. Alltech Adsorbosphere HS (C18) 5 µm, 250 mm x 3.2 mm, Part no. 28857, or Acquity UPLC BEH C18 1.7 um, 2.1 mm x 150 mm, Part No. 186002353, or equivalent.

6.13. Bottle rotating apparatus for soil extractions.

6.14. Glass fiber filter, Whatman GF/F, catalog number 1825 090 or equivalent.

7. REAGENTS AND STANDARDS

7.1. Reagent grade chemicals shall be used in all tests whenever available. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on the Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2. The extraction solvents, water, and methanol used for this procedure must be HPLC grade or better. Water can be Nanopure or Millipure if it is shown to be free of the analytes.

7.3. Reagent Sand: Ottawa Sand or equivalent

7.4. 200 mM NaOH solution

7.5. 2.0 M HCl solution

7.6. 90% Formic Acid, Laboratory Grade

7.7. Stock Standard Materials

7.7.1. PFOA and PFOS are purchased as a high purity solids (96% or greater) or as certified concentration in solution. Standard materials are verified compared to a second source material at the time of initial calibration. The solid stock material is stored at room temperature.

7.7.2. If solid material is used for preparing a standard, stock standard solutions are prepared from the solids and are stored at 4 ± 2°C. Stock standard solutions should be brought to room temperature before using. Standards are monitored for signs of degradation or evaporation. Standard solutions must be replaced at least annually from the date of preparation.

7.7.3. PFOS and MPFOS are usually purchased as the sodium salt of these compounds. In preparing the spiking solutions and standards a correction for the sodium must be done. The molecular weight of PFOS is 500.1295 and the molecular weight of NaPFOS is 523.1193. Therefore the amount of NaPFOS used must be adjusted by a factor of 1.046. The same factor can be used for adjusting NaMPHOS to MPHOS.

7.8. Calibration Standards

The calibration stock solution is prepared by diluting the appropriate amounts of PFOA and PFOS stock solutions in methanol. The calibration stock solution is diluted with methanol to produce initial calibration standards. These are the normal calibration levels used. A different range can be used if needed to achieve lower reporting limits or a higher linear range.

7.9. Initial Calibration (ICAL) Levels

Composition of Calibration Solutions							
Level	**Concentration (ug/L)**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Native Components							
PFOA	0.2	0.5	1.0	2.0	5.0	10	20
PFOS	0.2	0.5	1.0	2.0	5.0	10	20
Labeled Components (Internal Standards)							
MPFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5
MPFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Note- The above calibration limits are provided only as an example. The actual ICAL level used for each analytical batch will depend upon the LOQ requirements of the program.

7.10. Initial Calibration Verification Standard (ICV), 4.0 µg/L

A second stock solution of PFOA and PFOS is prepared from a second source (different vendor than used for calibration standards) for use as an ICV. The recommended concentration of 4 ug/L may be adjusted if the initial calibration levels are changed.

7.11. LCS/Matrix Spike Solution, 500 ng/mL

A PFOA and PFOS spike solution is prepared by weighing and diluting PFOA and PFOS to produce a solution containing PFOA and PFOS at 500 ng/mL each in methanol.

7.12. Internal Standard Spike Solution, 250 ng/mL

The isotope dilution spike solution is prepared by weighing and diluting MPFOA and MPFOS to produce a solution at 250 ng/mL in methanol.

8. SAMPLE COLLECTION, PRESERVATION, AND STORAGE

8.1. Water samples are collected in pre-cleaned one-liter HDPE or glass containers. Soil samples are collected in pre-cleaned 250 mL HDPE or glass containers. Other containers may also be suitable. Samples are chilled to 4 ± 2 °C for shipment to the laboratory.

8.2. Samples are logged in following normal laboratory procedures and are stored under refrigeration at 4 ± 2°C. Water samples must be extracted within 7 days of collection. Soil samples must be extracted within 14 days of collection. Extracts must be refrigerated at 4 ± 2°C, and analyzed within 40 days from extraction.

NOTE: There is no prescribed regulatory holding time requirement for PFOA and PFOS. The scientific literature indicates that PFOA and PFOS are highly persistent compounds in the environment. TestAmerica Denver (formerly STL Denver) has conducted stability studies indicating that medium- and low-level standard solutions of PFOA are stable for at least three months in glass, polystyrene, and polypropylene plastics at 4 ± 2°C. The 7 day / 14 day / and 40 day holding times given above are based on the general EPA convention for the holding time of extractable organic compounds in water and soil.

9. QUALITY CONTROL

9.1. Initial Demonstration of Capability

The initial demonstration and method detection limit (MDL) studies described in Section 13 must be acceptable before analysis of samples may begin.

9.2. Batches are defined at the sample preparation step. Batches should be kept together through the whole analytical process as far as possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence. Refer to the QC program document (QA-003-SAC) for further details of the batch definition.

9.2.1. The quality control batch is a set of up to 20 samples of the same matrix processed using the same procedure and reagents within the same time period. The quality control batch must contain a matrix spike/matrix spike duplicate (MS/MSD), a laboratory control sample (LCS) and a method blank. Laboratory generated QC samples (Blank, LCS, MS/MSD) do not count toward the maximum 20 samples in a batch. Field QC samples are included in the batch count. In some cases, at client request, the MS/MSD may be replaced with a matrix spike and sample duplicate. If insufficient sample is available for an MS/MSD, an LCSD may be substituted if batch precision is required by the program or client. In the event that multiple MS/MSDs are run with a batch due to client requirements, the additional MS/MSDs do not count toward the maximum 20 samples in a batch.

9.3. One method blank (MB, laboratory reagent blank) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. For aqueous samples, the method blank is an aliquot of laboratory reagent water. For solid sample, the method blank is an aliquot of Ottawa sand. The method blank is processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when target analytes are detected in the method blank above the reporting limit or when surrogate recoveries are outside of the control limits. Re-extraction of the blank, other batch QC, and the affected samples are required when the method blank is deemed unacceptable. See policy QA-003-SAC for specific acceptance criteria.

9.3.1. If the MB produces a peak within the retention time window of any of the analytes determine the source of the contamination and eliminate the interference before processing samples.

9.3.2. The method blank must not contain any analyte at or above the reporting limit, or at or above 10% of the measured concentration of that analyte in the associated samples, whichever is higher.

9.3.3. If there is no target analyte greater than the RL in the samples associated with an unacceptable method blank, the data may be reported with qualifiers. Such action should be taken in consultation with the client.

9.3.4. Re-extraction and re-analysis of samples associated with an unacceptable method blank is required when reportable concentrations are determined in the samples.

9.3.5. Refer to QA-003-SAC for further details of the corrective actions.

9.3.6. Projects performed under the auspices of the DOD QSM or AFCEE must meet DOD-specific criteria for method blanks. Results are acceptable if the blank contamination is less than ½ of the reporting limit for each analyte, or less than 1/10 of the regulatory limit, or less than 1/10 of the sample result for the same analyte, whichever is greater. If the method blank does not meet the acceptance criteria, the source of contamination must be investigated and measures taken to correct, minimize or eliminate the problem. If contamination remains, the contaminated samples should be re-prepared and reanalyzed with a new MB and batch-specific QC samples.

9.4. A laboratory control sample (LCS) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LCS is an aliquot of laboratory matrix (e.g. water for aqueous samples) spiked with analytes of known identity and concentration. The LCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any spiked analyte is outside of the control limits. Re-extraction of the blank, other batch QC and all associated samples are required if the LCS is deemed unacceptable. See QA-0003-SAC for specific acceptance criteria. The results for the LCS must be within 70 to130% of the true level for all analytes until historical limits are established.

9.5. A matrix spike/matrix spike duplicate (MS/MSD or MS/SD) pair must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. An MS/MSD pair is aliquots of a selected field sample spiked with analytes of known identity and concentration. The MS/MSD pair must be processed in the same manner and at the same time as the associated samples. Spiked analytes with recoveries or precision outside of the control limits must be within the control limits in the LCS. Corrective actions must be documented on a nonconformance memo, then implemented when recoveries of any spiked analyte are outside of the control limits provided by the LIMS or by the client.

9.6. A duplicate control sample (LCSD or DCS) may be substituted when insufficient sample volume is provided to process an MS/MSD pair, or is requested by the client. The LCSD is evaluated in the same manner as the LCS. See QA-003-SAC for specific acceptance criteria.

9.7. Initial calibration verification (ICV) – When available, a second source standard is analyzed with the initial calibration curve. The concentration should be at the mid range of the curve.

Corrective actions for the ICV include:

- Rerun the ICV.
- Remake or acquire a new ICV.

- Evaluate the instrument conditions.
- Evaluate the initial calibration standards.

9.8. Internal Standards

9.8.1. The internal standard solution is added to each field and QC sample at the time of extraction, as described in Sections 11. As described in Section 7, this solution consists of isotopically labeled analogs of the analytes of interest.

9.8.2. Recoveries for each of the internal standards must be greater than 50 percent and less than 200 percent of the known value.

9.8.3. If internal standard recoveries are outside of the acceptance limits, reanalyze once to eliminate the possibility of a bad injection. If the recovery is still outside the acceptance limits, further corrective action may include diluting the extract to minimize matrix effects or reextracting the sample. Subject to client approval, re-extraction of a smaller sample aliquot may be appropriate to mitigate low IS recovery caused by matrix interferences.

10. CALIBRATION

10.1. For details of the calculations used to generate the regression equations, and how to use the factors generated by these equations, refer to SOP CA-Q-S-005 “Calibration Curves (General)”.

10.2. Routine instrument operating conditions are listed in Table 1 (Section 17).

10.3. Instrument Tuning

Instrument tuning is done initially when the method is first developed and thereafter as needed to maintain the sensitivity and selectivity of the method. Tuning is done by infusing each compound (PFOA, PFOS, MPFOA, and MPFOS) into the mobile phase using a tee fitting at a point just before the entrance to the electrospray probe. The responses for the parent and daughter ions for each compound are observed and optimized for sensitivity and resolution. Mass assignments are reviewed and calibrated if necessary. The mass assignments must be within ± 0.5 amu of the values shown in Table 1.

10.4. A new calibration curve must be generated after major changes to the system or when the continuing calibration criteria cannot be met. Major changes include, but are not limited to new columns or pump seals. A new calibration is not required after minor maintenance.

10.5. With the exception of the circumstances delineated in policy P-T-001, it is not acceptable to remove points from a calibration curve. In any event, at least five points

must be included in the calibration curve. Average Response Factor and linear fit calibrations require five points, whereas Quadratic (second order) calibrations require six points.

10.6. A fixed injection volume is used for quantitation purposes and is to be the same for both the sample and standards.

10.7. All units used in the calculations must be consistently uniform, such as concentration in ng/mL.

10.8. Initial Calibration

10.8.1. A number of analytical standards of different analyte concentrations are used to generate the curve. Each standard is injected once to obtain the peak response for each analyte at each concentration. These standards define the working range of the analysis.

10.8.1.1. A minimum of five analytical standards is used when using average response factor and or linear calibration fits.

10.8.1.2. A minimum of six analytical standards is used for quadratic fit to generate the curve.

10.8.2. Calibration is by average response factor, linear fit, or by quadratic fit. Quadratic fit is used if the response is non-linear.

10.8.2.1. For linear fit, the intercept of the line must be less than ½ the reporting limit, and the coefficient of determination (r^2) must be greater than or equal to 0.980 for the curve to be considered valid (or the correlation coefficient (r) $\geq$ 0.990).

10.8.2.2. For quadratic fit, the intercept of the line must be less than ½ the reporting limit, the coefficient of determination (r^2) must be greater than or equal to 0.980 for the curve to be considered valid.

10.8.2.3. For average response factor (RF_a), the relative standard deviation (RSD) must be $\leq$ 20% for the curve to be valid.

10.9. Calibration Curve Fits

10.9.1. Linear regression or quadratic curves may be used to fit the data to a calibration function.

10.9.2. The linear curve uses the following function:

Equation 1

$$y = ax + b$$

Where:

$$y = \frac{\text{Area (analyte)}}{\text{Area (IS)}} \times \text{Concentration (IS)}$$

x = concentration
b = slope
c = intercept

10.9.3. The quadratic curve uses the following function:

Equation 2

$$y = ax^2 + bx + c$$

Where y, x, b, and c are the same as above, and a = curvature.

10.9.4. Evaluation of Calibration Curves

The following requirements must be met for any calibration to be used:

- Response must increase with increasing concentration.
- The absolute value of the intercept of a regression line (linear or non-linear) at zero response must be less than the reporting limit.
- There should be no carryover at or above 1/2 MRL after a high CAL standard.

If these criteria are not met, instrument conditions and standards will be checked, and the ICAL successfully repeated before continuing.

10.9.5. Weighting of Calibration Points

In linear and quadratic calibration fits, the points at the lower end of the calibration curve have less absolute variance than points at the high concentration end of the curve. This can cause severe errors in quantitation at the low end of the calibration. Because accuracy at the low end of the curve is very important for this analysis, it is preferable to increase the weighting of the lower concentration points. 1/concentration weighting is encouraged. Visual inspection of the line fitted to the data is important in selecting the best fit.

10.10. Initial Calibration Blank (ICB)

10.10.1. Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of HPLC-grade methanol containing MPFOA and MPFOS internal standards.

10.10.2. The result for the calibration blank must be less than the reporting limit.

10.10.3. If the ICB is greater than the reporting limit then the source of contamination must be identified and any necessary cleaning completed, and then the instrument should be recalibrated.

10.11. Initial Calibration Verification (ICV)

10.11.1. Following the ICAL and the ICB, a 4.0 µg/L standard obtained from a different vendor than the ICAL standards is analyzed. This is a mid-level standard.

10.11.2. The recovery for the ICV must be within 70-130%.

10.11.3. See section 9.7 for corrective actions in the event that the ICV does not meet the criteria above.

10.12. Continuing Calibration Verification (CCV) – At the beginning of a run, the end of a run, and after every 10 samples are analyzed a CCV must be injected to determine if the calibration is still valid. The exception is after an acceptable curve and ICV are run 10 samples can be analyzed before a CCV is required. The CCVs are usually at the mid levels of the curve and should vary throughout the run. The curve and ICV do not need to be run every day. To start an analytical run a CCV can be analyzed and if it meets acceptance criteria a run can be started. In addition the low standard in the curve must be analyzed and must be within ± 50% of the expected value.

10.12.1. The recovery for the CCV standards must be 70-130%.

10.12.2. If this is not achieved, the instrument has drifted outside the calibration limits. The instrument must be recalibrated.

11. PROCEDURE

11.1. One-time procedural variations are allowed only if deemed necessary in the professional judgment of a supervisor to accommodate variation in sample matrix, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is approved by the supervisor and then automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group also receives NCMs by e-mail for tracking and trending purposes. The NCM process is described in more detail in SOP SAC-QA-0023. The NCM shall be filed in the project file and addressed in the case narrative.

11.2. Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

11.3. Water Sample Extraction

11.3.1. Visually inspect samples for the presence of settled and or suspended sediment. If sediment is apparent, filter the water sample through a glass fiber filter (Whatman GF/F Cat No 1825 090 or equivalent). Gravity or vacuum

can be used to pass the sample through the filter. Prepare a filtration blank with any samples requiring filtration.

Warning: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.3.2. Measure 250 mL of each sample using a graduated cylinder and pour into a labeled 8 oz bottle.

11.3.3. Prepare additional aliquots of one field sample for the MS/MSD, if requested.

11.3.4. Prepare two 250 mL aliquots of HPLC-grade water for the method blank and LCS.

11.3.5. Spike the LCS and MS/MSD (if requested) with 0.010 mL (10 uL) of the LCS/Matrix spike solution (section 7.11). This will result in a sample concentration of 20 ng/L.

11.3.6. Spike 0.05 mL (50 uL) of the internal standard solution (Section 7.12) into each sample and QC sample, for a sample concentration of 50 ng/L..

11.3.7. Acidify samples by adding 1 mL of 2M HCl to 250 mL of sample. Mix thoroughly. Check the pH by removing a few drops of the sample from the bottle with a disposable pipette and apply it to a pH test strip. Additional 2 M acid can be added as necessary to achieve a pH of < 2. Document the pH check on the prep sheet.

11.3.8. Extract each water sample and QC sample using solid phase extraction. The automated Zymark Auto-Trace Workstation can be used as long as the program follows these conditions.

11.3.8.1. Condition the SPE cartridges (Phenomenex Strata SPE C18 500 mg, or equivalent) by passing approximately 10 mL of methanol through the cartridge followed by approximately 20 mL of water.

11.3.8.2. Using vacuum, pull the entire 250 mL aliquot of the sample through the cartridge.

WARNING: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.3.8.3. After the sample has completely passed through the cartridge, elute the analytes from the cartridge with 4.0 mL of methanol.

11.3.8.4. Bring the final volume to 5.0 mL using HPLC grade water.

NOTE: *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

11.4. Soil Sample Extraction

11.4.1. Visually inspect soil samples for homogeneity.

11.4.2. Weigh a representative 10 g aliquot of each soil sample into a 250 mL polypropylene wide-mouth bottle. Weigh additional sample amounts for the matrix spike and matrix spike duplicate analyses if they are requested.

11.4.3. Use 10 g each of Ottawa sand for the method blank and LCS sample matrix.

11.4.4. Add 0.20 mL of the LCS/Matrix spike solution to the matrix spike samples and LCS for a sample concentration of 10 ug/kg.

11.4.5. Add 0.50 mL of the internal standard spike solution to each field and QC sample, for a sample concentration of 12.5 ug/kg.

11.4.6. Cap the bottles and allow the spike to settle into the sample matrix. Gently shake the bottles to mix the spike into the matrix.

11.4.7. Add 10 mL of 200 mM NaOH in water and allow the sample to soak for 30 minutes to one hour.

11.4.8. Add 34 mL of methanol to each sample. Ultrasonically extract each sample in a water bath for three hours.

11.4.9. Following the ultrasonic extraction, tumble each sample at room temperature for 24 hours. After 24 hours remove containers from the tumbler and allow to settle.

11.4.10. Carefully decant as much liquid as possible from the container into 50 mL graduated plastic centrifuge tubes. Add about 2 mL of methanol to the drained solid material and swirl to mix. Carefully decant this methanol again into the centrifuge tube. If the extract does not separate from the solid sufficiently, centrifuging can be done before decanting.

11.4.11. Add 1 mL of 2 M HCl to the sample and gently mix. Measure the pH of the extraction solution with wide range pH paper. If the pH is greater than 7, add an additional 1 mL of 2 M HCl. Repeat the HCl additions until the pH measures less than 7.

11.4.12. Add the appropriate amount of methanol to adjust the extract solution to 50 mL and then centrifuge.

11.4.13. Withdraw a 5 mL aliquot of the supernatant liquid and filter through a 0.45 µm syringe filter.

WARNING: Application of excessive pressure has caused disc filters to rupture and burst. Exercise discretion when filtering.

11.5. Instrument Analysis

11.5.1. Suggested operation conditions are listed below:

Routine Instrument Operating Conditions				
HPLC Conditions (Waters Acquity UPLC)				
Column	Waters Acquity BEH C18 1.7u, 2.1 x 150 mm or equivalent			
Flow Rate	0.2 mL/minute			
Mobile Phase Composition	A = Water with 1% Formic Acid, B = Methanol			
Gradient	**Time**	**%A**	**%B**	**Curve**
	0	75	25	6
	0.5	75	25	6
	1	50	50	6
	3	0	100	6
	6	0	100	6
	12	75	25	11
Injection Size	10 µL			
Run Time	12 minutes			

Mass Spectrometer Interface Settings (Quattro Premier XE)	
MS Interface Mode	ESI Negative Ion
Capillary (kV)	2.8
Source Temp	120 ºC
Desolvation Temp	450 ºC
Cone Gas (nitrogen) Flow	75 L/hour
Desolvation Gas (nitrogen) Flow	700 L/hour

Mass Spectrometer Scan Settings						
Analyte	**Parent Ion (amu)**	**Daughter Ions (amu)**	**Collision Cell (volts)**	**Dwell Time (sec.)**	**Cone (volts)**	**Delay (sec.)**
PFOA	412.6	368.7	11	0.05	16	0.02
PFOS	498.6	79.85	37	0.05	50	0.02
MPFOA	416.6	371.7	11	0.05	16	0.02
MPFOS	502.6	79.8	45	0.05	45	0.02

11.5.2. Tune and calibrate the instrument as described in Section 10.

11.5.3. A typical run sequence is as follows:

- Primer (A number of primers are injected before the analysis if the instrument was idled).
- Blank
- Calibration Curve
- ICB
- ICV
- MB
- LCS
- LCSD (if applicable)
- Sample 1
- Sample 1 MS (if applicable)
- Sample 1 MSD (if applicable)
- Sample 2 (up to sample 10 before next CCV)
- CCV
- Up to 10 samples.
- End sequence with CCV

12. CALCULATIONS

12.1. If the concentration of the analyte ions exceeds the working range as defined by the calibration standards, then the sample must be diluted and reanalyzed. It may be necessary to dilute samples due to matrix.

12.2. Qualitative Identification

12.2.1. The retention times of PFOA and PFOS must be the same as that of the labeled internal standards.

12.3. The ICAL established in Section 10 is used to calculate concentrations for the extracts.

12.4. Extract concentrations are calculated as below. The first equation applies to the linear fit, the second to the quadratic line fit.

Equation 3

$$\text{Concentration, ng/mL} = \frac{y-b}{c}$$

Equation 4

$$\text{Concentration, ng/mL} = \frac{-b+\sqrt{b^2-4a(c-y)}}{2a}$$

Where:

$$y = \frac{\text{Area (analyte)}}{\text{Area (IS)}} \times \text{Concentration (IS)}$$

x = concentration
a = curvature
b = slope
c = intercept

12.5. Water Sample Result Calculation:

Equation 5

$$\text{Concentration, ug/L} = \frac{C_{ex} V_t}{V_o}$$

Where:

C_{ex} = Concentration measured in sample extract (µg/mL)
V_t = Volume of total extract (mL)
V_o = Volume of water extracted (L)

12.6. Soil Sample Result Calculation:

Equation 6

$$\text{Concentration, } \mu g / L = \frac{C_{ex} V_t}{W_s D}$$

Where:

C_{ex} = Concentration measured in sample extract (ug/mL)
V_t = Volume of total extract (mL)
W_s = Weight of sample extracted (kg)
D = Fraction of dry solids, which is calculated as follows:

$$\frac{100 - \%\text{ moisture in sample}}{100}$$

12.7. If results are to be reported as ammonium perfluorooctanoate (APFO), instead of PFOA, apply a multiplier of 1.0406 to the sample results to correct for the molecular weight differences between PFOA and APFO. This adjustment can also be made during the preparation of the standards used for calibration.

12.8. Raw data, calibration summaries, QC data, and sample results are reviewed by the analyst. These must also be reviewed thoroughly by a second qualified person. See the Data Review Policy (QA-0012-SAC). These reviews are documented on the Data Review Checklist.

12.9. Any non-conformances with this SOP must be described in an NCM. The NCM process is described in the SOP NCMs and Clouseau (SAC-QA-0023).

13. METHOD PERFORMANCE

13.1. Method Validation

Because this method has not been validated by an authoritative standards setting body, such as the U.S. EPA or ASTM, TestAmerica Denver (formerly STL Denver) conducted a series of method validation studies before writing their SOP. The validation studies were based on the guidelines of the U.S. EPA Pesticide Program. These studies are described in detail in the STL Denver documents "Method Validation Study for Analysis of Perfluorooctanoic Acid in Waters by High Performance Liquid Chromatography / Tandem Mass Spectrometry (HPLC/MS/MS)" and "Method Validation Study for Analysis of Ammonium Perfluorooctanate in Soil Matrices by High Performance Liquid Chromatography / Mass Spectrometry (HPLC/MS/MS)."

13.2. Initial Demonstration of Capability (IDOC)

Each analyst performing this procedure must successfully analyze four LCS QC samples using current laboratory LCS control limits. IDOCs are approved by the Quality Assurance Manager and the Technical Director. IDOC records are maintained by the QA staff in the central training files.

13.3. The laboratory must generate a valid method detection limit for each analyte of interest. The MDL must be below the reporting limit for each analyte. The procedure for determination of the method detection limit is given in 40 CFR Part 136, Appendix B, and further defined in SAC-QA-0006 and policy S-Q-003.

14. POLLUTION PREVENTION

14.1. All waste will be disposed of in accordance with Federal, State and Local regulations.

14.2. Solid phase extraction used for water samples greatly reduces the amount of solvent used compared to liquid-liquid extraction.

14.3. Standards and reagents are purchased and prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.4. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.5. Do not allow waste solvent to vent into the hoods. All solvent waste is stored in capped containers unless waste is being transferred.

