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Header @ 1

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Procurement Folder: 1736767

Procurement Type: Central Purchase Order

Vendor ID: 000000203587

Legal Name: TRIAD ENGINEERING INC

Alias/DBA:

Total Bid: \$0.00

Response Date: 09/09/2025

Response Time: 18:20

Responded By User ID: shaas

First Name: Stacy

Last Name: McGhee

Email: smcghee@triadeng.com

Phone: 13048077598

SO Doc Code: CEOI

SO Dept: 0313

SO Doc ID: DEP2600000002

Published Date: 8/19/25

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Close Time: 13:30

Status: Closed

Solicitation Description: OER- EOI SEMS Evaluations

Total of Header Attachments: 1

Total of All Attachments: 1



Department of Administration
 Purchasing Division
 2019 Washington Street East
 Post Office Box 50130
 Charleston, WV 25305-0130

**State of West Virginia
 Solicitation Response**

Proc Folder: 1736767
Solicitation Description: OER- EOI SEMS Evaluations
Proc Type: Central Purchase Order

Solicitation Closes	Solicitation Response	Version
2025-09-10 13:30	SR 0313 ESR09092500000001756	1

VENDOR
 000000203587
 TRIAD ENGINEERING INC

Solicitation Number: CEOI 0313 DEP2600000002
Total Bid: 0
Response Date: 2025-09-09
Response Time: 18:20:19
Comments:

FOR INFORMATION CONTACT THE BUYER

Joseph (Josh) E Hager III
 (304) 558-2306
 joseph.e.hageriii@wv.gov

Vendor Signature X **FEIN#** **DATE**

All offers subject to all terms and conditions contained in this solicitation

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
1	EOI - Professional engineering services				

Comm Code	Manufacturer	Specification	Model #
81100000			

Commodity Line Comments: See attached Expression of Interest and Statement of Qualifications.

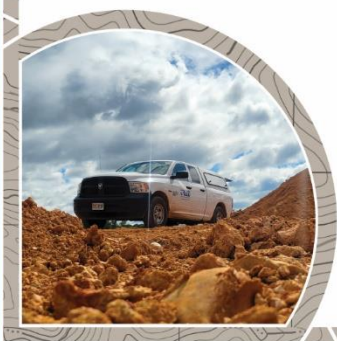
Extended Description:

EOI- Professional engineering services

West Virginia Department of Administration, Purchasing Division
WVDEP OER-EOI SEMS Evaluations
CEOI 0313 DEP2600000002
Expression of Interest & Statement of Qualifications

September 10, 2025

Professional Environmental Services



Prepared For:
West Virginia Department of
Administration, Purchasing Division
Josh Hager
2019 Washington Street East
Charleston, WV 25305

Prepared By:
Triad Engineering Inc.
10541 Teays Valley Road
Scott Depot, WV 25560

Ph: 304.755.0721
Fx: 304.755.1880

September 10, 2025

Mr. Josh Hager
Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, WV 25305-3970

RE: **OER-EOI SEMS Evaluations**
CEOI 0313 DEP260000002
Expression of Interest & Statement of Qualifications
Triad Project No: 04-25-0437

Dear Mr. Hager:

Triad Engineering, Inc. (Triad) is pleased to present our Statement of Qualifications for consideration to provide environmental services for the WVDEP SEMS Evaluations.

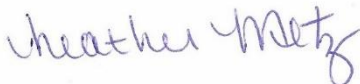
Our qualifications are demonstrated on **Attachment 1, Consultant Qualifications Questionnaire, Attachment 2, Brief Summary of Additional Information, Attachment 3, SEMS Project Experience Summary, Attachment 4, Technical Writing Example, Attachment 5, Required Documentation.**

We are confident that the attached documentation will allow you to understand our level of experience and expertise and illustrate how our Team is best suited to support your project.

If you have any questions or comments about our proposal, please do not hesitate to contact us at 304.755.0721.

Very truly yours,

Triad Engineering, Inc.