14.6. Transfer waste solvent from collection cups (tri-pour and similar containers) to jugs and/or carboys as quickly as possible to minimize evaporation.

15. WASTE MANAGEMENT

The following waste streams are produced when this method is carried out:

15.1. Assorted test tubes, autovials, syringes, filter discs, cartridges and extracted soil samples. Pour any excess liquid from the extracted soil samples as outlined below. Dump the solid waste into a contaminated lab trash bucket. When the bucket is full or at the end of the day, tie the plastic bag liner shut and put the lab trash into the steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.2. Waste Methanol. Collect the waste flammable solvents in tripours during use. Empty the tripours into a 1-liter to 4-liter carboy at the fume hood. When the carboy is full, or at the end of your shift, whichever comes first, empty the carboy into the steel flammable solvent drum in the H3 closet. When full to between one and four inches of the top, or after no more than 75 days, move the steel drum to the waste collection area for shipment.

15.3. Mixed water/methanol waste from soil extraction. Collect the waste in the HPLC waste carboy. When full, or after no more than one year, dump into the blue plastic HPLC collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.4. Aqueous acidic waste from the LCMS instrument contaminated with methanol. This is collected in a 1-gallon carboy at the instrument. When the carboy is full, or after no more than one year, it is emptied into the blue plastic HPLC collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.5. Autovials contaminated with methanol. As the autovials are removed from the instrument after analysis, they are collected in open containers at the instrument. After all autovials are removed, the open container must be dumped into a closed satellite collection container in a fume hood, as the punctured septa in the autovial can allow methanol and other contaminants to evaporate into the atmosphere. The satellite collection containers are transferred to the waste disposal area when full or after no more than one year, where they are disposed through the vial eater.

16. REFERENCES

16.1. Cheryl Moody, Wai Chi Kwan, Johnathan W. Martin, Derek C. G. Muir, Scott A. Mabury, "Determination of Perfluorinated Surfactants in Surface Water Samples by Two Independent Analytical Techniques: Liquid Chromatography/Tandem Mass Spectrometry and 19FNMR," Analytical Chemistry 2001, 73, 2200-2206.

16.2. John Giesy et al., "Accumulation of Perfluorooctane Sulfonate in Marine Mammals", Environmental Science & Technology, 2001 Vol. 35, No. 8, pages 1593-1598.

16.3. U.S. EPA, "Residue Chemistry Test Guidelines, OPPTS 860.1340, Residue Analytical Method", EPA 712-C-95-174, August 1995.

16.4. STL Denver White Paper DEN-W-LC-002, "Method Validation Study for Analysis of Ammonium Perfluorooctanate in Soil Matrices by High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, September 5, 2003.

16.5. STL Denver White Paper DEN-W-LC-003, "Addendum A to Method Validation Study for Analysis of Ammonium Perfluorooctanate in Soil Matrices by High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, August 6, 2003.

16.6. STL Denver White Paper DEN-W-LC-004, "Method Validation Study for Analysis of Perfluorooctanoic Acid in Waters by High Performance Liquid Chromatography/Tandem Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, January 26, 2005.

17. METHOD MODIFICATIONS

As this is an in-house method, there are no modifications at this time.

18. ATTACHMENTS

There are no attachments to this SOP.

19. REVISION HISTORY

19.1. WS-LC-0020, Revision 2.1, Effective 9/04/2009

19.1.1. Added Section 1.5, "When undertaking projects for Department of Defense (DoD) the relevant criteria in QA Policy WS-PQA-021 "DoD QSM and AFCEE QAPP Implementation" must be checked and incorporated."

19.1.2. Inserted Section 10.1, "For details of the calculations used to generate the regression equations, and how to use the factors generated by these equations,

refer to SOP CA-Q-S-005 “Calibration Curves (General)”.”

19.2. SOP WS-LC-0020, Revision 2, Effective 9/15/2007

19.2.1. This SOP has been modified to utilize the TestAmerica SOP format.

19.2.2. Added Section 4.5 to discuss the additional peak present in the internal standard for MPFOS.

19.2.3. Added requirement to record the pH check during aqueous sample preparation.

19.2.4. Updated the solid reporting limit to reflect the current actual reporting limit.

19.2.5. Updated ICV and ICAL solution concentrations to reflect current practice.

19.3. SOP SAC-LC-0020, Revision 1, Effective 2/23/2007
This was the original SOP.

Title: Sample Receipt and Procedures

[Quality Assurance Procedure]

Approvals (Signature/Date):

10/19/09	10/19/09
David Herbert — Date Technical Manager	Joe Schairer — Date Health & Safety Manager / Coordinator
for: 10/19/09	10/19/09
Douglas Weir — Date Quality Assurance Manager	Karla Buechler — Date Laboratory Director

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1. SCOPE AND APPLICATION

1.1. It is the responsibility of the employee to perform the procedure described here in full compliance with this SOP.

1.2. It is the responsibility of the Laboratory Director, QA Manager, and Departmental Supervisors of this facility to ensure that the analysis is performed in full compliance with this SOP. It is also their responsibility to supply adequate training, materials, and equipment to enable the employee to perform this SOP correctly.

2. SUMMARY OF METHOD

2.1. This SOP describes the procedures for laboratory chain-of-custody, including receipt and acceptance of sample shipments, storage requirements, generation of computer records, and corrective actions for sample receipt anomalies.

3. DEFINITIONS

3.1. Definitions of terms used in this SOP may be found in the glossary of the Quality Assurance Manual (QAM).

4. INTERFERENCES

4.1. Any checks on samples, or storage of samples, should be done to eliminate any cross contamination.

5. SAFETY

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001), the West Sacramento Addendum to the Corporate EH&S Manual (WS-PEHS-002), and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1. Specific Safety Concerns or Requirements

5.1.1. Eye protection that satisfies ANSI Z87.1, laboratory coat, and chemically resistant gloves must be worn while samples, standards, solvents, and reagents are being handled. Latex, vinyl and nitrile gloves all provide sufficient protection when handling closed sample containers.

5.1.2. If any ice chest or shipping container has one or more glass containers that have broken in shipment, associates must wear approved cut resistant gloves while removing the remainder of the samples and cleaning the shipping container. These can contain Kevlar, or NAPA Blue-Grip latex.. Chemical protective gloves must be worn under or over these gloves, as needed

5.1.3. Exposure to chemicals must be maintained **as low as reasonably achievable**; therefore all samples must be opened, transferred, sub-sampled and prepared in a fume hood. Solvent and waste containers will be kept closed unless transfers are being made.

5.1.4. Laboratory procedures such as repetitive use of pipettes, repetitive subsampling, moving heavy shipping containers, unloading shipping containers, and manipulation of glassware represent a significant potential for repetitive motion or other ergonomic injuries. Laboratory associates performing these procedures are in the best position to realize when they are at risk for these types of injuries. Whenever a situation is found in which an employee is performing the same repetitive motion, the employee shall immediately bring this to the attention of their supervisor, manager, or the EH&S staff. The task will be analyzed to determine a better means of accomplishing it.

5.1.5. Safety policies apply to ALL sample administration visitors, including auditors, employees, couriers or clients who deliver samples.

5.1.6. Some types of biological samples may present special hazards. Refer to Appendix 11 of this document for more information.

5.1.7. Samples containing or potentially containing chemical warfare agents or degredates present a special hazard. Review Appendix 10 of this document before opening any coolers containing these types of samples.

5.2. Primary Material Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. **NOTE: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Sulfuric Acid (1)	Corrosive Oxidizer Dehydra-dator	1 mg/m^3	This material will cause burns if comes into contact with the skin or eyes. Inhalation of vapors will cause irritation of the nasal and respiratory system.
Sodium Hydroxide	Corrosive Poison	2 ppm, 5 mg/m^3	This material will cause burns if comes into contact with the skin or eyes. Inhalation of Sodium Hydroxide dust will cause irritation of the nasal and respiratory system.
Hydrochloric Acid (1)	Corrosive Poison	5 ppm-Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Nitric Acid (1)	Corrosive Oxidizer Poison	2 ppm-TWA 4 ppm-STEL	Nitric acid is extremely hazardous. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Sodium Bisulfate	Corrosive	None listed	Contact may cause skin/eye burns. Inhalation can cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing and shortness of breath. Causes chemical burns to the respiratory tract. May cause fatal spasms, inflammation or pulmonary/respiratory edema.
Zinc Acetate	Irritant	None Listed	Symptoms of skin or eye contact include redness, itching and pain.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			

6. EQUIPMENT AND SUPPLIES

6.1. IR thermometer calibrated at a minimum of once per quarter against an NIST reference thermometer.

6.2. Filament thermometer calibrated at a minimum of once annually against an NIST reference thermometer.

6.3. Probe thermometer capable of reading to 0.1°C calibrated at a minimum of once annually against an NIST reference thermometer.

6.4. pH paper (Range pH 2 to pH 12 or equivalent).

6.5. Pipette.

6.6. Calibrated balance capable of reading 0.1g.

6.7. Packing materials, including wet ice.

7. REAGENTS AND STANDARDS

7.1. Not applicable. Use of preservatives or other reagents is performed in the laboratory areas.

8. SAMPLE COLLECTION, PRESERVATION AND STORAGE

8.1. This SOP does not address sample collection.

8.2. Preservation and storage of samples is determined by each method. See method SOPs.

9. QUALITY CONTROL

9.1. Not applicable.

10. CALIBRATION

10.1. Thermometers are calibrated according to WS-QA-0016.

10.2. All electronically operated thermometers (including IR thermometers) must have their calibration verified each day of use (see WS-QA-0016, Thermometer Calibration for further details). IR thermometers are to be calibrated quarterly against an NIST reference thermometer.

11. PROCEDURE

11.1. Procedural Variations

Procedural variations are allowed only if deemed necessary in the professional judgment of the supervisor to accommodate variation in sample matrix, radioactivity,

chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using a Nonconformance memo and approved by a supervisor and QA/QC manager. If contractually required, the client will be notified. The Nonconformance memo will be filed in the project file.

Any deviations from this procedure identified after the work has been completed must be documented as a nonconformance, with a cause and corrective action described. A Nonconformance memo shall be used for this documentation.

11.2. Before samples are received, the laboratory should provide the client's sample collection personnel the TestAmerica West Sacramento Sample Receiving Acceptance Policy (see Appendix 1). It is sent along with the bottle order.

11.3. Receiving Shipment

11.3.1. Verify accuracy of each shipping container's delivery address. Note the condition of the seal and if the custody seal number is present.

11.3.2. Record each delivery received in the computer entry SRL (Sample Receipt Logbook), see Appendix 2 for screen-print. A single shipping container may be listed as one or several lots. Record the client and/or shipper name(s), receipt date and time. If the lot number is generated for the shipment at this time, record the number in the far-left column. If a single shipment is subdivided into multiple lots at a later time, all lot numbers are listed on the original logbook entry. In the event of multiple package deliveries, the receipt time is the carrier's time of arrival, not the time when each package is handled. This document is required for legal chain of custody.

11.3.3. Initiate a LRC (Lot Receipt Checklist) for each sample shipment (see Appendix 3). Each person who completes an entry must check the box in the corresponding columns. For non-applicable items, enter "N/A", with initials and dates. The initiator must initial and date the portion of the form they complete. If another technician completes a portion of the LRC, they must also initial and date the portion they complete.

11.3.3.1. Enter client and assigned PM.

11.3.3.2. Enter SRL number as generated by the SRL program.

11.3.3.3. Enter date shipment is received and initial.

11.3.3.4. Enter time shipment is received.

11.3.3.5. Enter carrier (method of delivery). "Over the counter" indicates a delivery made directly to the laboratory by a client.

11.3.3.6. Enter condition of custody seal (if present). Enter pre-printed custody seal number or "N/A". Custody seals are defined by the presence of the shipper's signature accompanied with date/time. Note the presence of custody tape (which will have no space for entries and crumbles when removed). This is also required for legal chain of custody.

11.3.3.7. Record ownership/disposition of shipping container. Non-company containers must be returned to client if possible.

11.4. Opening Shipment

11.4.1. Following safety policies, open the shipping container and remove paper work. Bechtel, Navy Clean or Clean 3 projects must all be opened in the hood. In addition, shipments accompanied by MSDS documentation, shipments of concentrated product, or exhibiting strong, noxious odors must be opened in the hood. If a shipment contains broken or leaking samples, place the container in fume hood and notify the project manager via e-mail. Digital pictures may be taken of the broken samples and the files attached to the project manager’s email. Dispose of broken samples according to the facility hazardous waste procedures. The Hazardous Waste Specialist or Environmental Health and Safety Coordinator should be contacted if additional information is required.

11.4.2. Assume custody of the samples by signing and dating the COC in the section marked "Received for Lab By" or "Received By". This is also required for legal chain of custody. Immediately after opening, ascertain if ice or artificial coolants are present. Measure temperature and record the results in the temperature record section of the LRC.

11.4.2.1. Use the infrared thermometer by directing the thermometer at sample containers making sure no labels or packaging materials are interfering with the direct contact of the infrared beam and the sample container. If the COC lists a temperature blank, or one is present in the shipping container, locate the blank and measure the temperature. Take temperatures of random samples in the cooler to determine the average temperature. Measure temperature and record the results in the temperature blank and sample temperature section of the LRC.

11.4.2.2. A non-conformance memo must be entered if the temperature reading is below 2°C or above 6°C. This notifies the project manager via email and provides a hard copy to include with the lot folder. In the non-conformance memo software, be sure to include

the client ID for all samples that are associated with a temperature exceedance.

Note: Wisconsin compliant samples must be maintained at temperatures <4ºC.

11.4.2.3. Some sample matrices do not require cooling during transit. Situations where acceptable temperature range exceedance may be expected include, but are not limited to:

11.4.2.3.1. Samples delivered within six hours of close of daily sampling event.

11.4.2.3.2. Paperboard and dry pulp samples; non-conformance memo not necessary.

11.4.2.3.3. Dry incinerator ashes; non-conformance memo not necessary.

11.4.2.3.4. Samples for metals analysis only; non-conformance memo not necessary. Note: This does not apply to soil samples for mercury analysis. Such samples must be shipped on ice at 4 ºC, and narrated with a non-conformance memo if not on ice.

11.4.2.3.5. Dry product samples; non-conformance memo not necessary.

11.4.3. Verify that the sample collector's name appears on the COC and document by checking the associated box on the LRC. Record the pre-printed COC number (if a COC is present) and the sequential document number on the LRC. Examine accompanying documentation. If documentation is absent and the shipment arrival was unexpected, contact the lead project manager for assistance.

11.5. Prioritizing Workload

11.5.1. Examine the analyses requested and the sampling dates/times. Be aware of any notation for expected Turn-Around-Time (TAT), or a due date that is less than 14 days, or hold times that will expire within 72 hours. Most aqueous organic analyses require extraction within seven days of sampling. If three days or less are remaining, consider the lot to be a priority and file in a manila folder (Methods 8280 and 8290 dioxin/furan analyses are an exception, requiring extraction within thirty days).

11.5.2. Any analysis that has a standard holding time of forty-eight hours or less is

considered a "Short-Holding Time" (SHT) analysis. These are reported to the affected department immediately with the Short Holding Time Test notification (see Appendix 4). The receiving chemist initials, dates and records the time on the SHT form. Any requested TAT of fourteen days or less is also considered a priority.

11.5.3. Prioritize the shipment according to the TAT, while ensuring extraction holding times have not been exceeded. "RUSH" projects are placed in a red folder, SHT analyses are processed immediately, projects requiring shipment of subcontracted samples are placed in purple folders, projects requiring a project managers immediate attention to add tests are placed in blue folders while all other projects are placed in manila folders.

11.6. Sample Processing

11.6.1. Select the project with the highest priority:

11.6.1.1. Short holds are processed immediately.

11.6.1.2. Blue folder (requires a project managers immediate attention)

11.6.1.3. Red folder (rush)

11.6.1.4. Purple folders (to be shipped out)

11.6.1.5. Manila folder (normal TAT)

11.6.2. Read shipment documentation. Ideally, samples are to have possession documented on a COC form. The COC will identify samples individually by alphanumeric designators, list sampling dates/times for each sample, requested analyses and document possession. Signatures of possession qualify samples as having been "received under Chain-of-Custody". A Letter-of-Transmittal is also accepted as definitive documentation. Other forms of documentation include Request for Analysis, Shipping Order, Purchase Order, and various computer listings of sample information. If no documentation that lists sample identifications exists, complete a COC when accepting the samples.

11.6.3. Check the samples against the COC for accuracy (e.g., sample ID, collection date/time, etc.). If the samples have not been received in good condition, it must be noted on the LRC and an NCM must be filed. All discrepancies must be noted as well, including the lack of a relinquishing signature from the shipper.

NOTE: Good condition is loosely defined as all containers intact with no obvious discrepancies present. The shipment is estimated at this time to be viable; what is being requested coincides with what has been received.

Temperature exceedances and minor discrepancies become issues when so specified by contract or client instruction. The presence of bubbles in volatile containers is documented. All such observations must be documented on custody chains, the LRC, and by using the non-conformance memo software.

11.6.4. Complete the bottle inventory on the project receipt checklist (see Appendix 5). Compare the containers and their state of preservation with the list of analyses requested. Although some exceptions are permitted regarding particular clients, container types must compare to those listed in the TestAmerica West Sacramento Quality Assurance Manual Tables 8.5-1, 8.5-2 and 8.5-3. Discrepancies of this nature must also be annotated on the COC and a non-conformance memo filed.

11.6.5. For all work sampled at or concerning government property, any federal projects, or as specified in client QAPjPs, the pH of the preserved aqueous samples must be checked and recorded, except for the VOA vials. The pH is noted as <2 or >12 with the preservative type following (example: pH<2 H_2SO_4). Enter the information in the pH section on the LRC.

11.6.5.1. After placing the samples in the hood, invert the sample container three times, remove the cap, insert a clean pipette into the sample container and remove a small amount. Release a droplet of the aliquot on a fresh piece of pH indicator paper. Compare against the pH color grid table located on the pH strip container. Do not reuse the pipette. Use a clean pipette for each container. Recheck readings that indicate samples were unpreserved when they should have been. Note discrepancies on the COC. Notify the project manager and file a non-conformance memo for the concerned sample. Transport samples to the general chemistry or metals departments when sample preservation is necessary as a corrective action. Check the indicated boxes on LRC.

11.6.6. Obtain a lot number and quote number. Enter this information in the top section of the LRC in the designated area.

11.6.7. Note storage location on LRC. Designate a storage location using the following guide:

11.6.7.1. V - volatile containers awaiting transfer to the VOA group refrigerators.

11.6.7.2. F10 - samples requiring freezing, including plant/animal tissues, and soil samples for method 1668;

11.6.7.3. R22 - any samples where secondary containment in Ziploc bags is deemed necessary due to smells, spillage, degradation of container exterior or suspected high concentration of analytes.

11.6.7.4. C1 - dry pulp or paper samples;

11.6.7.5. EPA1 - soil samples received from the Environmental Protection Agency, solvents, air toxics projects for method 29 or clients requiring dioxin work under SOW DFLM01.1.

Note: Location selections (specify shelf by letter, Example: W4A).

Note: Dioxin soil samples received in clear glass jars must be stored in boxes to protect from light.

11.6.8. Label sample containers. Be certain the labels adhere to containers. Attempt to leave all client label information exposed. However, when impossible to do so, affix label so that at least the client ID, sampling date/time, and preservative are showing. Preprinted laboratory names may be covered with no consequence. If label adhesive is insufficient, use cellophane tape to secure label. Place sample in Ziploc bag when storage location is R22. Check the appropriate box on the LRC. Labeling may be peer reviewed whenever the complexity of the project warrants a second check to ensure accuracy. A peer compares the order of the samples to the documentation and ensures that all containers of a sample have the same sample number and are sequential. The reviewer then initials/dates the LRC in the peer review section. If no review is performed, the labeler checks the box on the LRC.

11.6.9. Circumstances where a review is warranted include:

11.6.9.1. A large number of samples are present.

11.6.9.2. Many containers per sample are present.

11.6.9.3. VOA containers are present.

11.6.9.4. Client identifications are illegible or confusing.

11.6.9.5. A review is requested by a TestAmerica West Sacramento employee.

11.7. Shipping Container Return

11.7.1. Broken samples and packing material contaminated with spilled samples MUST be disposed of as hazardous lab trash. Shipping containers must be decontaminated before being put back into use. Decontamination procedures will depend on what was spilled. See EH&S staff for specific instructions.

11.7.2. Except when discarded, shipping containers are cleaned in bottle prep or returned to the client. Containers belonging to TestAmerica West Sacramento are marked with a permanent marker with an easily identified tracking number. If the container belongs to a client, be certain the return address is recorded before stripping the container of used tape and labels. All hazardous materials labeling must **be removed or defaced** in some way. Dry the interior of the container if wet, replace packing and return to bottle prep.

11.7.3. Packing, artificial ice, and temperature blanks are returned to the client. Packing which is deemed re-usable may be returned. Packing which resembles trash or is ruined during unpacking is disposed as trash. Drain any water from the container before sealing it closed. Due to partially frozen artificial ice, client containers may not be perfectly dry when returned. Complete a return-mailing label. Secure it with cellophane tape and seal the container.

11.7.4. Per USDA permit regulations, ice chest hat have been used to ship soil samples must be separated from those that did not have soil samples in them for further cleaning before re-use. Ice chests that have had soil samples are to be stacked on a pallet outside sample control and moved to the bottle prep area where they are cleaned. Ice chests that do not require further cleaning are stacked on a separate pallet and moved to the warehouse.

11.8. Disposal of Ice

11.8.1. When ice is present, it is often enclosed in plastic bags. A basin used for dumping ice is located in sample administration. Open the bags and dump ice into the basin. Water should not be left running in the basin as the basin drains into a closed system. When excessive amounts of ice are received, collect the ice in an ice chest and dump it over the storm drains outside the building. **This is permissible only if the ice and coolers are uncontaminated and the amounts disposed in this way are recorded. Additionally, ice used to ship any soil samples may not be disposed down the storm drain. It may only be disposed of down the basin in sample administration.**

11.9. Lot Generation

11.9.1. Lots are created by using quotes that are provided by the project manager. Determine the appropriate quote number by using the “Quote Search” program, via either the client name or project manager. If the quote cannot be determined, send an email to the project manager by using the Review Login Data of the Sample Receipt Logbook program. If the quote information is not

available and must be set-up from scratch, determine the name and location of client. This information can be found on the COC, or shipping labels and forward this information to the project manager so they can create a quote.

11.10. Sample Login

11.10.1. Refer to the QuantIMS E-Z Login sheet.

11.10.2. Record lot number in SRL on the line corresponding to the shipment's arrival. Complete Lot Review Checklist #1 (see Appendix 7). File an HTV, if necessary, by entering "Anomaly" and the lot number at your prompt. Answer the queries, and be certain to mail the HTV to the department supervisor and project manager involved. The HTV is filed by sample administration when a holding time is expired upon receipt. If the holding times have not completely expired for a project, the department handling the analysis in question files the HTV. Place the project manager folder in the project manager's tray and the internal tracking folder in the checkout boxes (both located in sample administration).

11.11. Project Manager Folder Assembly

11.11.1. Place in an appropriately colored folder (see Section 5.6.1.):

11.11.1.1. Lot Receipt Checklist #1 and bottle inventory; (yellow page).

11.11.1.2. Lot Review Checklist #1 (green page).

11.11.1.3. Original COC.

11.11.1.4. Air bill and secondary documentation.

11.11.1.5. Sample confirmation report, (QuantIMS) (white page).

11.11.2. In-house COC Folder Assembly

Align folder (any color) with the tab on right-hand side. On the right-hand side of the folder, staple the in-house COC form (see appendix 6). On the left-hand side, staple a copy of the inventory sheet. If the entire bottle inventory for any sample is not complete on the sample confirmation report, include a copy of the bottle inventory (reverse side of LRC). If an MSDS is provided in shipment, place a copy on the right-hand side of the folder.

11.12. Refrigerator and Freezer Temperatures

11.12.1. Refrigerator and freezer temperatures will be monitored and recorded once daily Monday through Saturday. Any temperature below 2°C or above 6°C

for the refrigerators and above -10°C for the freezer will need corrective action. Refer to WS-QA-0005, Temperature Monitoring and Corrective Action for Refrigerators and Freezers. Temperatures will be recorded on the appropriate charts. Temperature charts will then be stored in the temperature logbook. All charts for a particular refrigeration unit will be stored together in chronological order.