Heather A. Metz, LRS
Environmental Services Manager
hmetz@triadeng.com

Attachment 1, Consultant Qualifications Questionnaire



**WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CONSULTANT QUALIFICATION QUESTIONNAIRE**

PROJECT NAME OER-EOI SEMS Evaluations Solicitation ID: CEOI 0313 DEP2600000002		DATE (DAY, MONTH, YEAR) 9/10/2025	FEIN 55-0592364
1. FIRM NAME Triad Engineering, Inc.		2. HOME OFFICE BUSINESS ADDRESS 10541 Teays Valley Road Scott Depot, WV 25560	3. FORMER FIRM NAME (IF APPLICABLE) NA
4. HOME OFFICE TELEPHONE 304-755-0721	5. ESTABLISHED (YEAR) 1975	6. TYPE OF OWNERSHIP <input type="checkbox"/> Individual <input checked="" type="checkbox"/> Corporation <input type="checkbox"/> Partnership <input type="checkbox"/> Joint-Venture	6a. WV REGISTERED DBE (DISADVANTAGED BUSINESS ENTERPRISE) Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
7. PRIMARY OFFICE: ADDRESS/ TELEPHONE/ PERSON IN CHARGE/ NO. (name particular type) PERSONNEL IN EACH OFFICE			
10541 Teays Valley Road Scott Depot, WV 25560 304-755-0721 Jerry "JD" Kinder Regional Manager		59 Scott Depot, WV 40 Morgantown, WV 42 Hagerstown, MD 35 Winchester, VA	13 Satellite Offices (Portsmouth, OH, New Stanton, PA, Mechanicsburg, PA, Frederick, MD, Sterling, VA)
8. NAMES OF PRINCIPAL OFFICERS OR MEMBERS OF FIRM Brad Reynolds, PE, CEO 301-797-6400			8A. NAME, TITLE, & TELEPHONE NUMBER - OTHER PRINCIPALS T. Anders Bush, CAO/VP 304-755-0721
9. KEY PERSONNEL (Check mark key personnel below that you have on staff and will work on project)			
<input checked="" type="checkbox"/> ADMINISTRATION	<input checked="" type="checkbox"/> GEOLOGISTS	<input checked="" type="checkbox"/> QA/QC OFFICER	
<input type="checkbox"/> CHEMISTS	<input checked="" type="checkbox"/> HYDRO-GEOLOGIST	<input checked="" type="checkbox"/> TECHNICIAN	
<input checked="" type="checkbox"/> ENVIRONMENTALISTS	<input type="checkbox"/> LABORER	<input checked="" type="checkbox"/> CADD OPERATORS	
<input checked="" type="checkbox"/> FIELD OPERATIONS MANAGERS	<input checked="" type="checkbox"/> PROJECT MANAGER	<input checked="" type="checkbox"/> OTHER <input type="checkbox"/> Engineers, Drillers	
10. If submittal is by joint-venture, list participating firms & outline specific areas of responsibility (including administrative, technical, & financial) for each firm. Each participating firm must complete a "Consultant Confidential Qualification Questionnaire".			
NA			
10a. HAS THIS JOINT-VENTURE WORKED TOGETHER BEFORE? Yes <input type="checkbox"/> No <input type="checkbox"/>			
NA			

12.a Identify each individual supporting this project and their assigned tasks.

The individuals Triad will assign to support this project have over 100 years of combined experience in performing Superfund/SEMS site assessments. These individuals and assigned tasks include: **Heather Metz** - will serve as the Project Manager and Primary Point of Contact for the WVDEP, OER for communication and project status updates, will prepare the HRS Quickscore and corresponding explanation in the Confidential Memo, and provide a QA review of all document deliverables. **Shannon Johnson** - will prepare a CLP request (or communicate with WVDEP certified laboratory if applicable), communicate and schedule with the CLP laboratory, perform the SCRIBE data management and act as the field operations manager (FOM) for the field sampling activities and prepare report deliverables. **Matt Wright** - will provide field sampling support, including monitoring well installation, multi-media sampling activities, data evaluation and groundwater modeling (if needed), and prepare report deliverables. **Cadaris Woods** - will act as Health and Safety Officer and provide field sampling support, including multi-media sampling. **Matt Kirchoff** - will provide field sampling support, including multi-media sampling, data evaluation and assist in report generation. **Jason McCabe** will provide field sampling support, multi-media sampling activities, regulatory file reviews, data evaluation and report generation. All of our team members have provided critical support for other Superfund/SEMS assessments, including site inspections, SAWP preparation, field sampling activities, SCRIBE data management, report writing, data evaluation and compilation, contaminant exposure pathway and receptor evaluations. Heather Metz and Shannon Johnson have both previously performed preliminary HRS site scoring. As CEO, **Brad Reynolds** will support the Project Manager with technical guidance, capital purchases, equipment, and/or software (if necessary).

12b. Are the individuals supporting this project experienced in performing environmental site assessments according to USEPA Guidance for Performing Preliminary Assessments under CERCLA, Site Inspection (SI) Guidance Manual, Risk Assessment Guidelines for Superfund (RAGS), Hazard Ranking System (HRS) Guidance Manual, and using Dynamic Field Activities for On-Site Decision Making?

YES Identify the project(s) and describe work performed that relates directly to the question:

All of the individuals Triad will assign to support this project, including **Heather Metz, Shannon Johnson, Matt Wright, Cadaris Woods, Matt Kirchoff, and Jason McCabe** have direct experience in performing multi-media sampling and environmental site assessments for residential, commercial, and industrial manufacturing sites of various sizes, conditions, and complexities throughout our region for a variety of private, state and federal uses. Additionally, our Team have direct experience performing site assessments following USEPA Guidance for Performing Preliminary Assessments under CERCLA, Site Inspection (SI) Guidance Manual, Risk Assessment Guidelines for Superfund (RAGS), Hazard Ranking System (HRS) Guidance Manual, using Dynamic Field Activities for On-site Decision Making and the CLP Guide for Field Samplers. Our Triad team has supported the WVDEP in environmental site assessment activities (including PAs, SIs, Combined PA/SIs, SIs, ESIs, and SIRs) on approximately 100 SEMS sites throughout WV in support of the WVDEP, OER. A summary of the projects and type of assessment our Team has performed following the above referenced guidance is included in the attached Table 1, SEMS Site Summary.

As examples: **Heather Metz** has previously performed a variety of environmental site assessment tasks, including Forms II Lite/SCRIBE data management, direct coordination/communication with CLP program, multi-media sampling, data evaluation, contaminant exposure pathway evaluations, HRS generation, and report preparation at numerous SEMS site on behalf of the WVDEP, including Par Industries, Sloan Glass, and Ownes Illinios Plant #3. Additionally, **Shannon Johnson** has performed these similar tasks at the Big Scary Creek Landfill (currently), White Park, and Smith Creek Dump SEMS sites.

NO

12c. Are the individuals supporting this project experienced in USEPA *Guidance for Quality Assurance Project Plans* (EPA QA/G-5) and the WVDEP *Quality Assurance Program Plan for the WVDEP OER CERCLA (Superfund) Program* ?

YES Identify the project(s) and describe work performed that relates directly to the question:

Our Team, specifically **Heather Metz, Shannon Johnson, and Matt Wright** have extensive experience developing Quality Assurance Project Plans (QAPPs) for WVDEP, OER, and USEPA following the above referenced guidance. Members of this team have completed 46 site specific QAPPs for review and approval by the WVDEP and USEPA for SEMS sites throughout West Virginia. A summary of those projects are included in Attachment 2, SEMS Project Experience Summary. Additionally, our Team has extensive experience following the WVDEP QAPR for the CERCLA and Brownfields programs.

NO

12d. Are the individuals supporting this project experienced in USEPA Contract Laboratory Program under the guidelines of Sample Submission Procedures for the *Laboratory and Technical Services Branch (LTSB/ASQA, August 2019)*, the *EPA Region 3 Analytical Request Form 2.1 or current (and instructions)*, and the *most recent Statement of Work (SOW SFAM01.1 or current)*?

YES Identify the project(s) and describe work performed that relates directly to the question:

The individuals Triad will assign to support this project, specifically **Heather Metz** and **Shannon Johnson** have experience with the USEPA Contract Laboratory Program (CLP) as well as the EPA Region 3 Analytical Request Form. Our Team has utilized the USEPA CLP to provide validated analytical data for 46 West Virginia SEMS sites on behalf of WVDEP, OER. We are experienced with the requirements of the request form, sample submission procedures, the selection of analysis based on the current SOW, scheduling and submission of the request form, the communication requirements before/during/after the sampling event.

As examples, we have performed these CLP tasks at the following SEMS sites: Libbey Owens Ford, Big Scary Creek Landfill, South Charleston Landfill, Sloan Glass and Georges Creek Landfill. A complete summary of the SEMS Sites that our Team has utilized CLP services are provided in Attachment 2, SEMS Project Experience Summary.