11.13. Internal Sample Tracking

11.13.1. Analyst selects sample checkout folder for the lot of interest and ascertains storage location. Analyst removes appropriate containers from storage unit and organizes them by lot and sample number. Analyst completes checkout portion of internal COC. For a legal chain of custody, a sample custodian must verify the record and container labels and initial under the witness field on the internal COC. For non-legal COCs, “NA” may be entered in the witness field.

11.13.2. If a sample is completely used up in the extraction laboratory, then the disposition of the container must be documented. The code DIT (destroyed in testing) may be used. All empty containers not returned to sample administration must be recorded on the Internal COC. If the containers are not to be returned and will enter the waste stream through the extraction lab, the analyst will also enter this information during checkout.

11.13.3. Analyst files the checkout folder before leaving the room. At return, the analyst completes the check-in portion of the Internal COC. Analyst returns samples to their storage location. If subsampling or aliquoting is performed, whether outside the area or not, containers must be checked out by the analyst. The original containers' whereabouts and those of any other containers generated must be documented. Transfer of volatile containers from VOA to RD and RF do not require verification.

11.14. Sending Out Subcontracted Work

11.14.1. In the event samples require being subcontracted to another lab, the samples will be processed in the very same manner as all other samples. Samples should be received and processed as described in Sections 5.1 to 5.13 of this SOP. The project manager should notify the sample receiving staff as to all samples they require to be shipped out.

11.14.2. Using QuantIMS, generate a new TestAmerica West Sacramento chain of custody for the subcontracted samples. The destination for the samples should be entered on the COC. Contact the project manager for assistance if any

difficulties are encountered.

11.14.3. Log samples to be subcontracted onto a sample receiving shipping log. In addition, use the in house COC (see Appendix 6) to check out the samples from sample control. In the sample check-in section, document that the sample was subcontracted and its' destination.

11.14.4. Samples should be packaged in a manner in accordance with the TestAmerica West Sacramento Receiving Acceptance Policy. Samples are packaged in a plastic bag to insure labels do not get wet. Additional packing may be used to insure samples have adequate protection from breakage. Samples are subsequently packaged in a bag containing copious amounts of wet ice. There should be sufficient ice to maintain the samples within the temperature range of 2°C to 6°C throughout transit. The ice packed samples are stored in the appropriate sized insulated container.

11.14.5. Relinquish custody of the samples by signing the appropriate space on the TestAmerica West Sacramento COC. A copy should be included with the samples. Insure that it is packed in the shipping container and that it is protected from moisture from ice and/or samples (in the event any containers become compromised). The original should be filed in the project manager purple colored folder.

11.14.6. The packed container is then sealed with a generous amount of shipping tape to ensure the contents remain secured. Samples are now ready for shipment. Ensure they are labeled with the appropriate shipping labels and delivered to the courier.

11.15. Client Deliveries ("Over the Counter")

11.15.1. Samples received "over the counter" are samples hand delivered by the client, sampler or courier directly employed by the client's company. The pivotal question in such deliveries is whether the person possessing the shipment is in custodial possession of the samples or merely transporting the shipment. If in custodial possession, the deliverer will need to relinquish custody to you before departing and will probably retain a copy of the documentation. To determine the matter, simply ask the deliverer if they have signed any of the sample documents.

11.15.2. If the client, sampler or courier does not wish to remain while the samples are unpacked and verified, sign the COC in the "Received By" section. Include a statement that only the shipping container was received (example: One cooler received from Company X in good condition. MMDDYY/ Initials).

11.15.3. Mention any discrepancies and allow corrections to be made by the client, sampler or courier. Also ask for any special instructions or important aspects of the project (i.e. rush turn-around times, impending hold-time violations, sample matrix specifics, etc.). Solicit the client's needs such as shipping containers, bottle orders, to speak with a project manager or any other requests. After the client's departure, complete any aspects of Sections 5.1 through 5.15 left unfinished. Prioritize the new project within the existing workload and proceed with the highest priority.

11.16. After hours sample receipt instructions for non-sample administrative personnel (see Appendix 12)

12. CALCULATIONS/DATA REDUCTION

12.1. Not applicable.

13. METHOD PERFORMANCE

13.1. The Department Manager has the responsibility to ensure that this procedure is performed by an associate who has been properly trained in its use and has the required expertise.

14. POLLUTION PREVENTION

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Environmental Health and Safety Manual (CW-E-M-001) for "Waste Management and Pollution Prevention."

All waste will be disposed of in accordance with Federal, State and Local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment.

14.1. All ice, or melted ice, that has been used to store or ship any soil samples, or in any container with soil samples, must be allowed to melt through a 100 mesh screen, in order to comply with our USDA soil permit.

14.2. Per USDA permit regulations, ice chests that have been used to ship soil samples must be decontaminated with 10% bleach solution during the cleaning process before being re-used.

15. WASTE MANAGEMENT

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to WS-EHS-0001. The following waste streams are produced when this method is carried out.

15.1. Uncontaminated packing materials such as vermiculite, bubble wrap, foam inserts, plastic bags, paperwork, etc. These are collected in the uncontaminated lab trash cans, and are disposed of to the dumpster at the end of the day.

15.2. Contaminated solid packing materials, including broken glass, caused by the breakage of sample containers during shipment. Dump the solid waste into a contaminated lab trash bucket. When the bucket is full, tie the plastic bag liner shut and put the lab trash into the steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.3. Contaminated melted ice and aqueous samples of unknown hazards, spilled when their sample container breaks during shipment. These materials are collected and disposed of in accordance with instructions from the Hazardous Waste Specialist, depending on the type of sample that was spilled.

15.4. Contaminated melted ice and solid or soil samples of unknown hazards, spilled when their sample container breaks during shipment. These materials are collected and disposed of in accordance with instructions from the Hazardous Waste Specialist, depending on the type of sample that was spilled.

16. REFERENCES/CROSS REFERENCES

16.1. Manual for the Certification of Laboratories Analyzing Drinking Water, Fifth edition, January 2005, Appendix A.

17. METHOD MODIFICATIONS

17.1. There are no deviations from the method.

18. ATTACHMENTS

18.1. Appendix 1 - TestAmerica West Sacramento Sample Receiving Acceptance Policy

18.2. Appendix 2 - Sample Receipt Logbook

18.3. Appendix 3 - Lot Receipt Checklist

18.4. Appendix 4 – Short Hold Test Notification

18.5. Appendix 5 – Project Receipt Checklist

18.6. Appendix 6 – In House Chain of Custody

18.7. Appendix 7 – Lot Review Checklist #1

18.8. Appendix 8 – Lot Review Checklist #2

18.9. Appendix 9 – Flow chart

18.10. Appendix 10 – Chemical Warfare Degradates – Potential Hazards in Sample Receipt

18.11. Appendix 11 – Handling of Blood or Other Potential Infectious Materials

19. REVISION HISTORY

19.1. WS-QA-0003, Revision 11.2, Effective 10/19/09

19.1.1. Revised Section 11.6.7.2 from F2 to F10, and added wording "and soil samples for method 1668."

19.1.2. Editorial changes.

19.2. WS-QA-0003, Revision 11.1, Effective 09/09/2009

19.2.1. Reformatted Lot Receipt Checklist (Appendix 3)

19.2.2. Editorial changes.

19.3. WS-QA-0003, Revision 11, Effective 3/31/2008

19.3.1. Updated to TestAmerica format.

19.3.2. Updated Appendices to TestAmerica format.

19.3.3. Editorial changes.

19.4. SAC-QA-0003, Revision 10.3, Effective 3/12/2007

19.4.1. Updated to reflect documentation practices when samples are/are not received in good condition.

19.5. SAC-QA-0003, Revision 10.2, Effective 12/26/2006

19.5.1. Clarified instances that do not require Non-conformance Memos.

19.5.2. Updated Appendix 4 to include current revision of Short Hold Time form.

19.6. SAC-QA-0003, Revision 10.1, Effective 10/17/2006

19.6.1. Updated to reflect current practices regarding legal versus non-legal COC documentation.

19.6.2. Updated form ID QA-188 to change the footnote for field #7 for peer witness initials.

19.6.3. Added Appendix 12 for after hours sample receipt instructions for non-sample administrative personnel.

19.7. SAC-QA-0003, Revision 10, Effective 12/22/2005

19.7.1. Updated to include legal chain of custody.

19.7.2. Updated format.

19.8. SAC-QA-0003, Revision 9.1, Effective 8/5/2005

19.8.1. Short hold test determinations were updated from 48 hours to 72 hours.

19.8.2. References to orange folders were removed.

19.8.3. Samples for Air Toxics projects analyzed by Method 29 were added to the list of samples stored in EPA-1.

19.8.4. Appendices 3, 5, 6, and 9 were updated to reflect the current revisions.

19.9. SAC-QA-0003, Revision 9, Effective 8/30/2004

APPENDIX 1

TESTAMERICA WEST SACRAMENTO
SAMPLE RECEIVING ACCEPTANCE POLICY

NELAC and TestAmerica West Sacramento have specific requirements under which all samples will be received by the laboratory for analysis. TestAmerica West Sacramento will review your sample shipment against those requirements as listed below, and will communicate any discrepancies to you. Your project manager will assist you in the appropriate resolution of any issues related to sample receipt. Please contact your project manager with any questions.

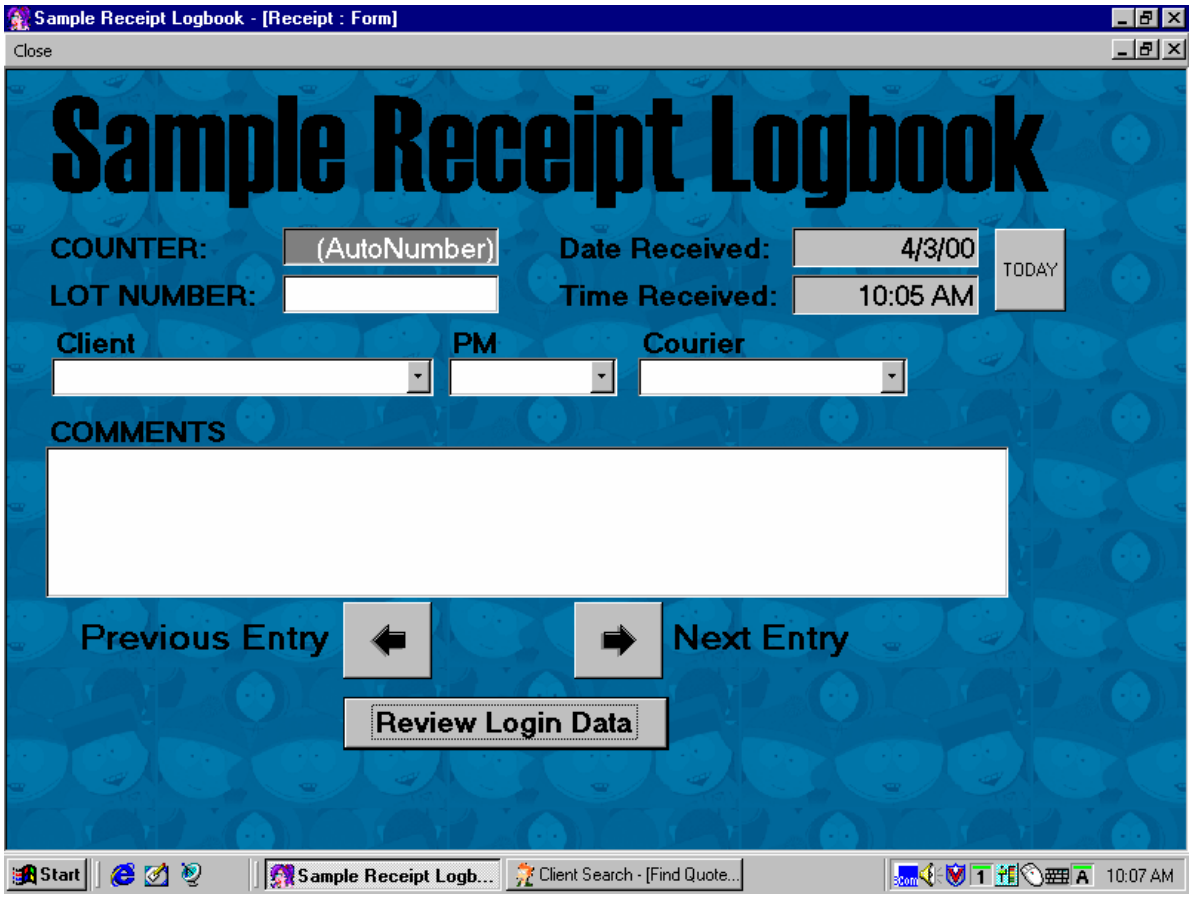
TestAmerica West Sacramento requirements are as follows:

- ✓ Proper, full and complete documentation, which includes sample identification, the location, date and time of collection, the collector's name, the preservation type, the sample matrix type, the requested testing method, and any special remarks concerning the samples, shall be provided.
- ✓ Samples must be accompanied by written disclosure of the known or suspected presence of any hazardous substances, as defined by applicable federal or state law.
- ✓ Each sample shall be collected in the appropriate sample container and labeled with unique, durable and indelible identification.
- ✓ Drinking waters samples for Method 1613B that may have residual chlorine must be checked and treated in the field, or collected in sodium thiosulfate preserved containers.
- ✓ The samples shall arrive at the laboratory with adequate remaining holding time for the analyses requested.
- ✓ Sufficient sample volume must be available to perform the requested analyses.
- ✓ Received samples must not exhibit obvious signs of damage, contamination or inadequate preservation.
- ✓ For samples undergoing chemical warfare degradate analysis, the sample must be screened for agent prior to shipment in accordance with appendix 10 of our Sample Receipt Procedure (WS-QA-0003).
- ✓ Samples containing mammalian tissue will not be accepted without prior coordination with a project manager. Additional conditions for receipt and handling of tissue are outlined in appendix 11 of our Sample Receipt Procedure (WS-QA-0003).

The laboratory will notify the client/Project Manager upon sample receipt if the samples fail to meet any of the above requirements.

When completing the chain of custody form, please do not forget to sign your name in the "relinquished by" box.

APPENDIX 2


Sample Receipt Logbook - [Receipt : Form]
Close
Sample Receipt Logbook
COUNTER:
(AutoNumber)
Date Received:
4/3/00
TODAY
LOT NUMBER:
Time Received:
10:05 AM
Client
PM
Courier
COMMENTS
Previous Entry
Next Entry
Review Login Data
Start
Sample Receipt Logb...
Client Search - [Find Quote...
10:07 AM

APPENDIX 3

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

LOT RECEIPT CHECKLIST
TestAmerica West Sacramento

CLIENT _____ PM _____ LOG # _____

LOT# (QUANTIMS ID) _____ QUOTE# _____ LOCATION _____

Checked (✓)

DATE RECEIVED _____ TIME RECEIVED _____ ☐

DELIVERED BY ☐ FEDEX ☐ ON TRAC ☐ CLIENT
☐ GOLDENSTATE ☐ UPS ☐ GO-GETTERS ☐ OTHER
☐ TAL COURIER ☐ TAL SF ☐ VALLEY LOGISTICS ☐

CUSTODY SEAL STATUS ☐ INTACT ☐ BROKEN ☐ N/A ☐

CUSTODY SEAL #(S) _____

SHIPPPING CONTAINER(S) ☐ TAL ☐ CLIENT ☐ N/A ☐

COC #(S) _____ ☐

TEMPERATURE BLANK Observed: _____ Corrected: _____

SAMPLE TEMPERATURE - (TEMPERATURES ARE IN °C)

Observed: _____ Average _____ Corrected Average _____

LABORATORY THERMOMETER ID:

IR UNIT: #4 ☐ #5 ☐ ☐ OTHER _____ ☐

Initials Date

==========

pH MEASURED ☐ YES ☐ ANOMALY ☐ N/A ☐
LABELED BY..... ☐
LABELS CHECKED BY..... ☐
PEER REVIEW _____ ☐ NA

SHORT HOLD TEST NOTIFICATION SAMPLE RECEIVING ☐
WETCHEM ☐ N/A ☐
VOA-ENCORES ☐ N/A ☐

☐ METALS NOTIFIED OF FILTER/PRESERVE VIA VERBAL & EMAIL ☐ N/A ☐

☐ COMPLETE SHIPMENT RECEIVED IN GOOD CONDITION WITH ☐ N/A ☐
APPROPRIATE TEMPERATURES, CONTAINERS, PRESERVATIVES

☐ CLOUSEAU ☐ TEMPERATURE EXCEEDED (2 °C – 6 °C)*1 ☐ N/A
☐ WET ICE ☐ BLUE ICE ☐ GEL PACK ☐ NO COOLING AGENTS USED ☐ PM NOTIFIED

Initials Date

Notes _____

*1 Acceptable temperature range for State of Wisconsin samples is ≤4°C.

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APPENDIX 4

TestAmerica West Sacramento
SHORT HOLDING TEST NOTIFICATION

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

CLIENT _____
LOT ID _____
DATE & TIME RECEIVED BY SAMPLE CONTROL_____
DATE & TIME RECEIVED IN GEN CHEM _____

☐ SHT ANALYSIS
☐ PENDING HTV (ROUTINE TESTS)
☐ RUSH (24 - 48 - 72 HR TAT)
☐ SEE ATTACHED

CHEMIST NOTIFIED _____

QAS # _____

GENERAL ANALYSIS	SAMPLE #	ASSIGNED CHEMIST
☐ pH ☐ Alkalinity	_____	_____
☐ $Cr6^+$ ☐ EC	_____ _____	_____
☐ Turbidity ☐ Color	_____ _____	_____
☐ SS ☐ SO_3	_____ _____	_____
☐ pH-Soils	_____ _____	_____
Lachat		
☐ NO_2+NO_3	_____	_____
☐ NO_2	_____	_____
☐ NO_3	_____	_____
Method 365.3		
☐ OPO_4	_____	_____
Method 300.0		
☐ NO_3 ☐ NO_2 ☐ OPO_4	_____	_____
☐ Br ☐ Cl ☐ SO_4 ☐ F	_____	_____
Metals		
☐ Dissolved Metals, Filter & Pres	_____	_____
☐ OTHER _____	_____	_____
_____	_____	_____
_____	_____	_____

Holding time already violated? ☐ Yes ☐ No

HTV filed? ☐ Yes ☐ No

☐ MS/MSD required on sample # ____ ☐ MS/DU required on sample # ___

Comments: _____

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APPENDIX 5

TestAmerica West Sacramento
TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Bottle Lot Inventory

Lot ID:_____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
VOA*																				
VOAh*																				
AGB																				
AGBs																				
250AGB																				
250AGBs																				
250AGBn																				
500AGB																				
____AGJ																				
500AGJ																				
250AGJ																				
125AGJ																				
____CGJ																				
500CGJ																				
250CGJ																				
125CGJ																				
PJ																				
PJn																				
500PJ																				
500PJn																				
500PJna																				
500PJzn/na																				
250PJ																				
250PJn																				
250PJna																				
250PJzn/na																				
Acetate Tube																				
_____"CT																				
Encore																				
Folder/filter																				
PUF																				
Petri/Filter																				
XAD Trap																				
Ziploc																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

h = hydrochloric acid **s** = sulfuric acid **na** = sodium hydroxide **n** = nitric acid **zn** = zinc acetate

Number of VOAs with air bubbles present / total number of VOA's

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Page 3

LEAVE NO SPACES BLANK. USE "NA" IF NOT APPLICABLE.

774APPENDIX 6

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

IN-HOUSE CHAIN OF CUSTODY

LOT # _____

TestAmerica West Sacramento

LOCATION _____

SAMPLE CHECK OUT						SAMPLE CHECK IN						
SAMPLE (S)	CONTAINER	INIT	TEST	DATE	TIME	SAMPLE(S)	CONTAINER	INIT	DATE	TIME	Return Location	COMMENTS

1. Sample # (ex: 1,2,4-10)
2. Container (ex: AGB)
3. Test: analysis sample is for
4. Date: date taken/returned
5. Time: time taken/returned
6. Init: your initials
7. RtnLoc: location samples returned to
8. Comments: (ie: empty, subsampled)

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PAGE _____

APPENDIX 7

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

LOT REVIEW CHECKLIST #1

Lot # _____

SHIPMENT RECEIPT:

____ COC/Letter of Transmittal signed and dated with time of receipt
____ Condition of samples noted on COC
____ Lot Receipt Checklist completed
____ COC generated for undocumented samples (from label information)

LOT FOLDER:

____ Means of delivery present on yellow sheet
____ Correct receipt date and time recorded
____ Sample ID(s) and collection date(s)/time(s) match COC or discrepancies noted on COC
____ Lot# labels are correct
____ Lot # entered in Excel spread sheet
____ Log # noted on yellow sheet

NOTIFICATION:

____ Anomaly sent via Clouseau
____ Wetchem notified of Short Holding tests
____ Metals notified of filtering and/or preservation
____ Rush E-Mail notification sent to PM and appropriate department(s)
____ HTV Filed for sample with expired hold times upon receipt (if applicable)
____ Subcontracted Samples

IN-HOUSE COC FOLDER:

____IN-HOUSE COC stapled to right side of folder
____ Bottle checklist stapled to the left side of folder
____ Folder filed

INITIAL/DATE _____

QA-235 EM 8/19/02

APPENDIX 8

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

LOT REVIEW
CHECKLIST #2
TestAmerica West Sacramento

LOT # _____ DATE RECEIVED _____

SECTION I

LOG RELEASE

___ Verified Correct Quantims Quote
___ Verified Contact name/Report copy
___ Verified Billing name/address
___ Verified P.O. #
___ Verified Mail to address
___ Verified prices
___ Verified SAC's assigned properly
___ Verified sample Ids and date/time sampled
___ Client specific QC assigned
___ Lot Receipt Checklist complete
___ COC discrepancies resolved and documented
___ Verified TAT or due date
___ Confirmation sent to client
___ QAS assigned
___ Report Production Form completed
___ Verified Sufficient Sample Available for All Tests
___ Log released
___ Verified Short Holding Time Notification

SUBCONTRACTED WORK

___ Confirmation of shipment (chain of custody of samples shipped)
___Expected Due Date entered in Target List system

SECTION I REVIEWED INITIAL/DATE _____

SECTION II

REPORT REVIEW

___ Signature page variables correct
___ Preliminaries documented
___ Table of contents correct
___ Correct TEQ Summary Sheet included
___ Data for all requested analyses
___ QA/QC data in control or anomalized
___ Case Narrative/Anomalies documented
___ EDD generated and completed

INVOICING

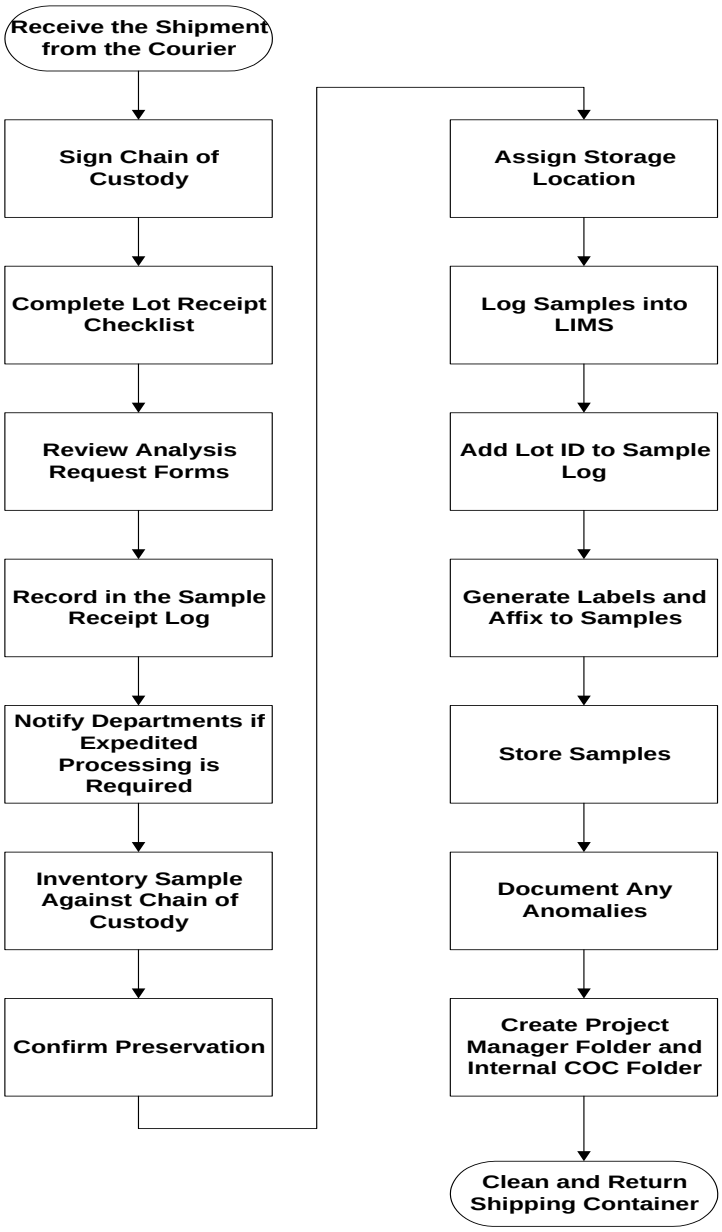
___ Additional costs added
___ Revenue Centers correct for additional items

SECTION II REVIEWED INITIAL/DATE _____

QA-235A EM 11/13/03

APPENDIX 9

Flow Diagram



APPENDIX 10

Chemical Warfare Degradates - Potential Hazards in Sample Receipt

Background

TestAmerica West Sacramento regularly receives samples to be analyzed for degradates of chemical warfare agents. These degradates generally are no more toxic than most of the compounds we deal with every day. The fact that these compounds are degradates of chemical warfare agents does, however, present a different type of potential hazard for us. We have developed policies regarding the handling of such samples. The purpose of this document is to discuss these compounds and the potential hazards involved in handling them.