NO

12e. Are the individuals supporting this project experienced with the WVDEP OER SOPs?

YES Identify the project(s) and describe work performed that relates directly to the question:

The Triad Team assigned to support this project including **Heather Metz, Shannon Johnson, Cadaris Woods, Matt Wright, Matt Kirchoff** and **Jason McCabe** are familiar and experienced with the WVDEP OER SOPs. Our Triad sampling SOPs have been prepared/ revised to mirror those of WVDEPs. Our Team has followed these procedures on numerous sites in the SEMS, Brownfield, and VRP/UECA programs throughout West Virginia.

Representative projects where Triad followed the above referenced guidance documents include: Kanawha Manufacturing, Flint Pigments, Artistic Cleaners, Libbey Owens Ford and Big Scary Creek Landfill.

NO

12f. Are the individuals supporting this project experienced with the Scribe software?

YES Identify the projects and describe work performed that relates directly to the question:

The individuals that Triad will assign to support this project, specifically **Heather Metz** and **Shannon Johnson** have used SCRIBE software (and previous Forms II Lite) to generate necessary sample labels, tags, region and laboratory copies of the traffic reports and the chain of custody documentation. Triad has performed these tasks at over 46 WV SEMS sites for the WVDEP, OER.

Representative sites include: White Park, Libbey Owens Ford, Owens Illinois Plant #3 and Big Scary Creek Landfill. A full summary of these projects are included in the attached Table 1, SEMS Site Summary.

NO

12g. Have field personnel completed an OSHA 40-hour HAZWOPER course and mandatory 8-hour refresher training (as applicable)? The training must cover the requirements in 29 CFR 1910.120 including, but not limited to: personal protective equipment (PPE), toxicological effects of various chemicals, hazard communication, handling of unknown tanks and drums, confined-space entry procedures, etc.?

YES Describe the training and list the name of the individual(s) certified who will be supporting this project:

The individuals that Triad will assign to support this project, specifically **Heather Metz, Shannon Johnson, Matt Wright, Matt Kirchoff, Cadaris Woods** and **Jason McCabe** have all completed the OSHA 40-hour HAZWOPER as well as the 8-hour annual refresher as applicable. The initial HAZWOPER and the 8-hour refresher cover the requirements of 29 CFR 1910.120 as noted above.

NO

12h. Are the individuals supporting this project experienced with the technical writing skills needed to meet the requirements of this project?

YES Attach an example of the writing (preferably a Sampling Analysis Plan or equivalent; all reports will be kept confidential):

Our Team, including **Heather Metz, Shannon Johnson, Cadaris Woods, Matt Kirchoff, Matt Wright** and **Jason McCabe** have written hundreds of reports that have been reviewed and approved by the WVDEP for SEMS, Brownfield, VRP, EUCA and LUST sites following WVDEP and USEPA guidance.

Please refer to the attached example Sample and Analysis Work Plan, prepared by **Heather Metz** and **Shannon Johnson** for the Artistic Cleaners VRP Site.

NO

13a. PERSONAL HISTORY STATEMENT OF KEY PERSONNEL (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, MI):	Metz, Heather A Environmental Services Manager
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Years & Type of Experience:	24 - Environmental Scientist
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Brief Explanation of Responsibilities

Triad SW Environmental Services Manager & Senior Environmental Scientist; has assisted WVDEP & USEPA at numerous WV SEMS sites; has performed regulatory file reviews, negotiated ROE agreements, field operations management, multi-media sampling, data analysis, HRS site scoring, and report generation; as LRS, has performed a variety of tasks for sites in the WV UECA, VRP and Brownfields programs (including preparation of VRP applications, agreements, sampling and analysis plans, extensive site characterization activities, risk evaluation, remedial actions, and report preparation). Ms. Metz has 24 years experience in environmental media sampling, 24 years experience in environmental reporting, 24 years experience in CERCLA and Superfund requirements, and 24 years experience with hazardous waste and/or hazardous substances including the 40-hour OSHA HAZWOPER training and familiarity with RCRA and CERCLA waste storage criteria.

EDUCATION (Degree, Year, Specialization)

BS 2001 - Environmental Science (Marshall University, Huntington, WV)

MEMBERSHIP IN PROFESSIONAL ORGANIZATION(S) & REGISTRATION STATUS (Type, Year, State)

Air and Waste Management Association (AWMA)-Board Member and Treasurer
Society of American Military Engineers (SAME)

PROFESSIONAL LICENSE(S) (Type, State, Expiration Date)

WV Licensed Remediation Specialist (LRS), WV Monitoring Well Driller, HAZWOPER, OSHA 8 Supervisor

13b. PERSONAL HISTORY STATEMENT OF KEY PERSONNEL (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, MI):	Johnson, Shannon L. Senior Environmental Scientist
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Years & Type of Experience:	23 - Environmental Scientist
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Brief Explanation of Responsibilities

As a Senior Scientist, has assisted WVDEP-OER by performing site assessment tasks at various WV USEPA Superfund sites, including performing Site Inspections (SI), file reviews, site reconnaissance, & preparing various technical reports; performed numerous Ph I & II ESAs at commercial & industrial properties (included multi-media sampling activities & generating technical reports); assists on WV VRP sites, data evaluation, report generation; provides regulatory compliance assistance to clients (preparing air & water quality permits, under the Clean Water Act, Spill Prevention, Control and Countermeasure Plans, & under the Oil Pollution Prevention Act). Ms. Johnson has 23 years experience in environmental media sampling, 23 years experience in environmental reporting, 19 years experience in CERCLA and Superfund requirements, and 23 years experience with hazardous waste and/or hazardous substances including the 40-hour OSHA HAZWOPER training and familiarity with RCRA and CERCLA waste storage criteria.

EDUCATION (Degree, Year, Specialization)

BS 2002 - Environmental Science (Marshall University, Huntington, WV)

MEMBERSHIP IN PROFESSIONAL ORGANIZATION(S) & REGISTRATION STATUS (Type, Year, State)

Independent Oil & Gas Association (WV), Society of Hospital Engineers
Society of Hospital Engineers

PROFESSIONAL LICENSE(S) (Type, State, Expiration Date)

WV Monitoring Well Driller, Wetland Delineation (USACE)

13c. PERSONAL HISTORY STATEMENT OF KEY PERSONNEL (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, MI):	Kirchoff, Matt Staff Environmental Scientist
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Years & Type of Experience:	1 - Environmental Scientist
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Brief Explanation of Responsibilities

Assists project managers with Phase I & Phase II Environmental Site Assessments, NEPA Environmental Assessments, multi-media environmental sampling, performance of asbestos inspections.

EDUCATION (Degree, Year, Specialization)

MS 2020, Science Energy and Environmental Policy, University of Delaware; BS 2018, Environmental Science, University of Delaware

MEMBERSHIP IN PROFESSIONAL ORGANIZATION(S) & REGISTRATION STATUS (Type, Year, State)

PROFESSIONAL LICENSE(S) (Type, State, Expiration Date)

WV Licensed Asbestos Inspector

13d. PERSONAL HISTORY STATEMENT OF KEY PERSONNEL (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, MI):	Woods, Cadaris Project Environmental Scientist/Corporate Safety Manager
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Years & Type of Experience:	8 - Environmental Scientist
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Brief Explanation of Responsibilities

Conducts Phase I and Phase II environmental site assessments, performs multi-media environmental sampling, prepares NEPA Environmental Assessments, completes file reviews, site reconnaissance activities, performs data analysis and evaluation, and report preparation. Additionally, is Triad's Corporate Safety Manager. Ms. Woods has 8 years experience in environmental media sampling, 8 years experience in environmental reporting, and 8 years experience with hazardous waste and/or hazardous substances including the 40-hour OSHA HAZWOPER training and familiarity with RCRA and CERCLA waste storage criteria.