Please note that TestAmerica West Sacramento does NOT analyze samples for actual chemical warfare agents such as mustard, lewisite, Sarin, GD, VX, phosgene and tear gas. Parent compounds are analyzed by laboratories that have specialized personnel training, security, and handling procedures.

The toxicity of the by-products of some chemical warfare materials are more than the parent compound. An example of this is VX and EA 2192. Testing protocol for degradates is not necessarily specific for the analyte being screened for and the scientific community has not come to consensus on what "positive" test results actually mean. For this reason, in all cases where positive screening data is received for the parent compounds, Corporate EH&S, the Project Manager, local EH&S staff and senior management must be consulted before deciding to accept and proceed with handling such samples.

Review of Agent Compounds

Chemical warfare agents fall into a wide variety of categories, ranging from relatively mild chemicals such as tear gas to lethal nerve agents such as Sarin. The two types of agents we are most concerned with are **nerve agents** and **blistering agents**. Other lethal agents have been developed and tested for use in chemical warfare; however, these other compounds are either extremely volatile and reactive (and therefore highly unlikely to be present in an environmental sample) or were never produced in significant quantities in the U.S.

Nerve agents

These are members of the organophosphate class of compounds. They are similar to many common household pesticides such as diazinon. The difference is that nerve agents are far more toxic to humans. The first nerve agent, Tabun, was discovered prior to World War I by a German pesticide company during the process of screening new compounds for use as pesticides. Once the toxicity of Tabun was determined, various governments began screening many related compounds. Out of this effort have come five established (non-classified, i.e. public domain) agents. --- **Tabun (or GA), Sarin (or GB), GD, GF, and VX.**

All of these compounds are toxic via inhalation, ingestion, skin contact, or just about any other route of entry into the body.

A characteristic of these compounds is their volatility. A more volatile nerve agent will disperse in air more effectively than a less volatile one.

Less volatile agents, on the other hand, will remain around on soil, vegetation, clothing, etc. and will therefore last longer. Out of these various agents, the only two produced in significant quantities in the U.S. are Sarin and VX. **Sarin is the most volatile** of the above agents while VX is the least volatile. Both are extremely toxic - a drop of pure VX barely visible to the naked eye is enough to kill a person through skin contact.

Blistering agents

These were the first of the modern agents developed specifically for military purposes. Unlike nerve agents, blistering agents are different mixtures of one compound, sulfur mustard, with other non-toxic chemicals which affect its dispersion characteristics.

The primary hazard with sulfur mustard involves skin contact. The term "blistering agents" is somewhat of a misnomer - it will kill you if you inhale enough of it, but this is not likely to occur as it is not particularly volatile under normal conditions. Significant quantities of sulfur mustard (a.k.a. HD or HT) have been produced in the U.S.

Chemical Agents in the Environment

It is unlikely (but never impossible) that we at TestAmerica West Sacramento will receive a sample that contains a dangerous concentration of active agent. We **should not** receive samples from any areas known to be contaminated with active chemical agent (areas with buried drums, old munitions, etc.) because the Army policy for such sites is to destroy the agent onsite.

Additionally, most of the areas in which degradate analysis is required are areas in which agent was used decades ago - all active agent is likely to have degraded. Nonetheless, it is imperative that we know as much as possible regarding the compounds and the samples in order to protect ourselves against any potential hazard.

The behavior of these compounds in the environment has been extensively studied. Most of the information we have is from a study titled **Environmental Chemistry and Fate of Chemical Warfare Agents**. This study was prepared for the Army Corps of Engineers by Southwest Research Institute in 1994.

Sites containing chemical warfare related material or chemical warfare materials are divided into **"stockpile" and "non-stockpile" sites**. Stockpile sites are where the vast majority of CWM's are stored. Non-stockpile sites are where smaller amounts of CWM's are located. Non-stockpile sites may contain: buried CWM, chemical weapon production facilities, binary chemical weapons and miscellaneous CWM.

What is important to realize is that based on the **Survey and Analysis Report** prepared by the US Army Chemical Material Destruction Agency (11/93), there are "potential burials at 82 locations in 33 states, the US Virgin Islands and the District of Columbia.....Some of the 82 locations have multiple burial sites." Given this wide span of impacted areas, for every shipment received by TestAmerica West Sacramento for CWM analysis, adherence to procedures listed in this document

and the Environmental Health and Safety Manual is strictly required.

Nerve Agents

Both of the compounds we are concerned with (Sarin and VX) undergo **hydrolysis in the presence of water**. This hydrolysis proceeds at different rates, depending upon the compound. At worst (cool temperature, normal pH, no dissolved ions, no microbes), either of these compounds getting into water would be degraded to extremely low levels ($< 1 \times 10^{-6}$ of the original concentration) within a couple of years. It is more likely that this level of degradation would occur much more quickly.

Degradation in soil is a far more complex issue. The rate of hydrolysis will depend upon a variety of factors, including soil moisture, pH, mineral content, microbes, temperature, etc. Most available studies show that these compounds last no more than a few days in the tested soil types.

Sulfur Mustard

In some ways, sulfur mustard behaves in a fashion similar to the nerve agents - i.e. it hydrolyzes rapidly in the presence of water. There is, however, an important difference. Under the right conditions, **the hydrolysis products of mustard can polymerize and form bubbles containing active mustard**. The mustard inside of these bubbles is shielded from further hydrolysis by the hydrolysis products. This has turned out to be a problem in areas where large amounts of mustard were dumped at sea. Fishermen in such areas have been injured when pulling up nets contaminated with blobs of active mustard. An indication that this may have occurred would be a biphasic sample. This situation can also occur in soil.

Potential Hazards to TestAmerica West Sacramento Personnel

Following steps listed in this appendix and other safety policies will help reduce hazards to the greatest degree possible. However, such policies are no substitute for educated, observant personnel.

As always, you must think about what you are doing when you handle these materials. No policy can account for every potential situation. Staff members are expected to follow all sample handling policies identified in the Corporate Safety Manual and steps following sample receipt listed in this appendix.

Soil and water samples will be screened for agent prior to their shipment to TestAmerica West Sacramento, unless an exception has been granted by the Corporate Director of EH&S. Data should be reviewed at the project management and EH&S staff level to ensure samples are “safe” for handling. If the screening status is unknown (i.e. no data is available), project management personnel should be consulted. Samples will **not** be handled. If staff are unavailable, the cooler will be left in cold storage until the situation is resolved. The expiration of analytical holding times will not be considered as sufficient reason to handle/process CWM samples prior to receipt of screening data.

Positive “hits” on samples containing by-products of agents (like EA 2192) must also be reviewed at the project management and EH&S staff level to ensure samples are “safe” for staff to handle.

When in doubt, seek assistance from project management, operations manager, or EH&S staff.

Corporate EH&S staff are also a resource which must be consulted before deciding to proceed with any "questionable" samples received.

Sample Receipt Procedures

⇒ Follow WS-QA-003

⇒ Review screening data BEFORE opening the cooler if soil samples.

Note: Double gloves are required when handling chemical warfare degradate samples.

⇒ Following established safety policies, open the cooler, remove any paperwork, and check the interior condition.

⇒ All coolers from CWM sites will be initially opened in a fume hood. Once you have determined that there are no broken or leaking sample containers, the cooler may be moved to a bench top for further processing.

⇒ If a sample contains a broken or leaking sample, isolate the cooler in the hood and IMMEDIATELY contact the project manager, operation manager and/or EH&S staff.

⇒ Any sample which appears to be biphasic in appearance must be isolated. Immediate notification to project management, operation manager and/or EH&S staff is required.

⇒ When in doubt, get help regarding sample receipt. Worker health and safety is **paramount** to sample analysis.

⇒ Regardless of screening data, any cooler containing samples for degradate analysis (or any other samples from an area suspected of potential agent contamination) **should be inspected carefully** upon receipt. Anyone inspecting the samples, logging them in, or handling them for any other reason should observe all of TestAmerica West Sacramento's regular safety procedures.

In addition, **two pairs of gloves** will be worn in order to minimize any potential for skin contact with toxic compounds. Please note that **skin contact appears to be the most likely potential route of exposure.** This is based on the fact that nerve agents are likely to have degraded leaving sulfur mustard as the most likely potential contaminant and due to the likelihood that the samples will be cold. The temperature in the cooler is important from the standpoint of safety as well as sample integrity - cold samples mean a significantly lower potential for any kind of toxic vapor formation. Coolers containing broken jars or bottles should be placed in a hood immediately and left there until the client has been contacted. EH&S staff and/or the project managers will give instructions regarding return to client or disposal based on the screening data.

In conclusion, it must be emphasized that these samples must be handled with the appropriate level of care. Observant, educated personnel are our best defense against exposure to any kind of toxic materials found in our samples.

APPENDIX 11
Handling of Blood or Other Potentially Infectious Material

Background

TestAmerica West Sacramento has, upon occasion, received a variety of biological samples for various environmental analyses. Biological samples present a very different type of hazard than "typical" environmental samples. Depending on the type of sample delivered for analysis, and the types of analyses requested, a variety of additional precautions and protective measures may be required when receiving, processing and storing these samples.

Types of Biohazard Samples

There are many types of biohazard samples. Not all biological samples are necessarily biohazard samples. Some of the types of biohazard samples that have been received at TestAmerica West Sacramento in the past include:

Human blood
Human tissue
Human breast milk
Rodent or other mammalian tissue
Human waste products, usually samples from municipal sewage treatment plants

While fish, crawfish, clams, plant tissue, grasses and such are all biological samples, they are not generally considered to be a biohazard threat.

Specific Hazards Associated with Biohazard Samples

The unique threat associated with biohazard samples is infectious diseases. Typically, these are Human Immuno Virus (HIV) and Hepatitis B. Other potential hazards include (but are not limited to) rabies, bubonic plague and the Hanta virus. Some of these hazards we are prepared to work with effectively, and others we are not.

Samples potentially infected with rabies, bubonic plague, or the Hanta virus require engineering controls that are not in place at TestAmerica West Sacramento. Accordingly, we will not accept samples potentially infected by these diseases. These samples include whole rodents or other mammals, mammal parts, or homogenized mammal tissue. Mammal tissue samples that are known NOT to be infected with these diseases may be accepted for analysis under certain conditions. These samples must be homogenized and the sample tissue must be "fixed" in a 4% or higher formalin solution. The outside of the sample container must have been disinfected with a Centers for Disease Control (CDC) approved disinfectant after the sample was placed in the container but before it was shipped to us. Examples of this disinfectant solution are a 10% bleach solution or a 5% Lysol solution.

General Procedures

Universal precautions: All human and mammal blood, fluid and tissue samples are assumed to be infectious. All staff members will wear two pair of protective gloves when handling or working with biohazard samples. Safety glasses and a face shield are required. Fume hood sashes will be closed as far as possible, consistent with safe work practices. Lab coats will always be worn, buttoned up. Lab coats worn when handling biohazard samples will not be worn outside of the laboratory. When work is finished with biohazard samples, lab coats worn during the process will be sent out for cleaning. If they have been splashed or contaminated with any infectious sample, they will be disposed of as biohazardous waste. Workers will exercise caution to avoid injury with tools possibly infected from biohazard work, such as glass pipettes, metal spatulas, broken glass, etc. All waste material will be disposed of in appropriately marked containers as biohazardous waste. Workers with open wounds, sores or broken skin shall not handle biohazardous samples. Pregnant workers shall be especially familiar with and adhere to precautions to minimize the risk of transmission. Employees involved with handling human blood or tissue samples will be offered the opportunity to receive the Hepatitis

B vaccination series. This may be accepted, declined, or accepted at a later date.
Engineering and administrative controls: Signs will be posted on all doorways leading into areas where biohazardous samples are being handled. These signs will be clearly visible and will identify that biohazard work is in progress. When these signs are posted, personnel not involved in the work will stay out of the work area. If this is impractical, the biohazard work will be performed an isolated area that is clearly marked. No one may enter this area without permission from the sample administration technician or chemist doing the work. Personal protective equipment will be removed immediately upon leaving the area and disposed of or cleaned properly. Eating, drinking, use of tobacco products, gum, hard candy, applying cosmetics or lip balm and use of contact lenses are all prohibited in any areas where biohazard samples are being handled. Employees working with biohazard samples will thoroughly wash their hands with disinfectant soap when finished work and before leaving the lab. Work areas will be thoroughly cleaned and disinfected when biohazard work is complete. This includes properly disposing of bench paper and used equipment such as pipets, disinfecting all reusable equipment such as glassware, metal spatulas, and disinfecting work surfaces. Broken glassware that is potentially infected must not be picked up directly with the hands. Any trash cans or containers that may have been contaminated will inspected, cleaned and disinfected with an appropriate disinfecting solution.

Sample Receipt Procedures

Follow WS-QA-0003
If advance notification is provided of incoming biohazard samples, contact EH&S, review this appendix and ensure that you are familiar with the safety procedures involved. Ensure that you have a clear workspace, that you know in advance where the samples will be stored, and that there is space available to store them.
Note: All potential biohazard samples must be kept in locked storage, either WR1 or WF1.
Note: Double gloves and a face shield are required when handling biohazard samples.

Biohazard samples shall be opened in a fume hood.
Following established procedures, open the cooler, remove any paperwork and check the interior condition.
If a shipping container has a broken or leaking sample, isolate the cooler in a fume hood and IMMEDIATELY contact the project manager and EH&S staff.
Note any comments or warnings on sample containers (including shipment paperwork) regarding specific threats or hazards.
When in doubt, get help regarding sample receipt. Your health and safety is of paramount importance.

The most likely methods of transmission of disease when handling biohazard samples are splashing infected blood or tissue onto an open cut or sore or into your eyes, mucous membranes or mouth. The likelihood of transmission via these routes can be almost completely eliminated by following proper procedures.

Exercise care when handling samples so that they do not drop or get knocked over.
Wear two pair of protective gloves – latex, vinyl or nitrile.
Don’t work around biohazard samples with open cuts or sores.
Wear your safety glasses with a face shield.
Ensure that all skin is covered, such as your wrists and forearms
Wear your lab coat, properly fastened.

APPENDIX 12

After Hours Sample Receipt Procedures for Non-Sample Administrative Personnel

Normal business hours for receiving samples are Monday through Friday, 8:00 am to 6:00 pm, and Saturday, 8:00 am to 12:00 pm. In the event that samples are delivered outside of normal operating hours, and only non-Sample Administrative personnel are available to accept the delivery, the following procedures should be followed:

• If samples are delivered directly by a client, have him/her relinquish the COC, sign your name on the "Received By" line, note the time received, and make a copy of the signed COC for the client. Keep the original COC with the samples.

•If samples are delivered by a courier, and the COC is taped inside a cooler, note who delivered the samples and what time they arrived.

•Start a Lot Receipt Checklist (LRC), form QA-185, and complete the date/time received section and the custody seal section. Open the cooler/container and measure the temperature of the samples and/or temperature blank (if easily accessible) using the IR thermometer. Do not take the temperature of ice or packing material. Record the temperature(s) in the appropriate fields on the LRC. For clarity on which sections to complete, see the highlighted sections on the sample LRC posted next to these instructions.

•If samples are not contained in a cooler, document what kind of cooling agents were used, if any. Leave a note with this information with the COC.

•Place cooler/samples on a cart and store in the walk-in refrigerator.

•Send an email to "SACSC" to notify them that samples were received outside of normal hours, and include any pertinent information (i.e. when received, who delivered the samples, where they are located, sample receipt temperatures, etc.) to assist them in processing the samples when they return.

APPENDIX F

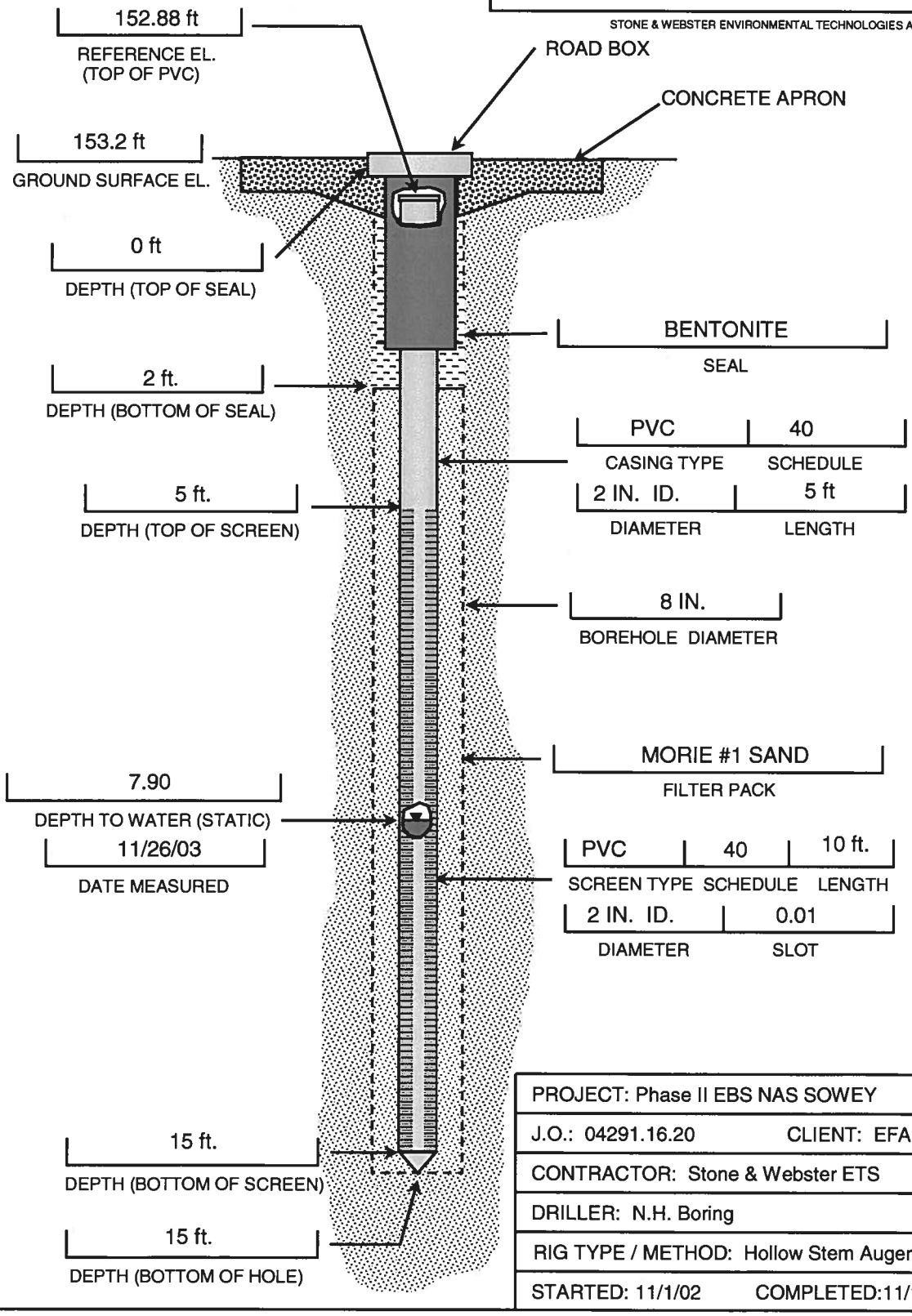
MONITORING WELL CONSTRUCTION LOGS

NOTES:

1. ALL DEPTHS MEASURED AS BGS. UNLESS OTHERWISE NOTED.
2. DRAWING NOT TO SCALE.

FIGURE 4
MONITORING WELL CONSTRUCTION DIAGRAM - MW05-303
Phase II EBS NAS SOWEY

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGIES AND SERVICES



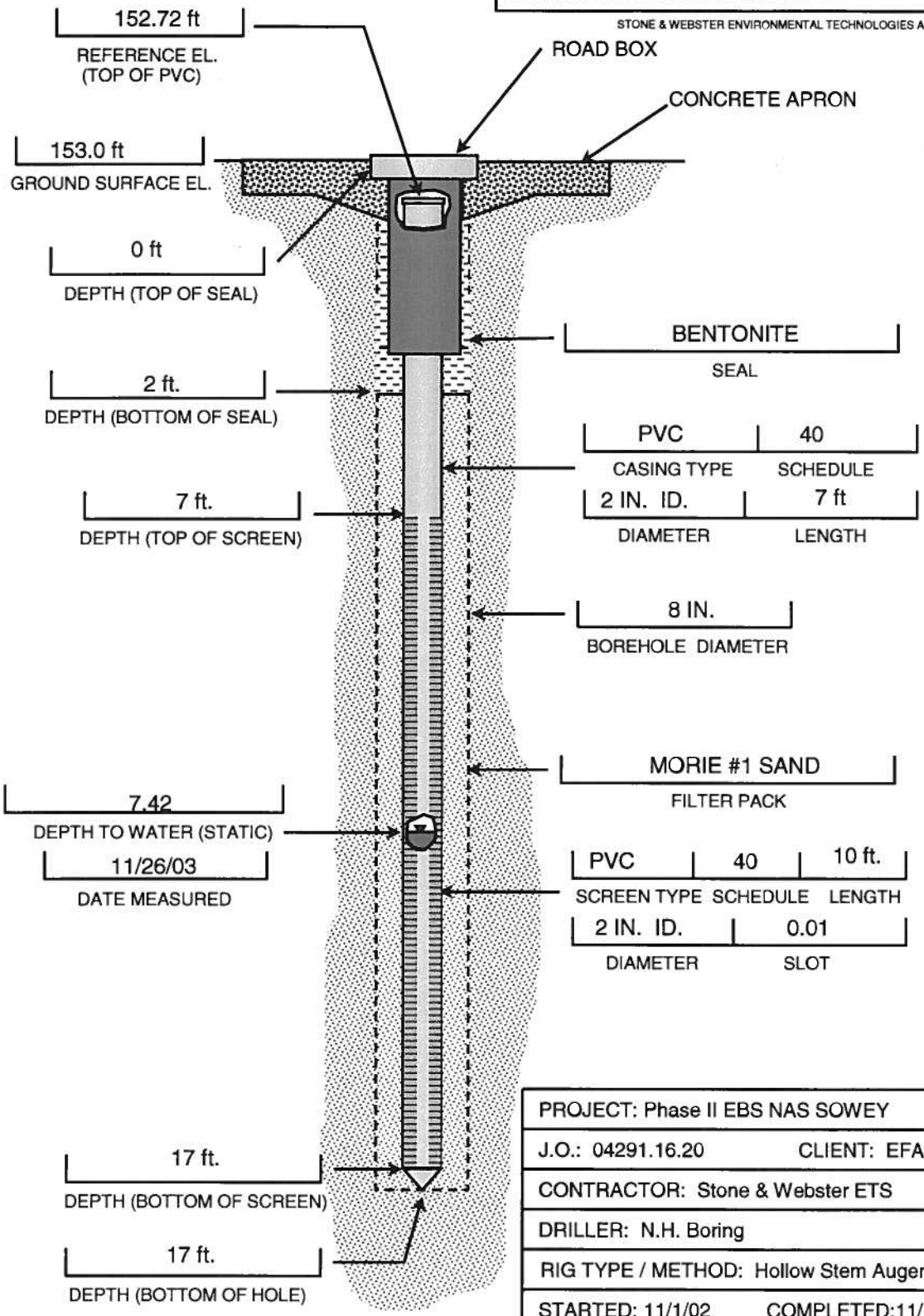
PROJECT: Phase II EBS NAS SOWEY	
J.O.: 04291.16.20	CLIENT: EFANE
CONTRACTOR: Stone & Webster ETS	
DRILLER: N.H. Boring	
RIG TYPE / METHOD: Hollow Stem Auger	
STARTED: 11/1/02	COMPLETED:11/1/02

NOTES:

1. ALL DEPTHS MEASURED AS BGS. UNLESS OTHERWISE NOTED.
2. DRAWING NOT TO SCALE.

FIGURE 5
MONITORING WELL CONSTRUCTION DIAGRAM - MW05-304
Phase II EBS NAS SOWEY

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGIES AND SERVICES



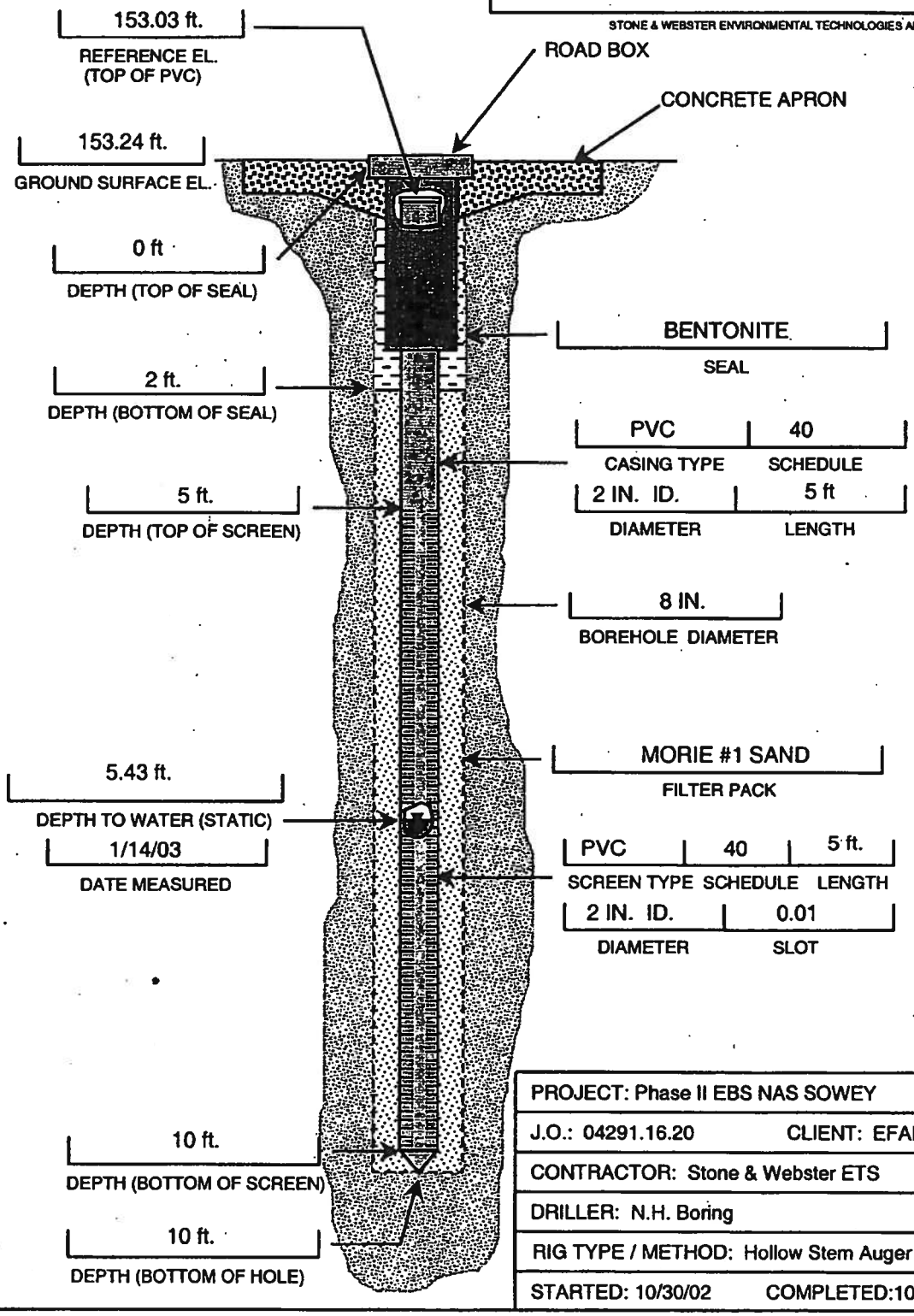
PROJECT: Phase II EBS NAS SOWEY	
J.O.: 04291.16.20	CLIENT: EFANE
CONTRACTOR: Stone & Webster ETS	
DRILLER: N.H. Boring	
RIG TYPE / METHOD: Hollow Stem Auger	
STARTED: 11/1/02	COMPLETED:11/1/02

NOTES:

1. ALL DEPTHS MEASURED AS BGS. UNLESS OTHERWISE NOTED.
2. DRAWING NOT TO SCALE.

FIGURE 4
MONITORING WELL CONSTRUCTION DIAGRAM - MW05-301
Phase II EBS NAS SOWEY

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGIES AND SERVICES



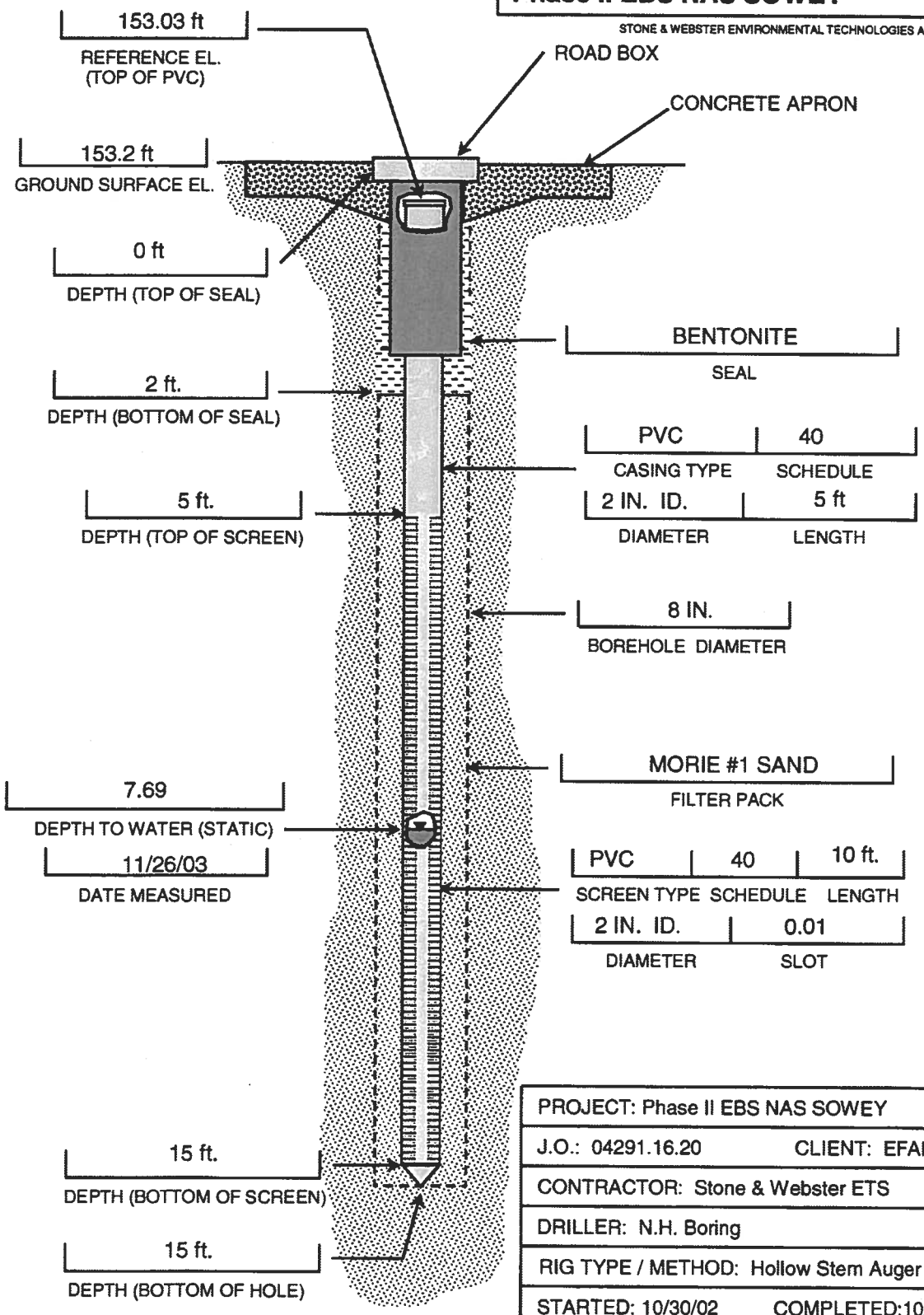
PROJECT: Phase II EBS NAS SOWEY	
J.O.: 04291.16.20	CLIENT: EFANE
CONTRACTOR: Stone & Webster ETS	
DRILLER: N.H. Boring	
RIG TYPE / METHOD: Hollow Stem Auger	
STARTED: 10/30/02	COMPLETED:10/30/02

NOTES:

1. ALL DEPTHS MEASURED AS BGS. UNLESS OTHERWISE NOTED.
2. DRAWING NOT TO SCALE.

FIGURE 3
MONITORING WELL CONSTRUCTION DIAGRAM - MW05-302
Phase II EBS NAS SOWEY

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGIES AND SERVICES



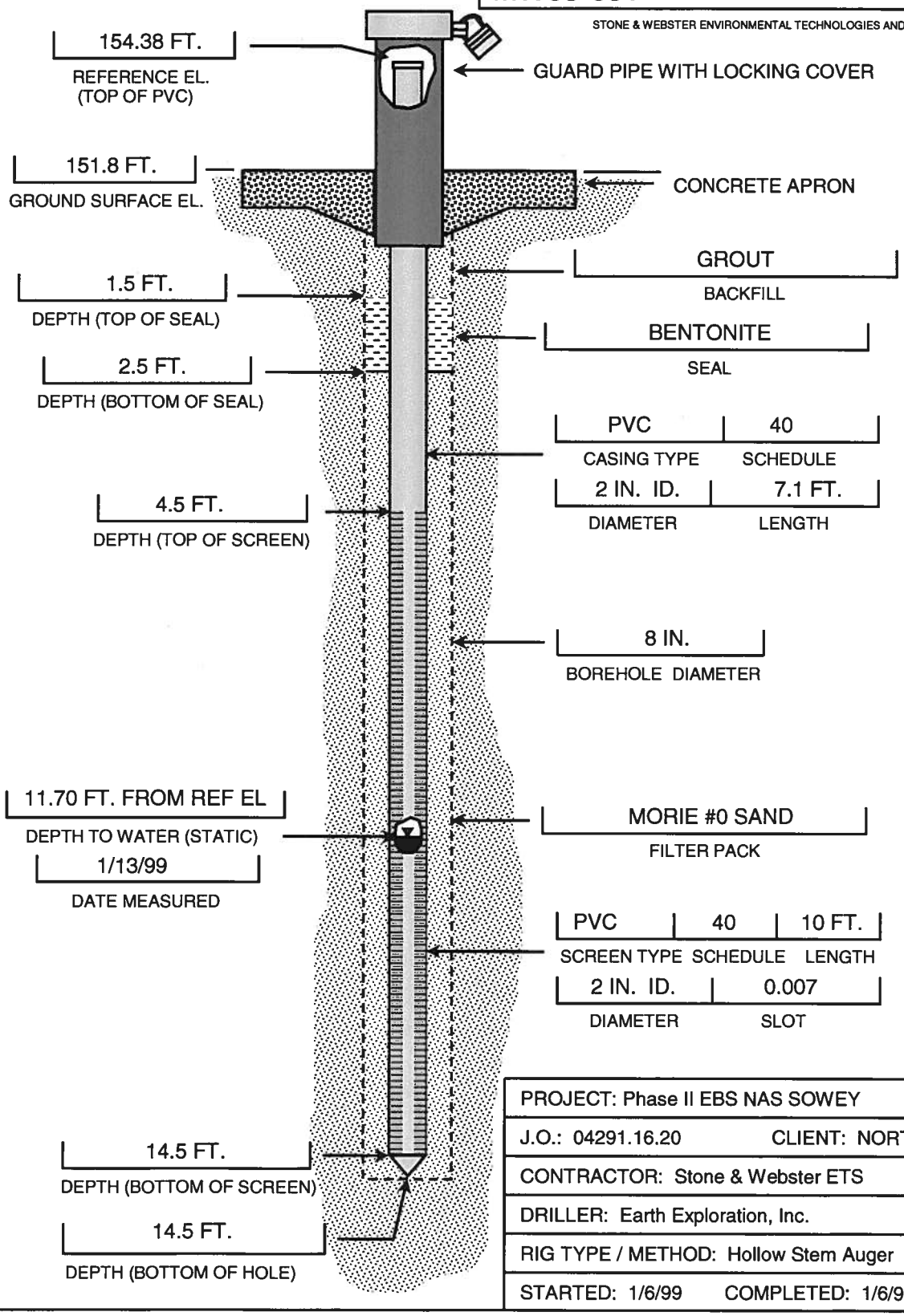
PROJECT: Phase II EBS NAS SOWEY	
J.O.: 04291.16.20	CLIENT: EFANE
CONTRACTOR: Stone & Webster ETS	
DRILLER: N.H. Boring	
RIG TYPE / METHOD: Hollow Stem Auger	
STARTED: 10/30/02	COMPLETED:10/30/02

NOTES:

1. ALL DEPTHS MEASURED AS BGS. UNLESS OTHERWISE NOTED.
2. DRAWING NOT TO SCALE.

MONITORING WELL LOG
Phase II EBS NAS SOWEY
MW05-031

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGIES AND SERVICES



PROJECT: Phase II EBS NAS SOWEY	
J.O.: 04291.16.20	CLIENT: NORTHDIV
CONTRACTOR: Stone & Webster ETS	
DRILLER: Earth Exploration, Inc.	
RIG TYPE / METHOD: Hollow Stem Auger	
STARTED: 1/6/99	COMPLETED: 1/6/99

FIELD WELL CONSTRUCTION LOG

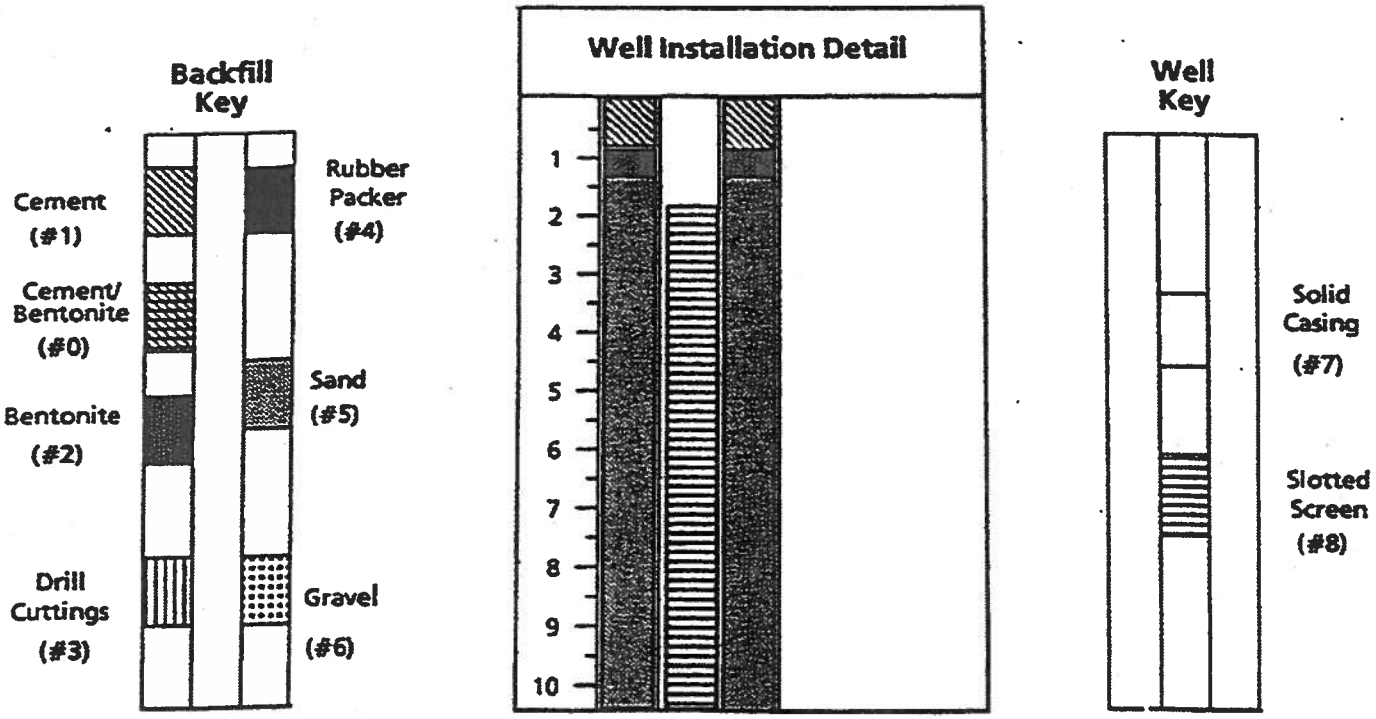
Michael Baker, Jr., Inc.

PROJECT: SWNAS
S.O. NO.:
BORING NO.: MW-14
COORDINATES: EAST:
NORTH:
ELEVATION: SURFACE: 148.39
TOP OF STEEL CASING: 150.99

Well Development

Pay Items			
Item	Quantity	Unit	Remarks
PVC screen	10'		
sand	1/2 bag	100 lb	
solid PVC	1.8'		
gaurdpipe	3 1/2'		
bentonite	1/4 bag	50 lb	
concrete	1/4 bag	94 lb	

WELL INFORMATION	DIAM. (INCHES)	TYPE	TOP DEPTH (FT.)	BOTTOM DEPTH (FT.)
Well Casing	2"	PVC Sched. 40	0.0	1.8
Well Screen	2"	PVC Sched 40 0.01"Slot	1.8	11.8

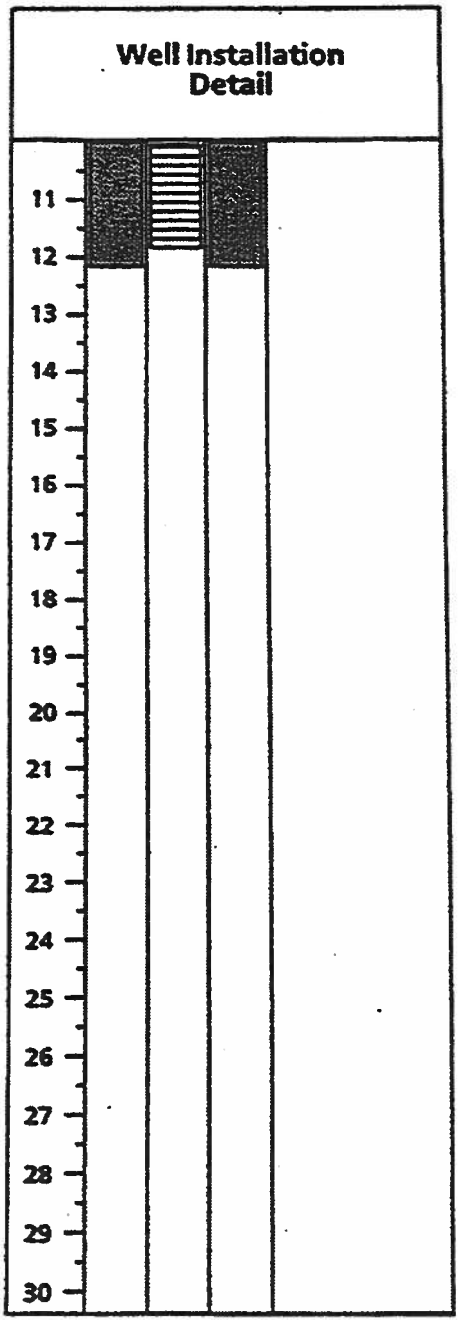


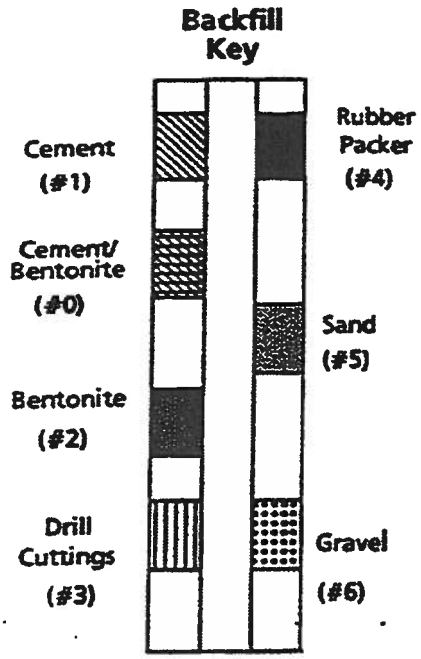
DRILLING CO.: Redwing Environmental Tech.
BAKER REP.: J. Wells, P. Turner
DRILLER: T. Vernon, D. Heffner
BORING NO.: MW-14
SHEET 1 OF 2

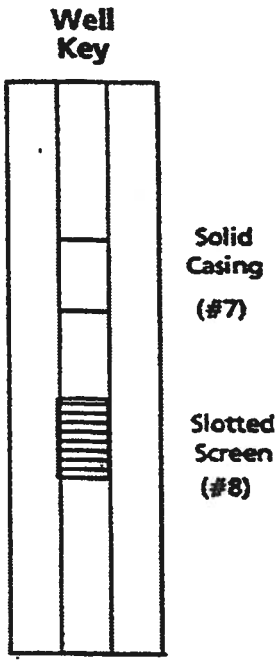
FIELD WELL CONSTRUCTION LOG

PROJECT: SWNAS
S.O. NO.: _____ BORING NO.: MW-14

Michael Baker, Jr., Inc.