EDUCATION (Degree, Year, Specialization)

BS 2015, Safety Technology, Marshall University; MS 2017, Environmental Science, Marshall University

MEMBERSHIP IN PROFESSIONAL ORGANIZATION(S) & REGISTRATION STATUS (Type, Year, State)

**Board of Certified Safety Professionals (Designation of Graduate Safety Practitioner)
Air and Waste Management Association (AWMA)**

PROFESSIONAL LICENSE(S) (Type, State, Expiration Date)

WV Licenced Remediation Specialist (LRS), WV licensed Asbestos Inspector; OH Asbestos Management Planner

13e. PERSONAL HISTORY STATEMENT OF KEY PERSONNEL (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, MI):	Wright, Matthew Project Geologist
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Years & Type of Experience:	35 - Project Geologist (13 of those as principal at another firm)
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Brief Explanation of Responsibilities
 Responsible for designing and implementing technical investigations, which include Phase I and Phase II, Brownfields, VRP, UECA, LUST, and Superfund environmental site assessments (include installation of direct-push technology and auger drill rig borings and monitoring wells, as well as multi-media sampling); develops sampling and analysis plans, evaluates environmental data, performs groundwater modeling evaluations, human health and ecological risk evaluations and prepares reports and documents. Mr. Wright has 35 years experience in environmental media sampling, 35 years experience in environmental reporting, 17 years experience in CERCLA and Superfund requirements, and 35 years experience with hazardous waste and/or hazardous substances including the 40-hour OSHA HAZWOPER training and familiarity with RCRA and CERCLA waste storage criteria.

EDUCATION (Degree, Year, Specialization)
BS 1986 - Geology (Morehead State , Morehead, KY)

MEMBERSHIP IN PROFESSIONAL ORGANIZATION(S) & REGISTRATION STATUS (Type, Year, State)
Air and Waste Management Association (AWMA)

PROFESSIONAL LICENSE(S) (Type, State, Expiration Date)
WV Licenced Remediation Specialist, WV Monitoring Well Driller

13f. PERSONAL HISTORY STATEMENT OF KEY PERSONNEL (Furnish complete data but keep to essentials)

NAME & TITLE (Last, First, MI):	McCabe, Jason Environmental Practice Leader
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Years & Type of Experience:	22 - Practice/Program Manager
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Brief Explanation of Responsibilities
 Triad Northwest Regional Environmental Practice Leader responsible for environmental program management and quality control in Northern WV. Primary point of contact with clients, regulatory agencies, and laboratories/drillers for environmental projects. Oversees the contracting, execution and quality control of Phase I/II ESAs, Subsurface Investigations, regulatory reporting, site remediation, and statewide AST/UST regulated sites. Interacts with private property owners and legal representatives on the applicability and development of environmental covenants and engineering controls - where necessary - in accordance with WVDEP requirements.

EDUCATION (Degree, Year, Specialization)
BS 2003 - Geology (Juniata College, Huntingdon, PA)
Grad Certificate 2011 Geotechnics - Missouri University of Science & Technology (Rolla, MO)

MEMBERSHIP IN PROFESSIONAL ORGANIZATION(S) & REGISTRATION STATUS (Type, Year, State)
Air and Waste Management Association (AWMA)
Society of American Military Engineers (SAME)

PROFESSIONAL LICENSE(S) (Type, State, Expiration Date)
WV Licenced Remediation Specialist, WV Monitoring Well Driller

13g. PERSONAL HISTORY STATEMENT OF KEY PERSONNEL (Furnish complete data but keep to essentials)	
NAME & TITLE (Last, First, MI):	May, Justin Staff CAD Technician
Years & Type of Experience:	22 - CAD Technician & Drafting
Brief Explanation of Responsibilities	
Responsible for creating, updating and modifying maps, and performing manual drafting using Computer-Aided Design computer software in support of a variety of projects.	
EDUCATION (Degree, Year, Specialization)	
AS 2008 - Applied Technology (Southern Community & Technical College, Foster, WV) Drafting Certification 2005 (Boone Career & Technical Center Vocational Education, Foster, WV)	
MEMBERSHIP IN PROFESSIONAL ORGANIZATION(S) & REGISTRATION STATUS (Type, Year, State)	
PROFESSIONAL LICENSE(S) (Type, State, Expiration Date)	
13h. PERSONAL HISTORY STATEMENT OF KEY PERSONNEL (Furnish complete data but keep to essentials)	
NAME & TITLE (Last, First, MI):	Amos, Joshua Lead GIS Analyst
Years & Type of Experience:	24-GIS
Brief Explanation of Responsibilities	
Josh Amos joined Triad February 2025, bringing 20+ years of experience applying geospatial and data technologies to issues in science and engineering. At Triad, Josh is involved with initiatives in water resources (e.g., spatially explicit groundwater budgets) , geomorphology (e.g., discontinuity and rockface characterization in 3D space), remote sensing (e.g., automated feature detection from drone imagery), GIS/CADD integration, ESRI GIS Administration, open-source application web mapping, and automation via code to scale up processes and improve efficiencies. A Certified GIS Professional (GISP), he has presented research on topics ranging from endangered species habitat modeling to climate-driven flood risk assessment.	
EDUCATION (Degree, Year, Specialization)	
BS 2000 - Biological Sciences (Clemson University, Clemson, SC) Graduate Certificate GIS 2008 (Penn State Univeristy, College Park, PA)	
MEMBERSHIP IN PROFESSIONAL ORGANIZATION(S) & REGISTRATION STATUS (Type, Year, State)	
PROFESSIONAL LICENSE(S) (Type, State, Expiration Date)	
Certified GIS Professional (GISP), July 2027	