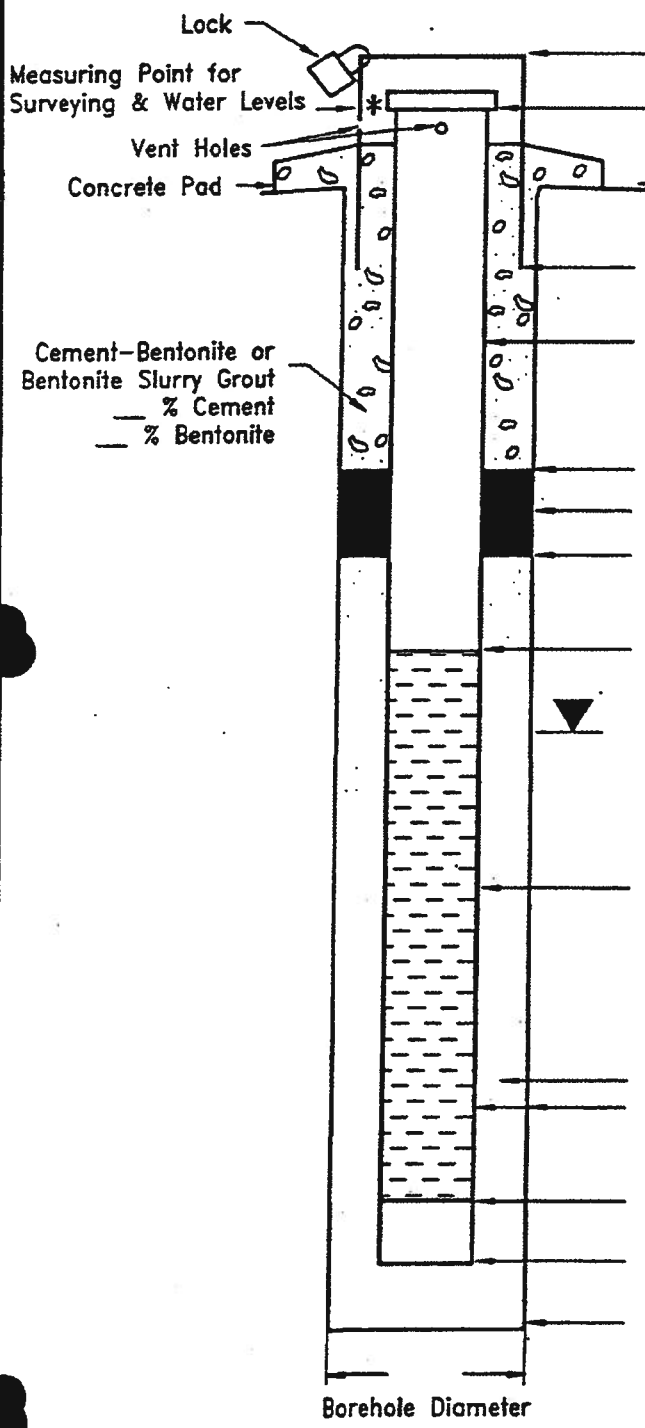
DRILLING CO.: Redwing Environmental Tech. BAKER REP.: J. Wells, P. Turner
DRILLER: T. Vernon, D. Heffner BORING NO.: MW-14 SHEET 2 OF 2

Project No: 5060-048 Client: Brown & Root/Navy Site: NAS South Weymouth **WELL No: MW-46**

Well Location: Site 4 - Fire Fighting Training Area (DSB-5) Date Installed: 2/22/96

Contractor: Environmental Drilling, Inc. Method: 4 1/4" I.D. HSA Inspector: J. Junod

MONITORING WELL CONSTRUCTION DETAIL



		Depth from G.S. (feet)	Elevation (NGVD)
Top of Steel Guard Pipe		+0.25	149.02
Top of Riser Pipe		+0.02	148.79
Ground Surface (G.S.)		0.00	148.77
Bottom of Steel Guard Pipe		0.55	148.22
Riser Pipe: Length	2.22'		
Inside Diameter (ID)	2"		
Type of Material	PVC		
Top of Bentonite Seal		0.51	148.26
Bentonite Seal Thickness	0.99'		
Top of Sand		1.50	147.27
Top of Screen		2.20	146.57
Stabilized Water Level	10/8/96	1.55	147.22
Screen: Length	8.9'		
Inside Diameter (ID)	2"		
Slot Size	0.010		
Type of Material	PVC		
Type/Size of Sand	#1 Silica		
Sand Pack Thickness	2.75"		
Bottom of Screen		11.10	137.67
Bottom of Tail Pipe: Length	0.8'	11.90	136.87
Bottom of Borehole		12.50	136.27

Approved:

* Describe Measuring Point: Top of PVC Riser

Signature Date

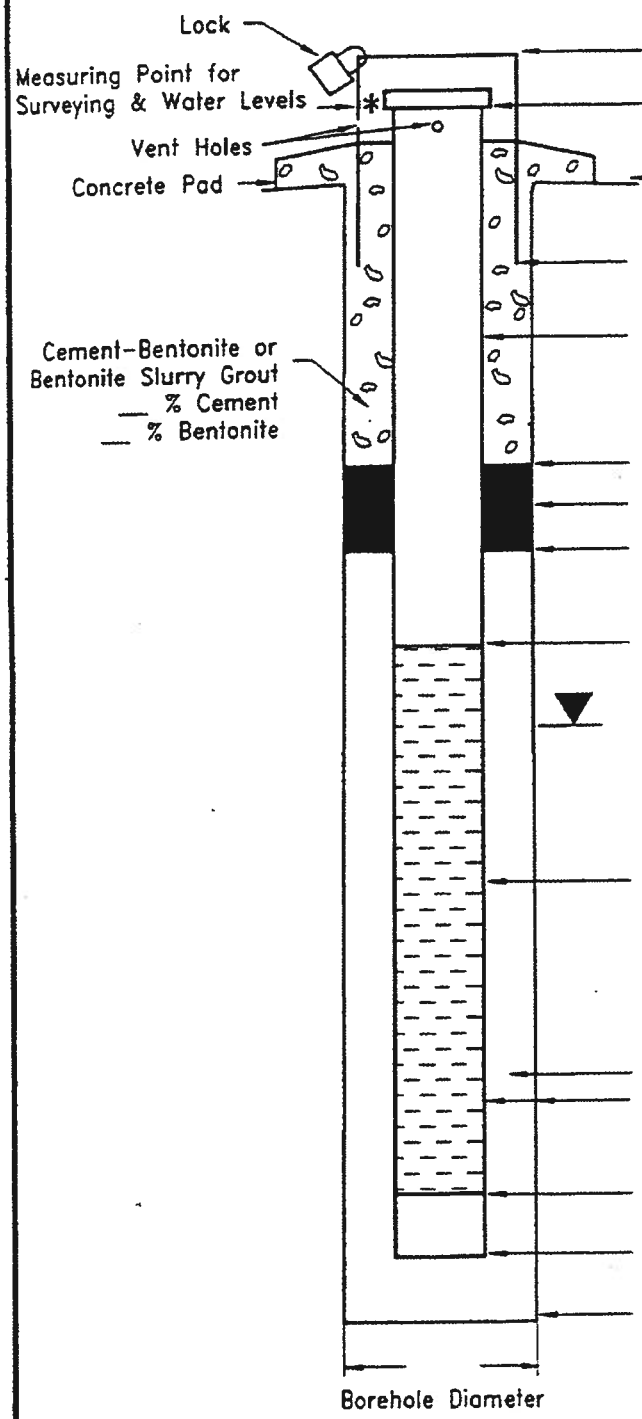
ENSR

Project No: [illegible] Client: Navy Site: NAS [illegible] WELL No: MW52D2

Well Location: FFTA Date Installed: 8/5/99

Contractor: ADS Method: HSA/coring Inspector: KM

MONITORING WELL CONSTRUCTION DETAIL



		Depth from G.S. (feet)	Elevation (NGVD)
Top of Steel Guard Pipe		~2.5	151.39
Top of Riser Pipe			150.76
Ground Surface (G.S.)		0.00	149.2
Bottom of Steel Guard Pipe		~2.5	146.7
Riser Pipe:			
Length	9.5		
Inside Diameter (ID)	2"		
Type of Material	pvc		
Top of Bentonite Seal		4'	145.2
Bentonite Seal Thickness	2'		
Top of Sand		6'	143.2
Top of Screen		8'	141.2
Stabilized Water Level		NM 8/5/99	-
Screen:			
Length	15'		
Inside Diameter (ID)	2"		
Slot Size	010		
Type of Material	pvc		
Type/Size of Sand	#005		
Sand Pack Thickness	~3"		
Bottom of Screen		23'	126.2
Bottom of Tail Pipe:		23'	126.2
Length	NA		
Bottom of Borehole		23'	126.2

Approved:

* Describe Measuring Point: Ground Surface

Signature: [illegible] Date: 8/5/99

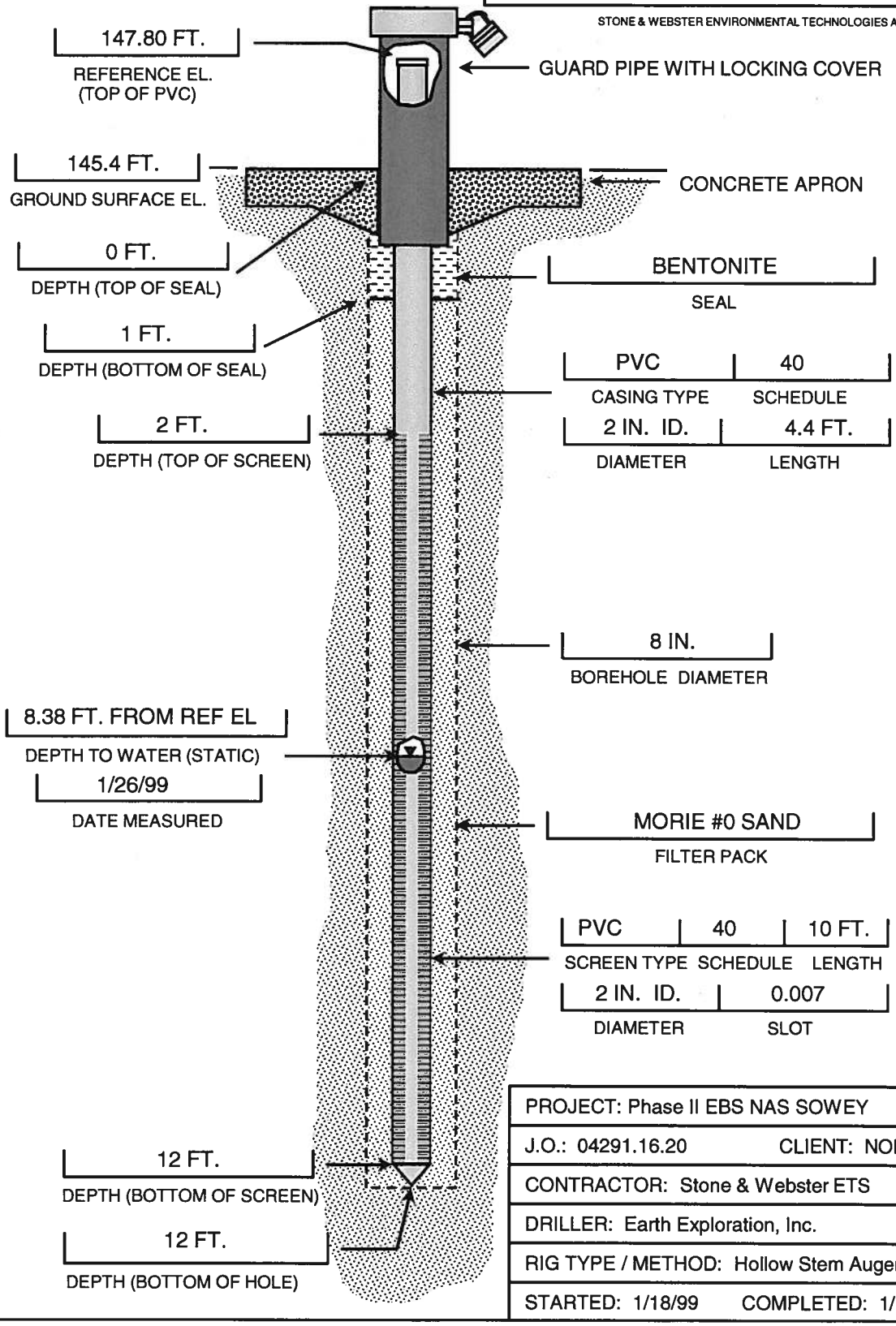
ENSR

NOTES:

1. ALL DEPTHS MEASURED AS BGS. UNLESS OTHERWISE NOTED.
2. DRAWING NOT TO SCALE.

MONITORING WELL LOG
Phase II EBS NAS SOWEY
MW01-093

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGIES AND SERVICES



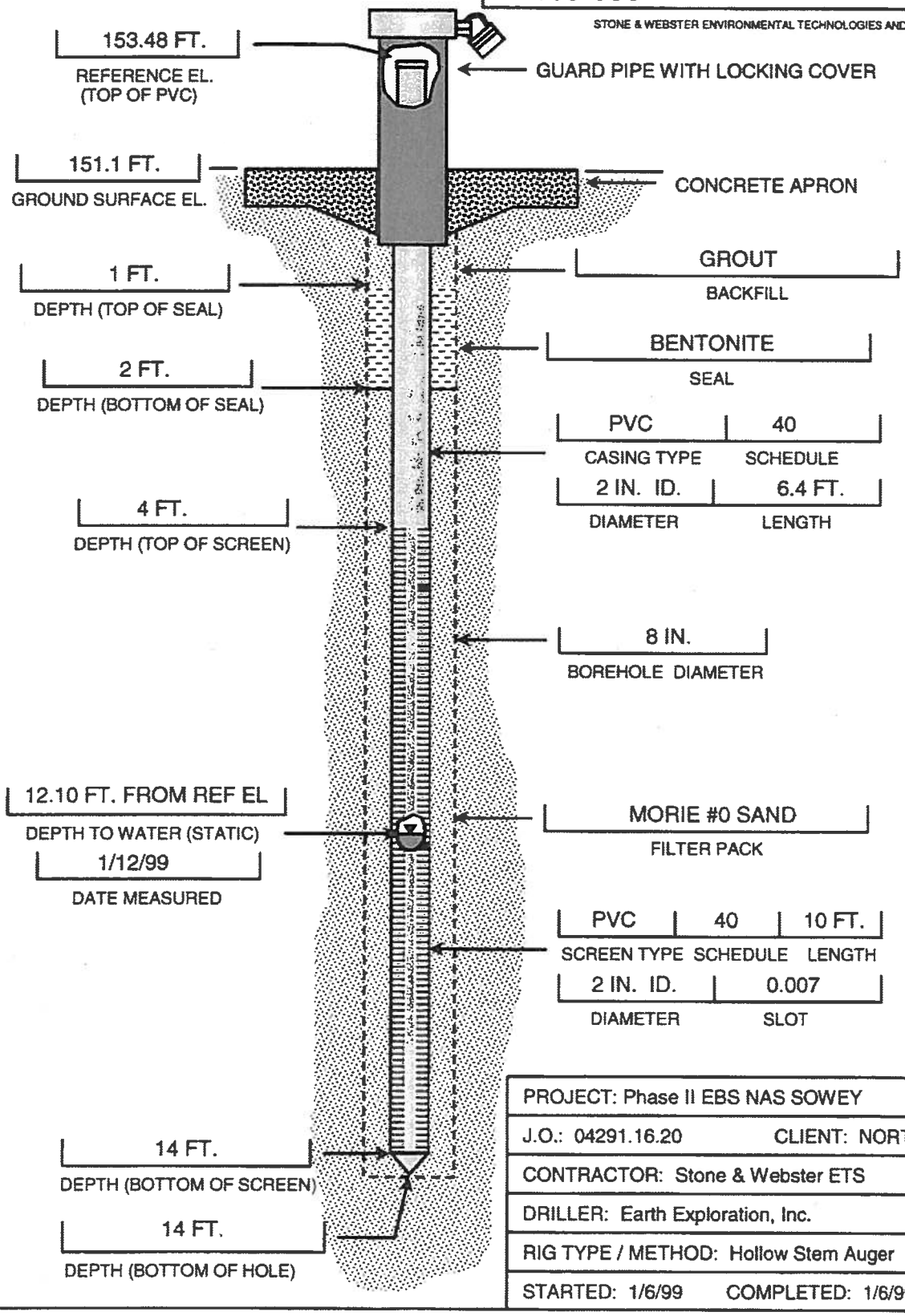
PROJECT: Phase II EBS NAS SOWEY	
J.O.: 04291.16.20	CLIENT: NORTHDIV
CONTRACTOR: Stone & Webster ETS	
DRILLER: Earth Exploration, Inc.	
RIG TYPE / METHOD: Hollow Stem Auger	
STARTED: 1/18/99	COMPLETED: 1/18/99

NOTES:

1. ALL DEPTHS MEASURED AS BGS. UNLESS OTHERWISE NOTED.
2. DRAWING NOT TO SCALE.

MONITORING WELL LOG
Phase II EBS NAS SOWEY
MW05-033

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGIES AND SERVICES



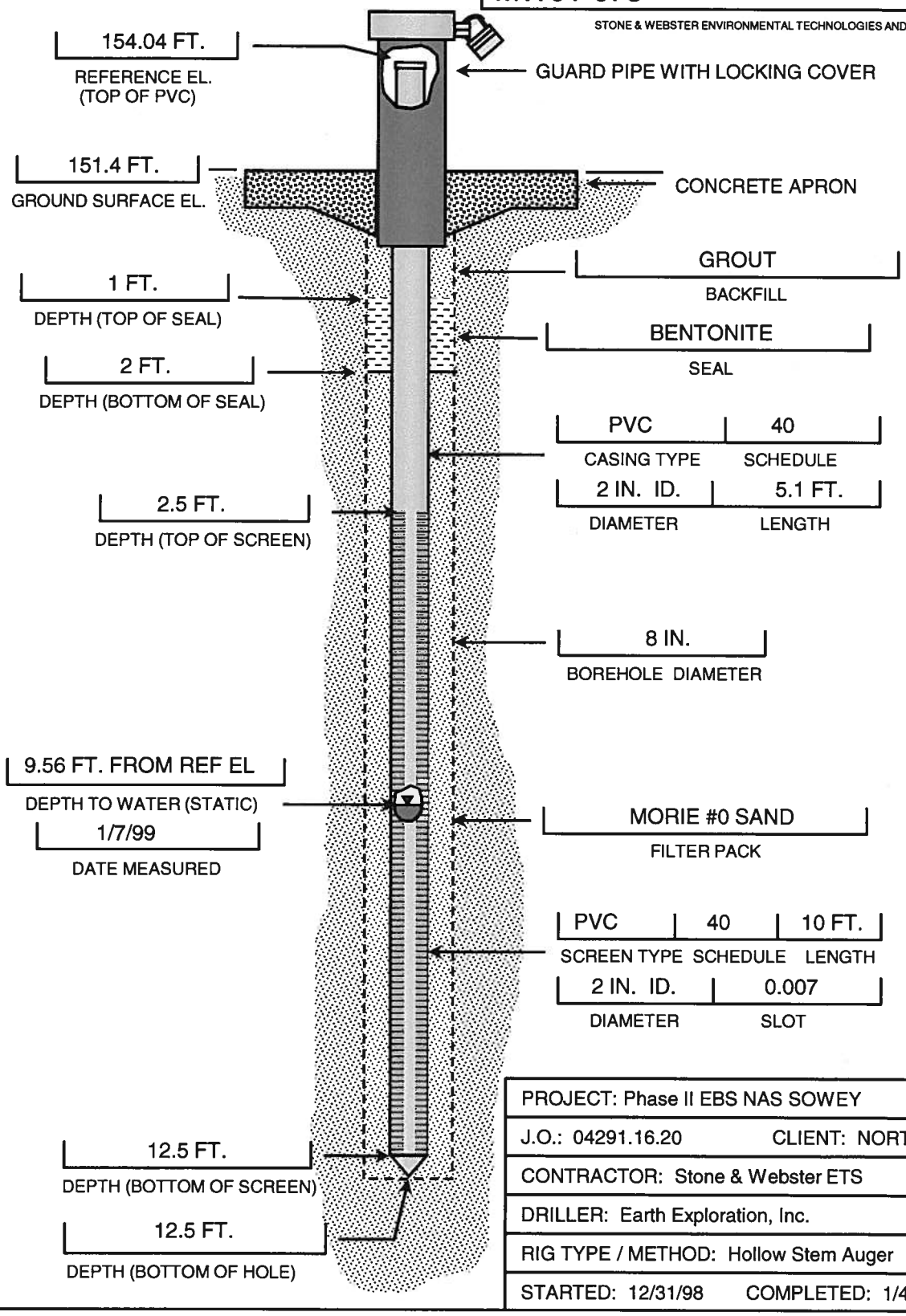
PROJECT: Phase II EBS NAS SOWEY	
J.O.: 04291.16.20	CLIENT: NORTHDIV
CONTRACTOR: Stone & Webster ETS	
DRILLER: Earth Exploration, Inc.	
RIG TYPE / METHOD: Hollow Stem Auger	
STARTED: 1/6/99	COMPLETED: 1/6/99

NOTES:

1. ALL DEPTHS MEASURED AS BGS. UNLESS OTHERWISE NOTED.
2. DRAWING NOT TO SCALE.

MONITORING WELL LOG
Phase II EBS NAS SOWEY
MW01-073

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGIES AND SERVICES



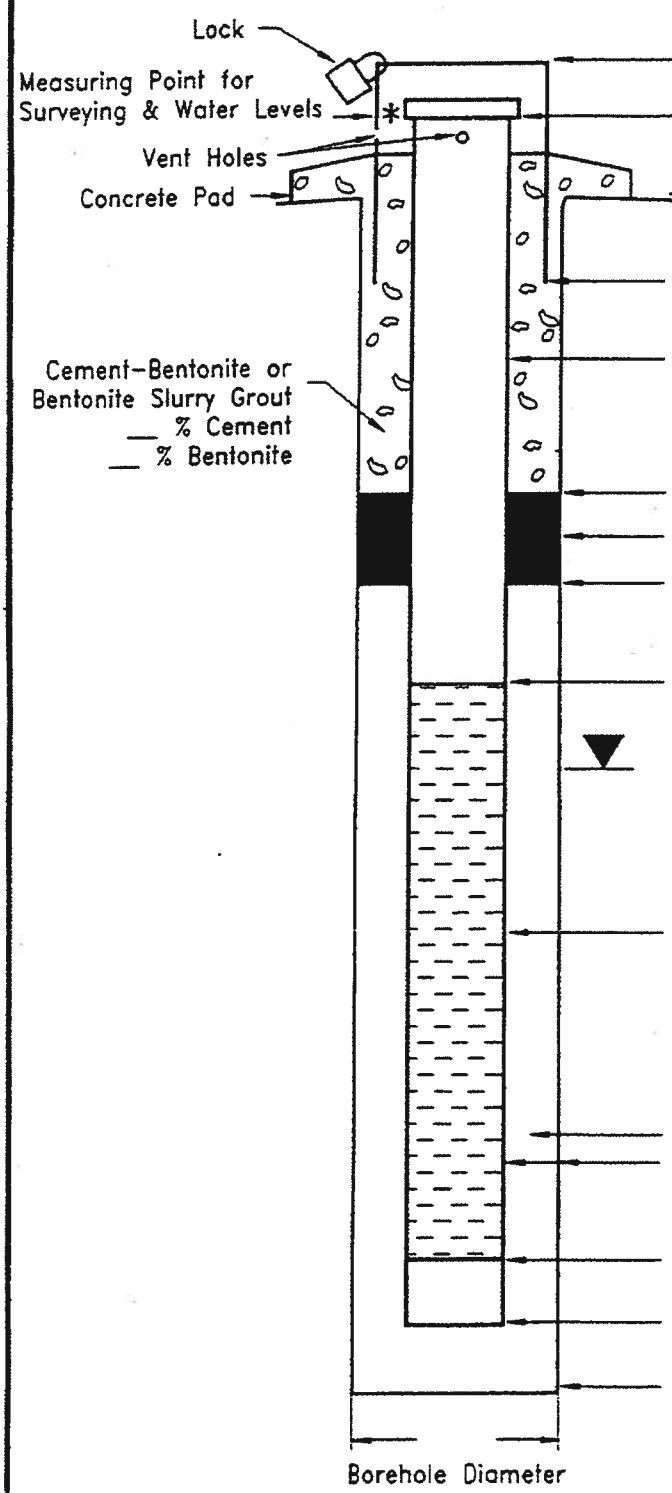
PROJECT: Phase II EBS NAS SOWEY	
J.O.: 04291.16.20	CLIENT: NORTHDIV
CONTRACTOR: Stone & Webster ETS	
DRILLER: Earth Exploration, Inc.	
RIG TYPE / METHOD: Hollow Stem Auger	
STARTED: 12/31/98	COMPLETED: 1/4/99

Project No: 5060-071-150 Client: NAVY Site: NAS S. Weymouth **WELL No: MW-55D**

Well Location: TLF Date Installed: 6/24/99

Contractor: ADS Method: HSA Inspector: T. Gilroy

MONITORING WELL CONSTRUCTION DETAIL



		Depth from G.S. (feet)	Elevation (NGVD)
Top of Steel Guard Pipe		~+3	~142.2
Top of Riser Pipe		~+2.5	141.65
Ground Surface (G.S.)		0.00	139.2
Bottom of Steel Guard Pipe		~2	137.2
Riser Pipe:			
Length	6.5		
Inside Diameter (ID)	2"		
Type of Material	PVC		
Top of Bentonite Seal		2'	137.2
Bentonite Seal Thickness	1'		
Top of Sand		3'	136.2
Top of Screen		4'	135.2
Stabilized Water Level		5'	134.2
Screen:			
Length	10'		
Inside Diameter (ID)	2"		
Slot Size	010		
Type of Material	PVC		
Type/Size of Sand	000		
Sand Pack Thickness	8"		
Bottom of Screen		14	125.2
Bottom of Tail Pipe:		14	125.2
Length	14'		
Bottom of Borehole		14	125.2