14. CURRENT ACTIVITIES ON WHICH YOUR FIRM IS THE DESIGNATED CONSULTANT ON:			
PROJECT NAME, TYPE AND LOCATION	NAME/TELEPHONE COMPNAY CONTACT	NATURE OF YOUR FIRM'S RESPONSIBILITY	PERCENT COMPLETE
Lookout Substation UECA Lookout, WV	WVDOH Amber Pennington 304-414-4607	Environmental services- site characterization, UST removal, remediation groundwater assessment	80%
Artistic Cleaners WV VRP Huntingon, WV	City of Huntington Cathy Burns 304-696-5540	Environmental services- WV VRP site characterization and remediation services	85%
Cabinet Supply, Inc. WV VRP Huntington, WV	Cabinet Supply Dave Chandler 304-429-6295	Environmental services - WV VRP-site characterization & remediation activities	90%
Marshall University Research Corporation-CEGAS WV Community and Business Resiliency Initiative Due Diligence WV-Statewide	WV Brownfield Assistance Center George Carico 304-696-5456	Environmental services - Phase I ESAs, Phase II ESA, Asbestos/Mold/Radon/Lead Inspections, Conceptual Site Planning	75%
Exxon Bulk Terminal WV VRP Huntington, WV	Intersection 215, LLC Eric Isabell 304-993-2726	Environmental services - WV VRP-site characterization & remediation activities	5%
Randolph County HQ WV VRP Elkins, WV	WVDOH Amber Pennington 304-414-4607	Environmental services- site characterization, remediation, risk assessment	95%

14. CURRENT ACTIVITIES ON WHICH YOUR FIRM IS THE DESIGNATED CONSULTANT ON:

PROJECT NAME, TYPE AND LOCATION	NAME/TELEPHONE COMPNAY CONTACT	NATURE OF YOUR FIRM'S RESPONSIBILITY	PERCENT COMPLETE
Big Scary Creek Landfill SEMS Scott Depot, WV	WVDEP Kevin Richardson 304-545-2134	Environmental services- SAWP, contract laboratory, multi-media environmental sampling, SCRIBE, ESI data evaluation, HRS	70%
Libbey Owens Ford SEMS Charleston, WV	WVDEP Kevin Richardson 304-545-2134	Environmental services- SAWP, contract laboratory, multi-media environmental sampling, SCRIBE, ESI data evaluation, HRS	70%
Richwood Industries Due Diligence Huntington, WV	Richwood Industries Josh Stoll 304-525-5436	Environmental services- Phase II ESA investigation MW installation, vapor sampling	80%

15. CURRENT ACTIVITIES ON WHICH YOUR FIRM IS THE DESIGNATED SUB-CONSULTANT ON:

PROJECT NAME, TYPE AND LOCATION	NAME/TELEPHONE COMPANY CONTACT	NATURE OF YOUR FIRM'S RESPONSIBILITY	PERCENTAGE COMPLETE
N/A			