* Describe Measuring Point: Ground Surface

Approved: Tracy A. Gil 6/24/99
Signature Date

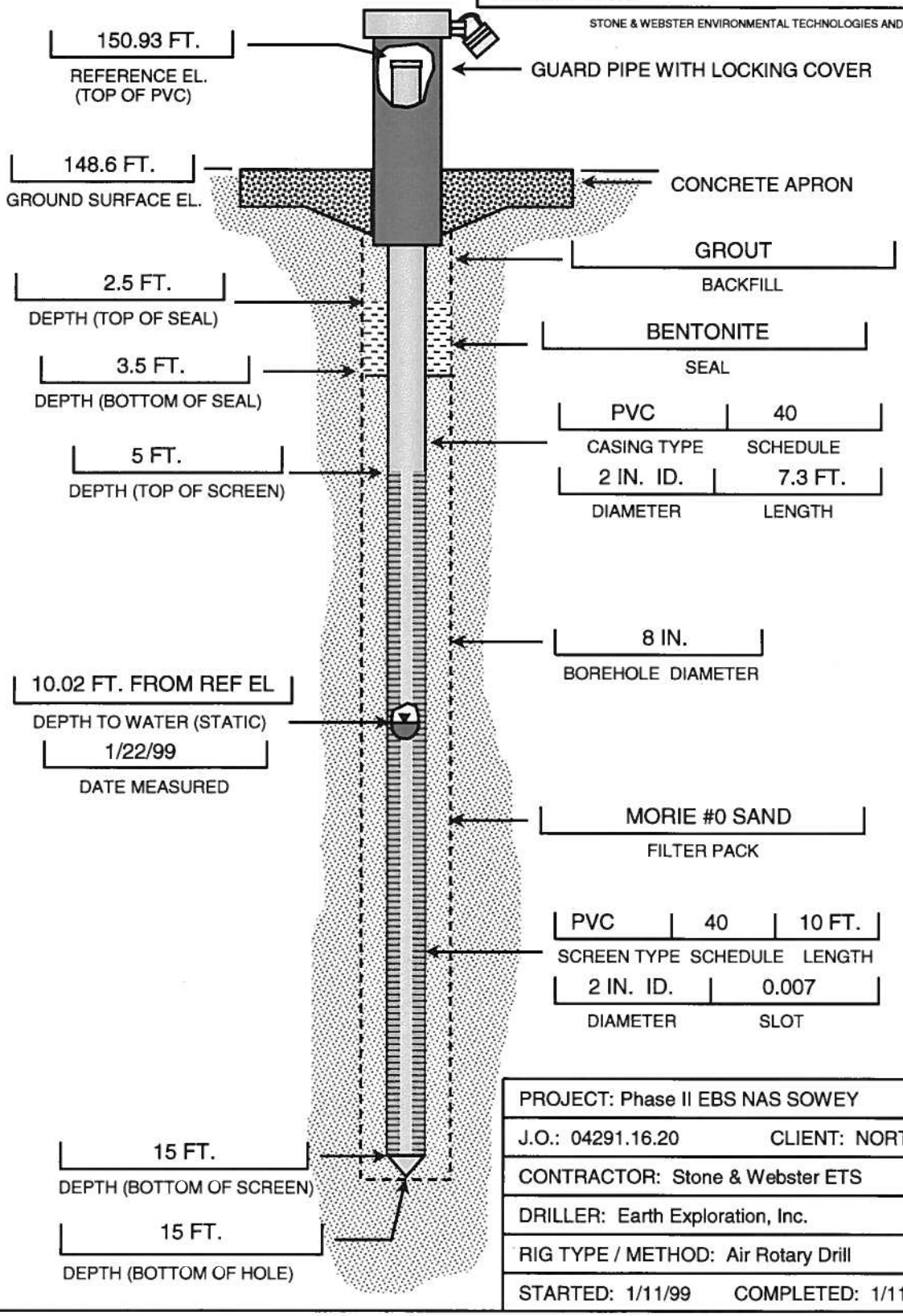
ENSR®

NOTES:

1. ALL DEPTHS MEASURED AS BGS. UNLESS OTHERWISE NOTED.
2. DRAWING NOT TO SCALE.

MONITORING WELL LOG
Phase II EBS NAS SOWEY
MW01-063

STONE & WEBSTER ENVIRONMENTAL TECHNOLOGIES AND SERVICES



PROJECT: Phase II EBS NAS SOWEY	
J.O.: 04291.16.20	CLIENT: NORTHDIV
CONTRACTOR: Stone & Webster ETS	
DRILLER: Earth Exploration, Inc.	
RIG TYPE / METHOD: Air Rotary Drill	
STARTED: 1/11/99	COMPLETED: 1/11/99

FIELD WELL CONSTRUCTION LOG

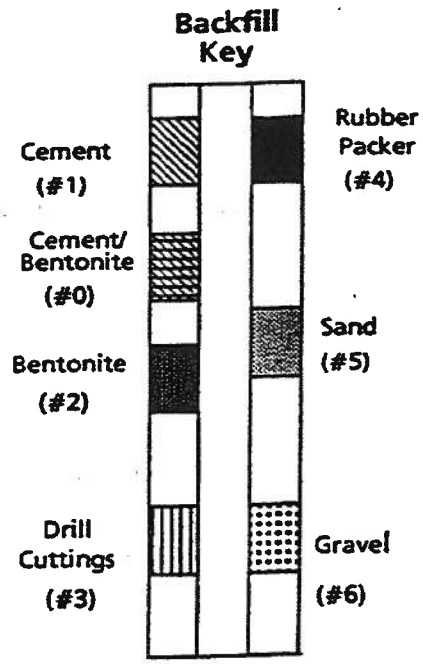
Michael Baker, Jr., Inc.

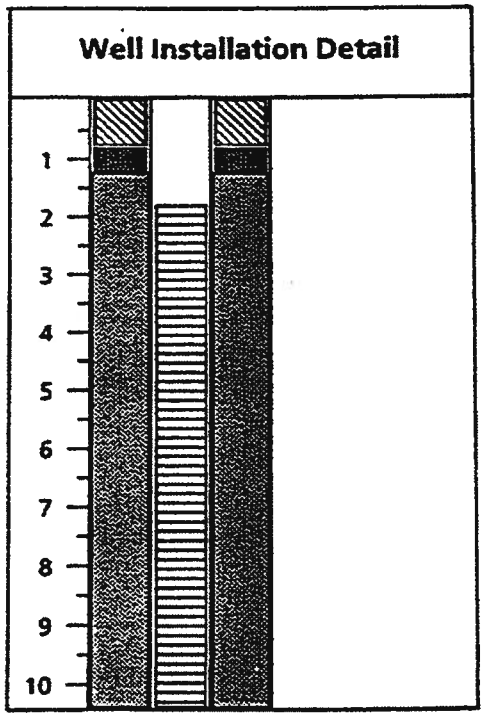
PROJECT: SWNAS
S.O. NO.:
BORING NO.: MW-13
COORDINATES: EAST:
NORTH:
ELEVATION: SURFACE: 148.5
TOP OF STEEL CASING: 150.87

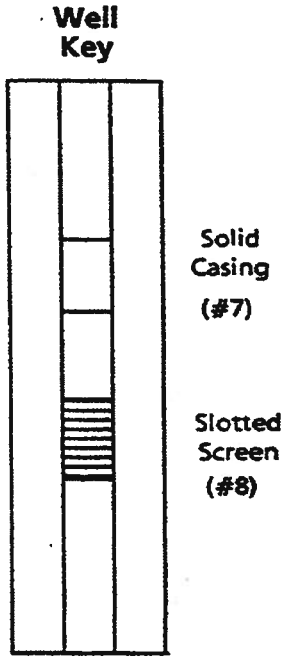
Well Development

Pay Items			
Item	Quantity	Unit	Remarks
Sand			
PVC Solid	3.8'		
PVC Screen	15'		
Bentonite	~1/3	50lb	
Guard Pipe	1		
Concrete	~1/2	94lb	

WELL INFORMATION	DIAM. (INCHES)	TYPE	TOP DEPTH (FT.)	BOTTOM DEPTH (FT.)
Well Casing	2"	PVC Sched. 40	0.0 16.8	1.8 18.8
Well Screen	2"	PVC Sched 40 0.01"Slot	1.8	16.8





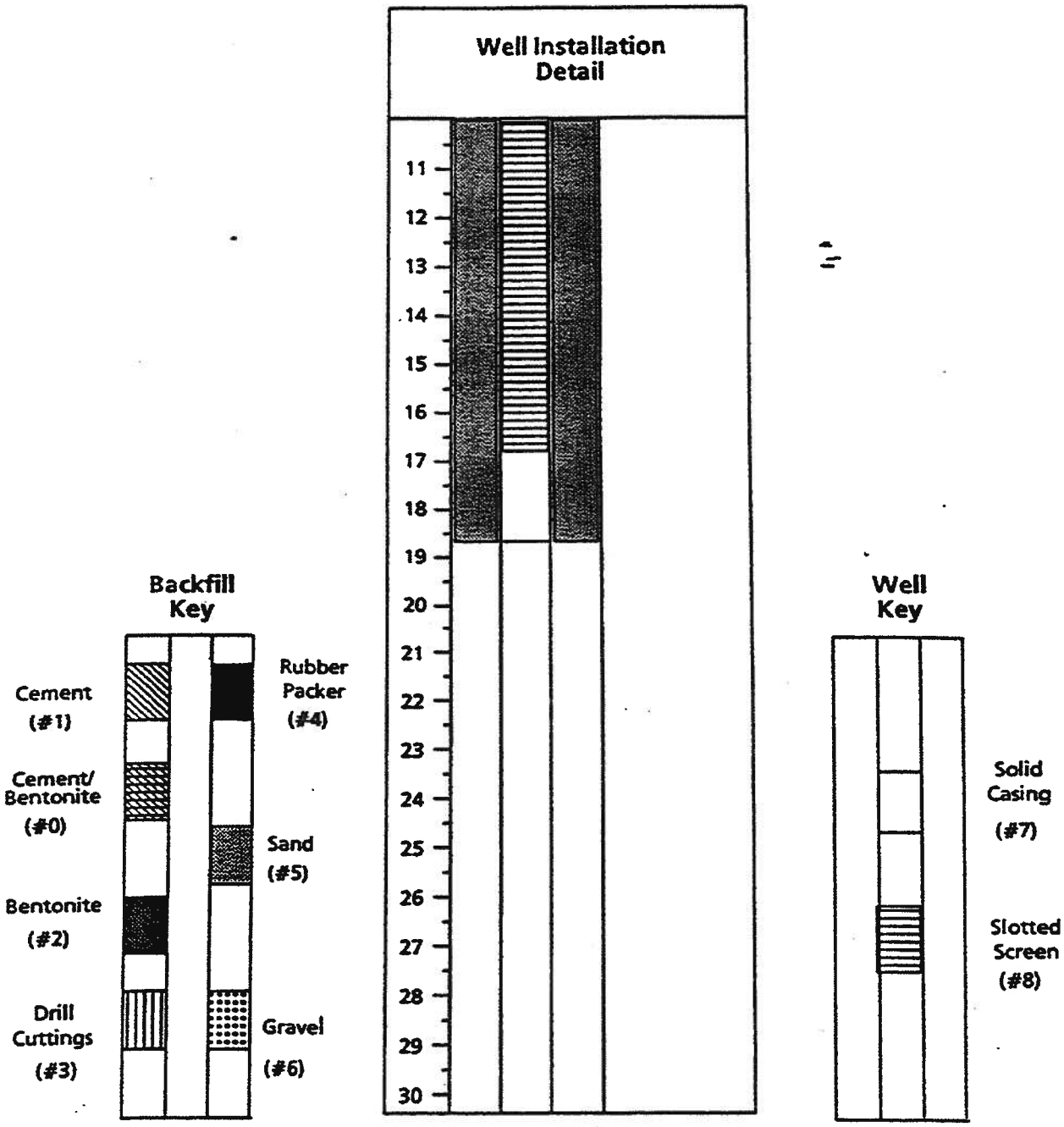


DRILLING CO.: Redwing Environmental Tech.
DRILLER: T. Vernon, D. Heffner
BAKER REP.: J. Wells, W. Brandon
BORING NO.: MW-13 SHEET 1 OF 2

FIELD WELL CONSTRUCTION LOG

PROJECT: SWNAS
S.O. NO.: _____ BORING NO.: MW-13

Michael Baker, Jr., Inc.



DRILLING CO.: Redwing Environmental Tech.
DRILLER: T. Vernon, D. Heffner

BAKER REP.: J. Wells, W. Brandon
BORING NO.: MW-13 SHEET 2 OF 2

FIELD WELL CONSTRUCTION LOG

Michael Baker, Jr., Inc.

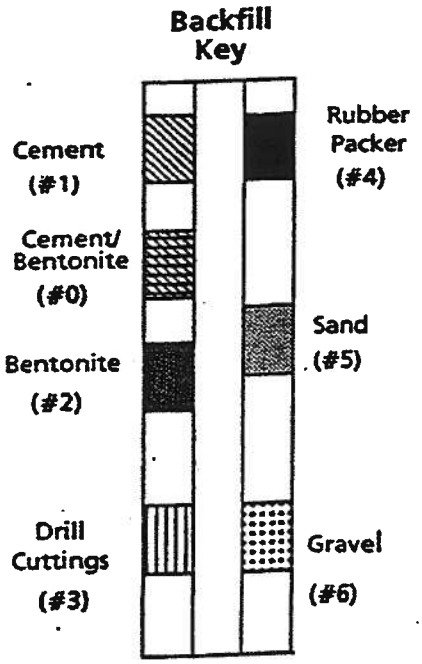
PROJECT: SWNAS
S.O. NO.:
COORDINATES: EAST:
ELEVATION: SURFACE: 148.7

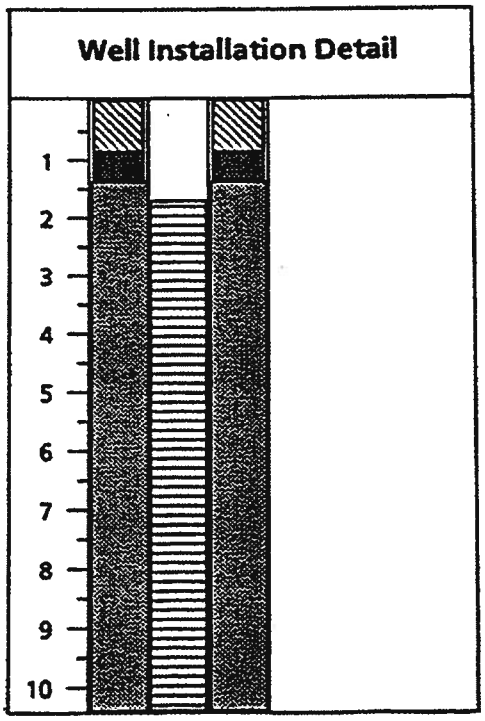
BORING NO.: MW-12
NORTH:
TOP OF STEEL CASING: 151.02

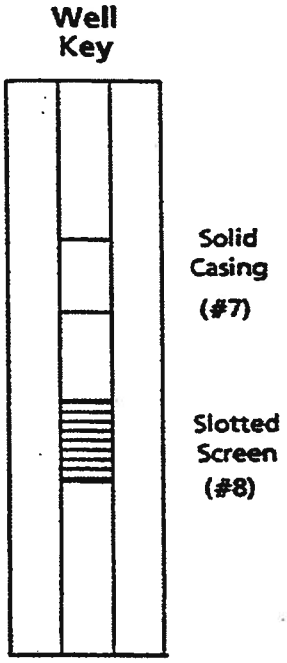
Well Development

Pay Items			
Item	Quantity	Unit	Remarks
Sand			
PVC Solid	3.8'		
PVC Screen	15'		
Bentonite	~1/3	50lb	
Guard Pipe	1		
Concrete	~1/2	94lb	

WELL INFORMATION	DIAM. (INCHES)	TYPE	TOP DEPTH (FT.)	BOTTOM DEPTH (FT.)
Well Casing	2"	PVC Sched. 40	0.0 16.8	1.8 18.8
Well Screen	2"	PVC Sched 40 0.01"Slot	1.8	16.8







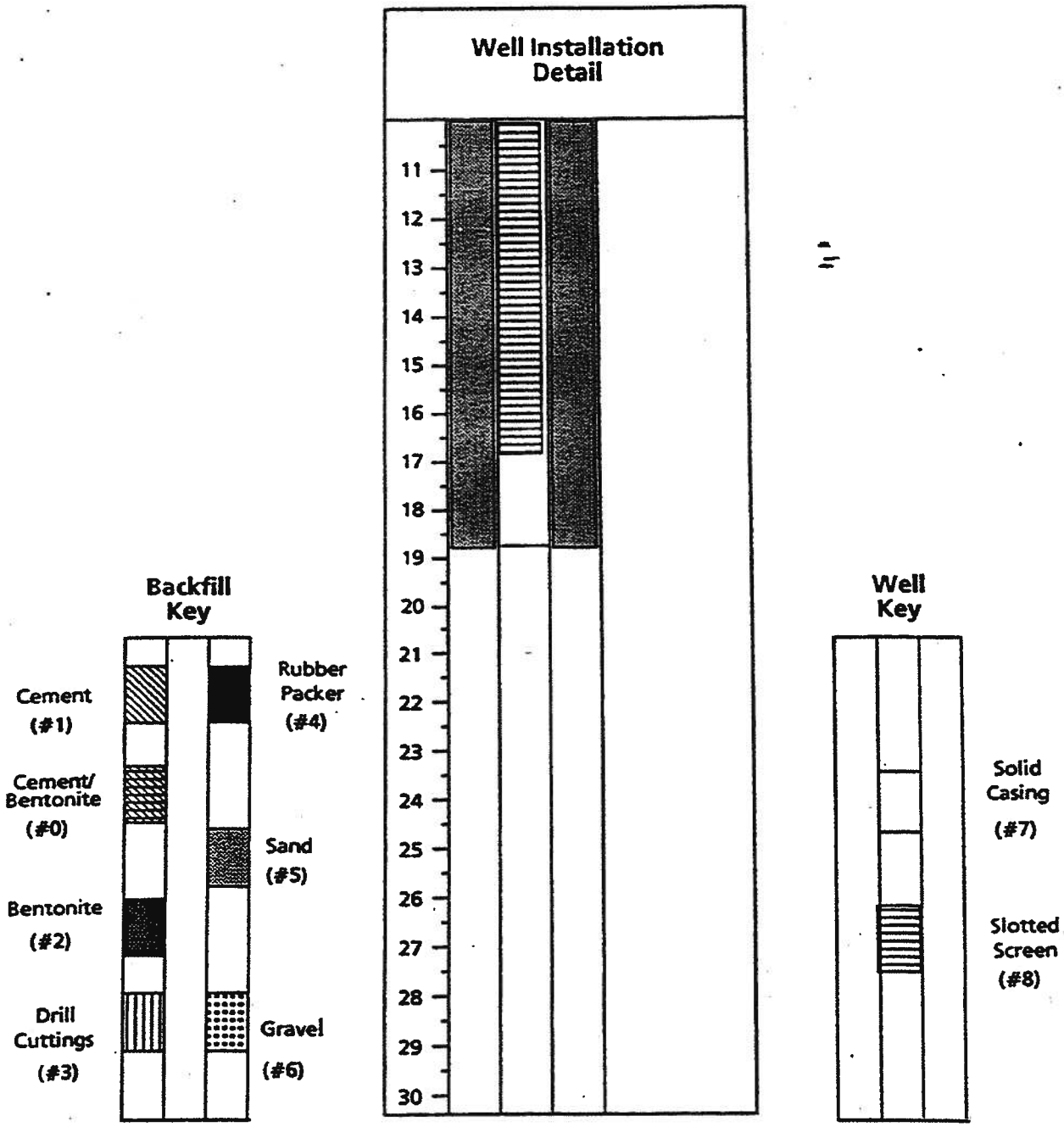
DRILLING CO.: Redwing Environmental Tech.
DRILLER: T. Vernon, D. Heffner

BAKER REP.: J. Wells, T. Skiles
BORING NO.: MW-12 SHEET 1 OF 2

FIELD WELL CONSTRUCTION LOG

PROJECT: SWNAS
S.O. NO.: _____ BORING NO.: MW-12

Michael Baker, Jr., Inc.

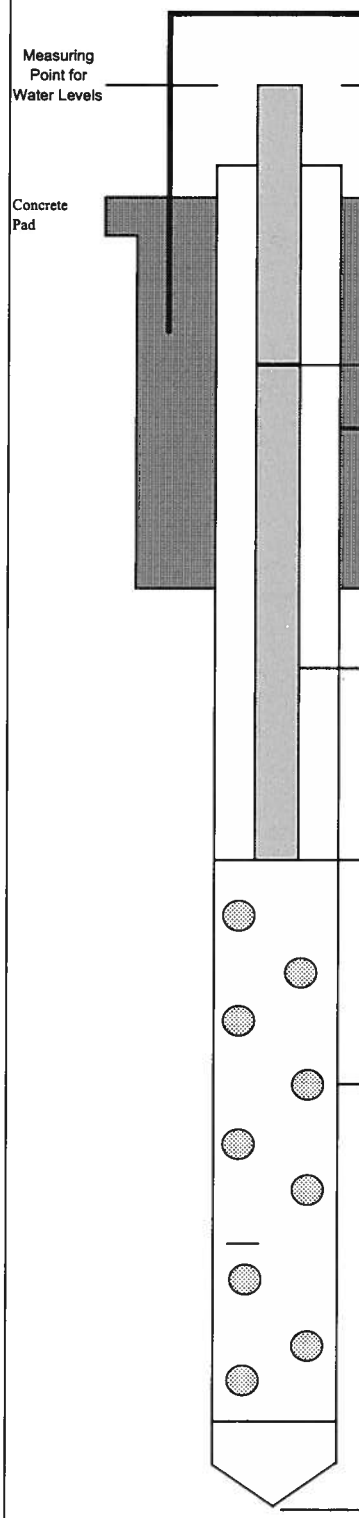


DRILLING CO.: Redwing Environmental Tech.
DRILLER: T. Vernon, D. Heffner

BAKER REP.: J. Wells, T. Skiles
BORING NO.: MW-12 SHEET 2 OF 2

ENSR	*Client:* NAS *Site:* S. Weymouth	***Drive Point ID:*** **PZ-11D**
	Project Number: 10834-06-200	
	Site Location: S. Weymouth, MA	*Date installed:* 1/12/06
	Contractor: Zebra *Method:* DP	*Inspector:* JM

PIEZOMETER CONSTRUCTION DETAIL



		Depth from G.S. (feet)	Elevation (feet) Datum _____
Top of Steel Guard Pipe		N/A	
Top of Riser Tube		48.5" ags	
Top of Casing		N/A	
Ground Surface		N/A	
Bottom of Steel Guard Pipe		N/A	
Water Level		8' bgs	
Casing	No Casing		
Length	N/A		
Inside Diameter	N/A		
Type of Material	N/A		
Depth of Cement		1' bgs	
Riser Tube			
Length	12'		
Inside Diameter	1'		
Type of Material	PVC		
Bentonite			
Top of Drive Point		12' bgs	
Drive Point Screen			
Length	1'		
Inside Diameter	1"		
Type of Material:	PVC		
Sand			
Bottom of Drivepoint and Borehole		13' bgs	

Describe Measuring Point:

_____ _____ _____

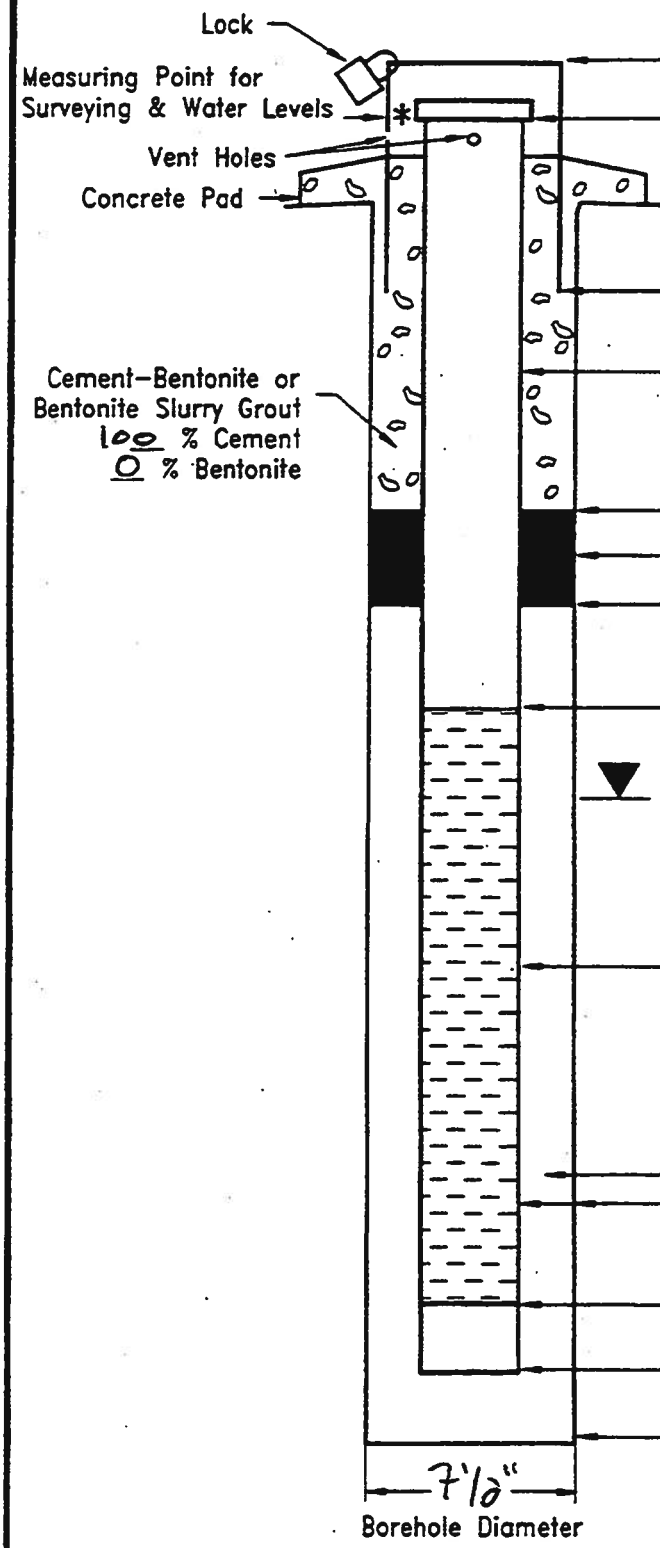
Signature Date

Project No: 5060-048 Client: Brown & Root/Navy Site: NAS South Weymouth **WELL No: MW-31**

Well Location: Miscellaneous - Southeast of FFTA, near Oregon Street (HSB-4) Date Installed: 2/28/96

Contractor: Environmental Drilling, Inc Method: 4 1/4" I.D. HSA Inspector: J. Junod

MONITORING WELL CONSTRUCTION DETAIL



		Depth from G.S. (feet)	Elevation (NGVD)
Top of Steel Guard Pipe		+2.49	165.64
Top of Riser Pipe		+2.19	165.34
Ground Surface (G.S.)		0.00	163.15
Bottom of Steel Guard Pipe		2.76	160.39
Riser Pipe: Length	5.99'		
Inside Diameter (ID)	2"		
Type of Material	PVC		
Top of Bentonite Seal		2.00	161.15
Bentonite Seal Thickness	1'		
Top of Sand		3.00	160.15
Top of Screen		3.80	159.35
Stabilized Water Level	4/16/96	+0.27	163.42
Screen: Length	8.5'		
Inside Diameter (ID)	2"		
Slot Size	0.010		
Type of Material	PVC		
Type/Size of Sand	#1 Silica		
Sand Pack Thickness	2.75"		
Bottom of Screen		12.30	150.85
Bottom of Tail Pipe: Length	0.2'	12.50	150.65
Bottom of Borehole		12.50	150.65

~0.5' of silica sand is at bottom of well.

Approved:

* Describe Measuring Point: Top of PVC Riser

Signature Date

ENSR

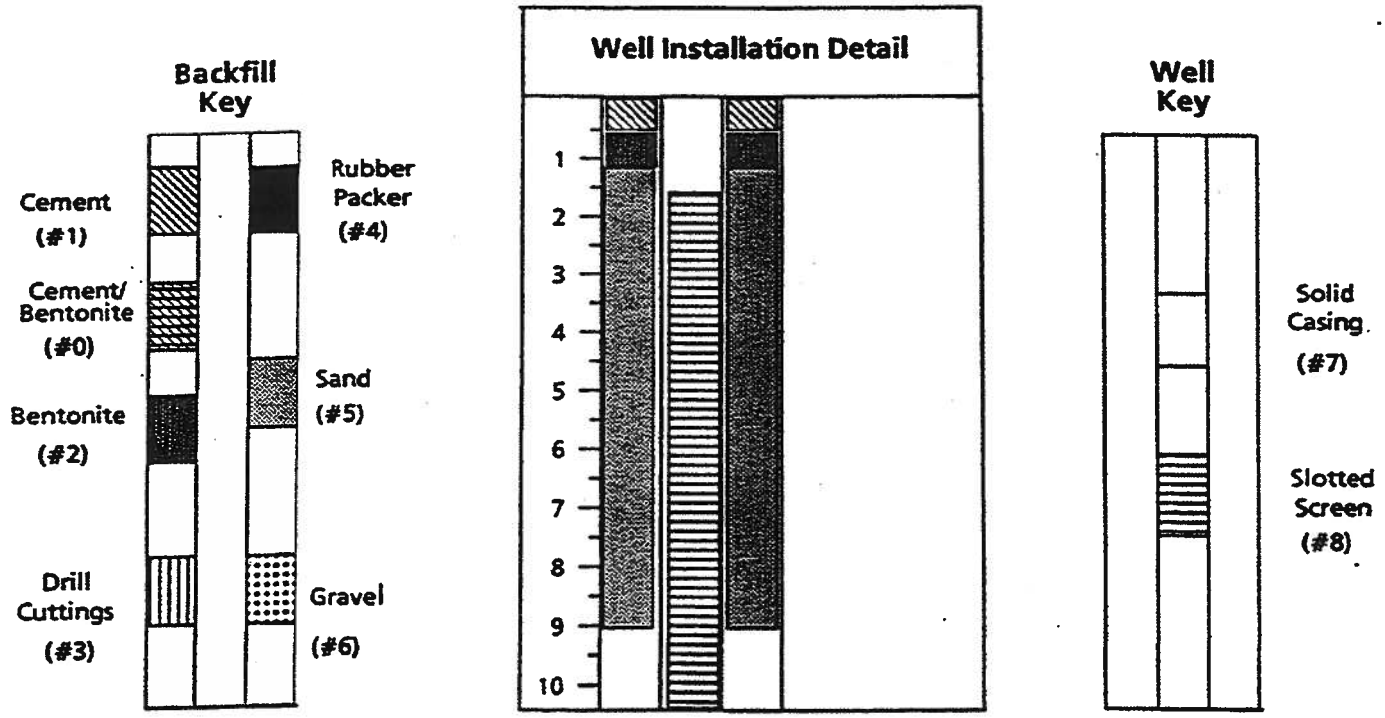
FIELD WELL CONSTRUCTION LOG

PROJECT: SWNAS
S.O. NO.: _____ BORING NO.: MW-11
COORDINATES: EAST: _____ NORTH: _____
Michael Baker, Jr., Inc. ELEVATION: SURFACE: 149.1 TOP OF STEEL CASING: 151.80

Well Development _____

Pay Items			
Item	Quantity	Unit	Remarks
sand	3 bags		
bentonite	25 lbs.		
PVC solid	3.6'		
PVC screen	10'		
concrete	1/2 bag	94 lb	
guard pipe	5'		

WELL INFORMATION	DIAM. (INCHES)	TYPE	TOP DEPTH (FT.)	BOTTOM DEPTH (FT.)
Well Casing	2"	PVC Sched. 40	0.0 1.6	1.6 13.6
Well Screen	2"	PVC Sched 40 0.01"Slot	1.6	11.6

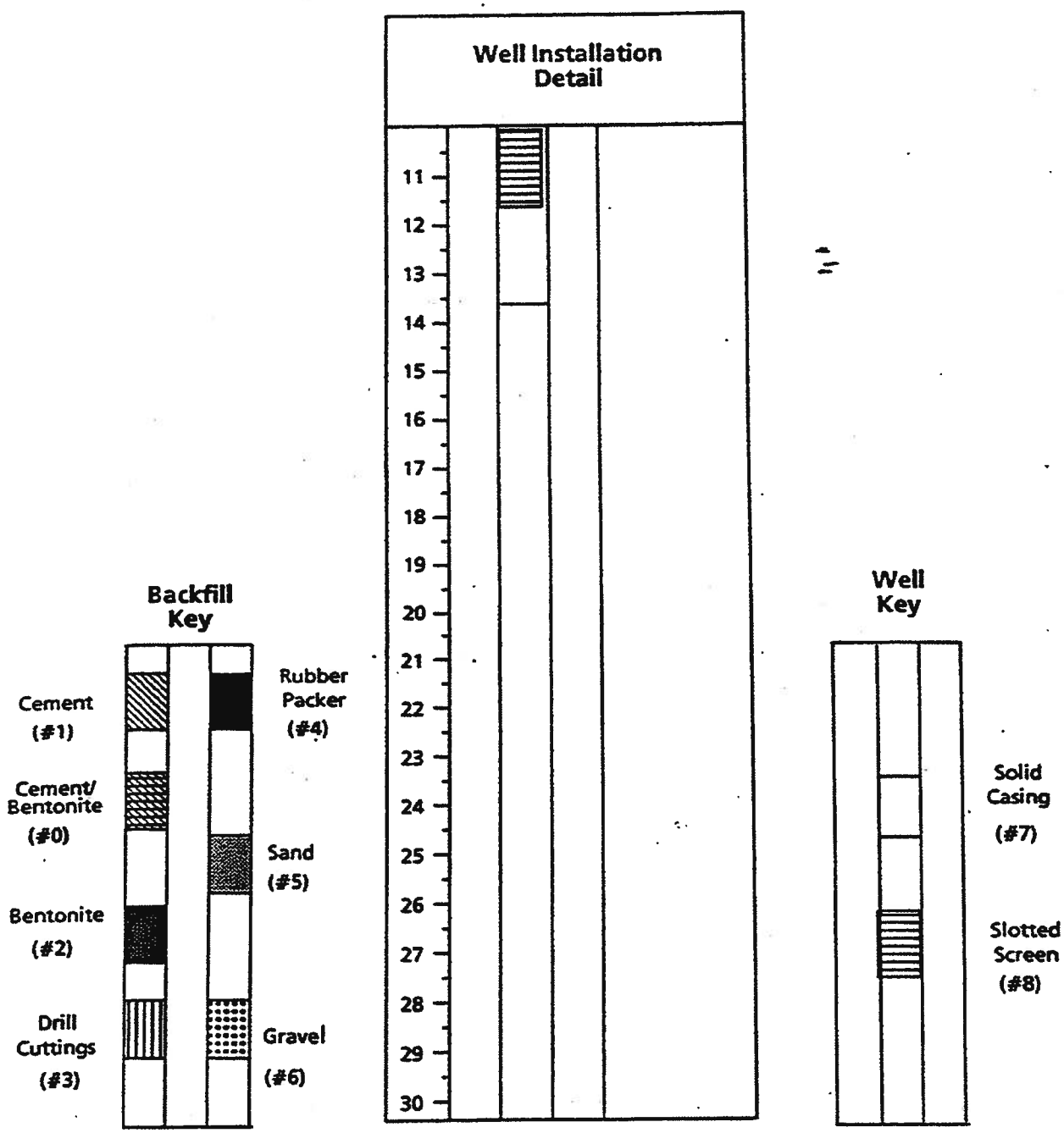


DRILLING CO.: Redwing Environmental Tech. BAKER REP.: J. Wells, P. Turner
DRILLER: T. Vernon, D. Heffner, R. Tiberri BORING NO.: MW-11 SHEET 1 OF 2

FIELD WELL CONSTRUCTION LOG

PROJECT: SWNAS
S.O. NO.: _____ BORING NO.: MW-11

Michael Baker, Jr., Inc.

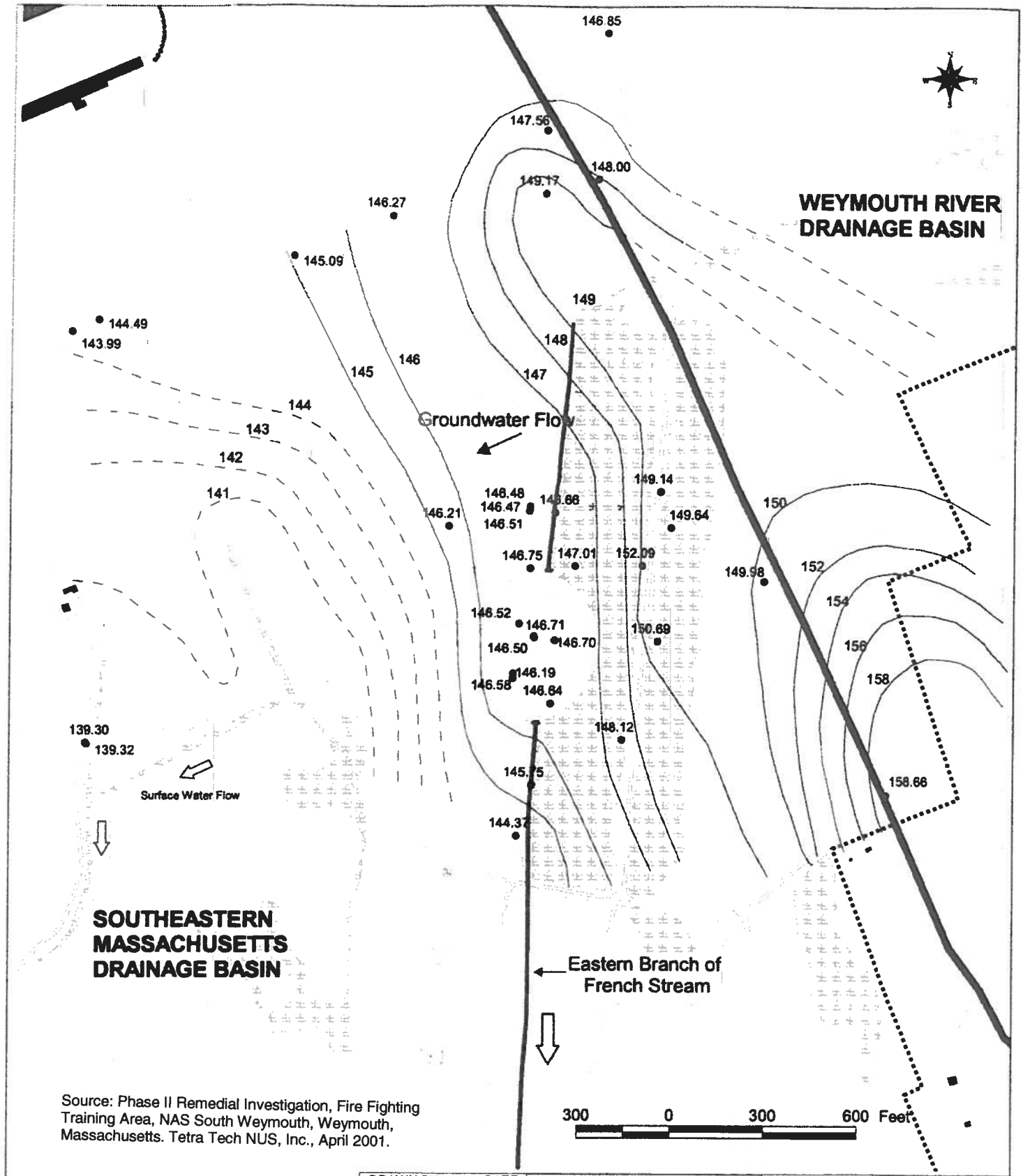


DRILLING CO.: Redwing Environmental Tech.
DRILLER: T. Vernon, D. Heffner, R. Tiberri

BAKER REP.: J. Wells, P. Turner
BORING NO.: MW-11 SHEET 2 OF 2

APPENDIX G

SUPPORTING INFORMATION



Source: Phase II Remedial Investigation, Fire Fighting Training Area, NAS South Weymouth, Weymouth, Massachusetts. Tetra Tech NUS, Inc., April 2001.

- Groundwater Elevation Contours
- Monitoring Wells/Piezometers
- MassGIS Drainage Basin Divide
- French Stream
- Property Perimeter
- Railroad tracks
- Pavement outlines
- Surface Water Line Features
- Building footprints
- Wetlands & Open Water Surface Water Areas
- 2' Topographic Contours

DRAWN BY AMT	DATE 9/27/00	GROUNDWATER FLOW FFTA REMEDIAL INVESTIGATION NAS SOUTH WEYMOUTH, MA	CONTRACT NO.	OWNER NO.
CHECKED BY	DATE		APPROVED BY MDK	DATE
COST/SCHED.-AREA			APPROVED BY	DATE
SCALE 1:5,000			FIGURE NO. 3-9	REV.

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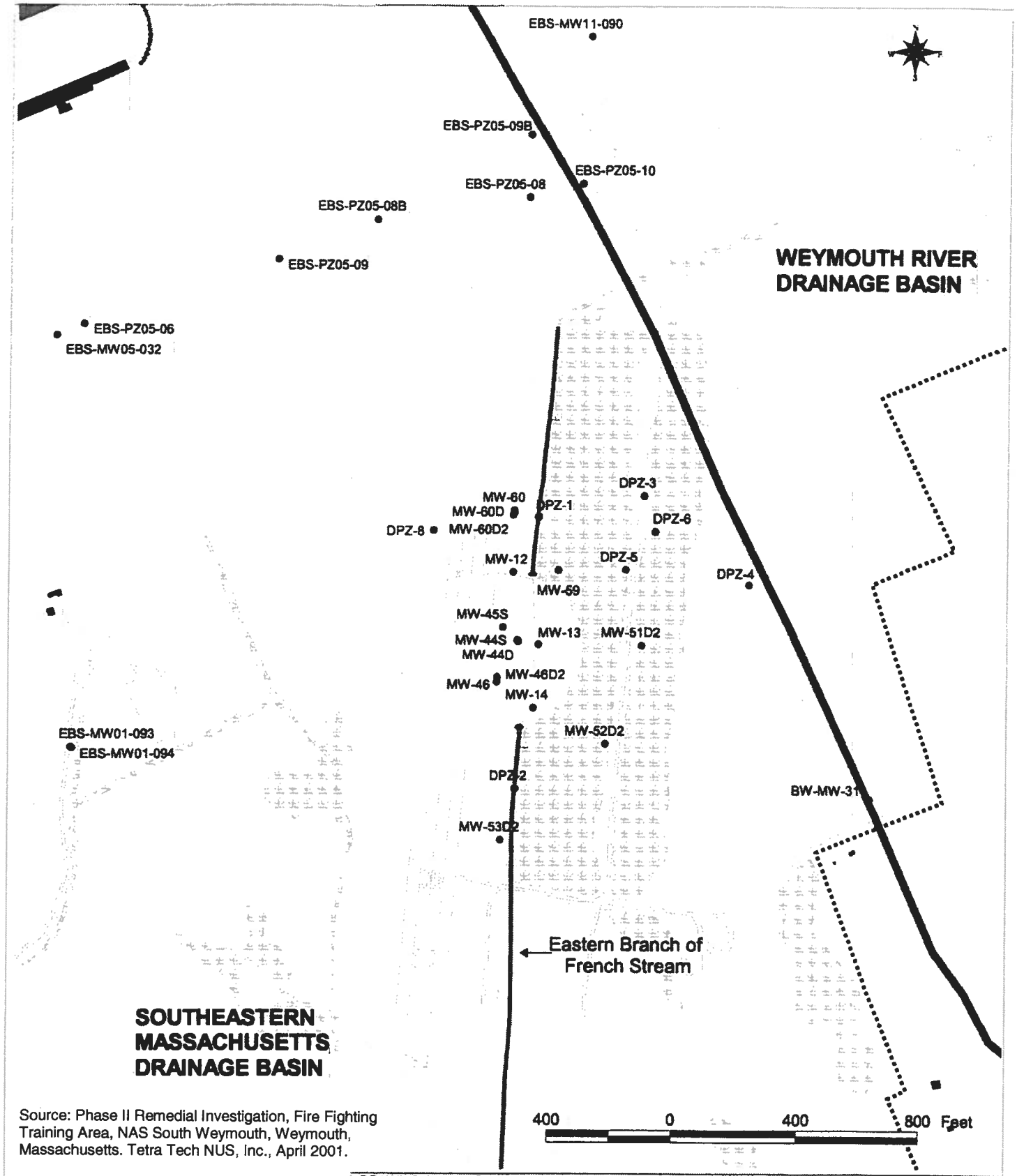

Source: Phase II Remedial Investigation, Fire Fighting Training Area, NAS South Weymouth, Weymouth, Massachusetts. Tetra Tech NUS, Inc., April 2001.

Monitoring Wells/Piezometers
MassGIS Drainage Basin Divide
French Stream
Property Perimeter
Railroad tracks
Pavement outlines
Surface Water Line Features
Building footprints
Wetlands & Open Water Surface Water Areas
2' Topographic Contours

DRAWN BY AMT	DATE 9/27/00	GROUNDWATER ELEVATION MEASUREMENT POINTS FFTA REMEDIAL INVESTIGATION NAS SOUTH WEYMOUTH, MA	CONTRACT NO.	OWNER NO.
CHECKED BY	DATE		APPROVED BY MDK	DATE
COST/SCHED -AREA			APPROVED BY	DATE
SCALE 1:5,000			FIGURE NO. 3-8	REV.

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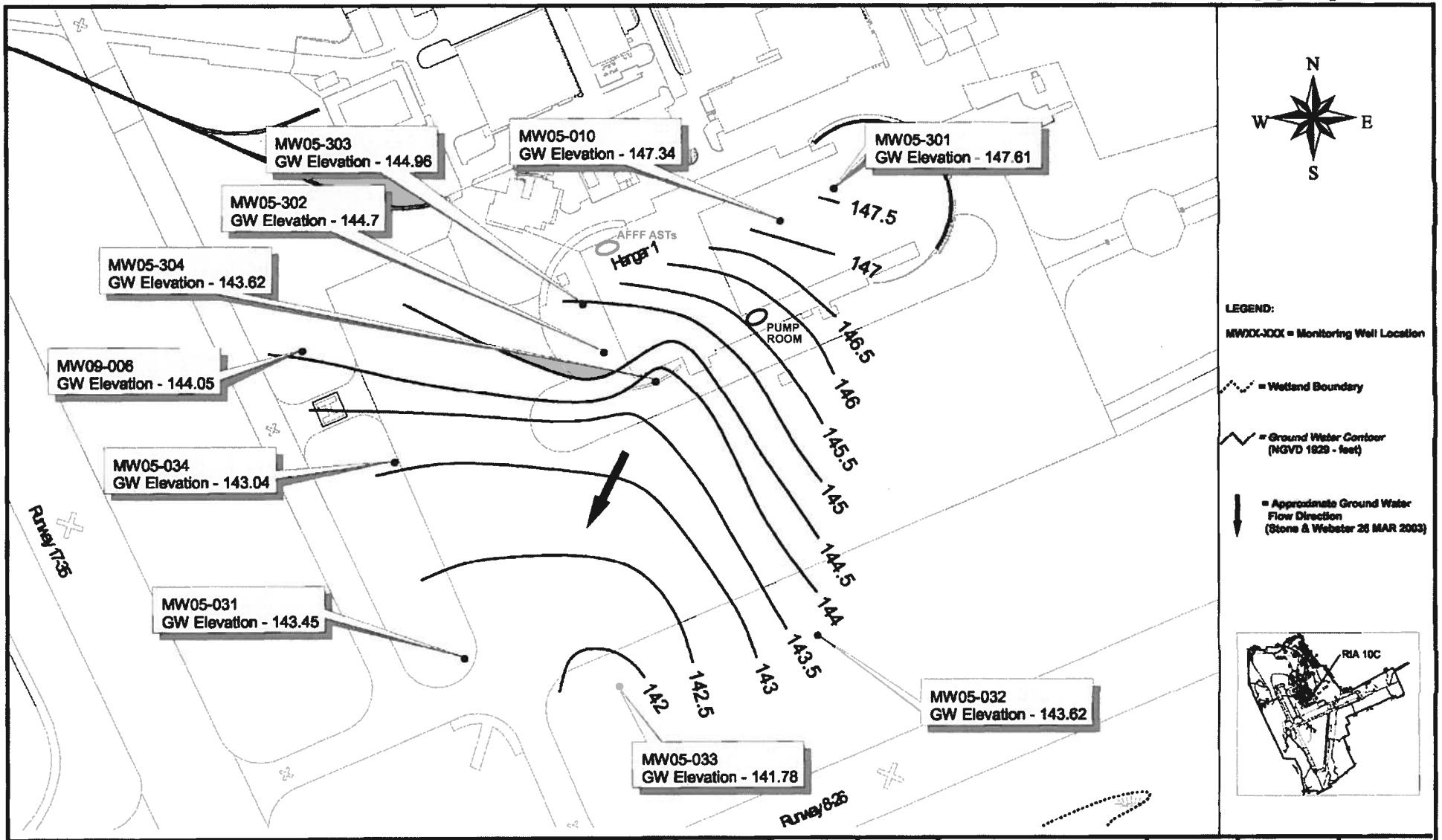
P:\GIS\WEYMOUTH\MAPDOCS\MXD HANGAR1_GW_CONTOUR_MAP.MXD 01/08/10 SP



NAS SOUTH WEYMOUTH EBS PHASE II	Figure 8: Ground Water Contour Map (March 2003) Review Item Area 10C - North and South Lean-Tos of Hangar 1	PROJECT MGR KCC	DESIGNED BY BSM	DRAWN BY BSM	CHECKED BY JJC	SCALE 0 100 200 300 Feet	DATE 07 DEC 04	PROJECT NO 29600.75	FILE No. sw_mob3.apr

Adapted from: *Phase II Environmental Baseline Survey Decision Document for Review Item Area 10C North & South Lean-Tos of Hangar 1*. NAS South Weymouth, Weymouth, Massachusetts. Stone & Webster Environmental Technology & Services. December 2004.