16. COMPLETED WORK WITHIN THE LAST 5 YEARS ON WHICH YOUR FIRM HAS BEEN A CONSULTANT TO:

PROJECT NAME, TYPE AND LOCATION	NAME/TELEPHONE COMPANY CONTACT	NATURE OF YOUR FIRM'S RESPONSIBILITY	YEAR COMPLETED
Chemours Bell Plant Optima Building 216 Belle, WV	Optima Bell Michelle Given 304-949-7162	Environmental Services - Direct push drilling and soil sampling for waste profile to prepare for excavation and new construction.	2023
Region 2 PDC; Brownfield Hazardous Coalition Grant, various locations, WV	Region 2 PDC Chris Chiles 304-638-9294	Grant management & environmental investigation activities for a USEPA Brownfield hazardous waste coalition assessment grant.	2022
Jet Stop UECA/LUST Charleston, WV	Green Oak Corp. Shannon Bland 304-344-3691	Environmental services- LUST/UECA site with product recovery, site characteriation and remediation	2021
Prichard Building Phase I ESA and Asbestos Inspection Huntington, WV	Winterwood Inc. Hannah Spillman 859-977-6956	Environmental services- Phase I ESA, Asbestos Inspection and NEPA EA	2021
WCEDA Brownfield Hazardous Assessment Grant Wayne County, WV	HADCO David Lieving 304-525-1161	Grant management & environmental investigation activities for a county-wide USEPA Brownsfield assessment grant	2024
Flint Pigments-Tract A WV VRP Huntinton, WV	PM Company Jared Deker 304-494-6966	Environmental Services- WV VRP-site characterization & remediation activities	2025

17. COMPLETED WORK WITHIN 5 YEARS ON WHICH YOUR FIRM HAS BEEN A SUB-CONSULTANT TO:

PROJECT NAME, TYPE AND LOCATION	NAME/TELEPHONE COMPANY CONTACT	NATURE OF YOUR FIRM'S RESPONSIBILITY	YEAR COMPLETED
N/A			

18. Use this space to provide any additional information or description of resources supporting your firm's qualifications to perform work for the WV Department of Environmental Protection.

Triad has a proved track record of successfully performing environmental site assessments for a variety of sites throughout West Virginia. Additionally, we have performed PAs, SI, SIRs, ESIs at approximately 100 WV SEMS sites on behalf of the WVDEP though a cooperative agreement with the USEPA. We have extensive experience in working with CLP and are familiar with the WVDEP sampling SOPs.

Our office locations in Scott Depot, WV, Morgantown, WV and Winchester, VA would provide for greater coverage, shorter commutes, and easy access to any site state-wide. Triad is extremely familiar with the SEMS PA, SI, ESI, SIR scopes of work, including utilizing contract laboratories and SCRIBE management. Based on our familiarity with the scope of work required, our overall SEMS experience, our office footprint will provide greater efficiency and cost savings in completing the project tasks outlined in this EOI.

19. The foregoing is a statement of facts. Should any information in the questionnaire be falsified or determined at a later date, the West Virginia Department of Environmental Protection reserves the right to void any agreement or contract entered into between the undersigned and their respective firm and the WVDEP.

Signature: 

Title:

Printed Name:

Date:

Attachment 2, Brief Summary of Additional Information



1. Corporate/Personnel Experience as it relates directly to the project

Triad Engineering, Inc. (Triad) has performed over 100 PA, SI, ESI, and SIR assessments on behalf of the WVDEP at SEMS sites throughout West Virginia under contract to the WVDEP-OER through a cooperative agreement with USEPA. The Triad Team supporting you on this project have over 100 years of combined experience performing environmental site assessments and are extremely familiar with the USEPA and WVDEP guidelines and requirements.

2. Uniquely Qualifying Examples or Qualifying Information

Triad is uniquely qualified to perform the work for your project. The professional staff assigned to this project:

- Are experienced in performing site assessments, including multi-media sampling following WVDEP Standard Operating Procedures.
- Have completed PA, SI, ESI, SIR assessments at over 100 SEMS sites throughout West Virginia.
- Are experienced in developing site-specific Sampling and Analysis Work Plans (SAWPs) and following the WVDEP Quality Assurance Program Plan (QAPrP).
- Have experience with the EPA Contract Laboratory Program and understand the requirements before, during and following a sampling event.
- Are familiar with the CLP Analytical Request Form and current SOW.
- Have experience with Scribe computer software.
- All of our Team Members have completed an OSHA 40-hour HAZWOPER and mandatory annual 8-hour refresher training.
- Have necessary technical writing skills.
- Are experienced in evaluating contaminant exposure pathways and preparing HRS site scoring packages.
- Routinely evaluate receptors and prepare risk evaluations.

Additionally, with offices in Scott Depot, West Virginia, Morgantown, West Virginia, and Winchester, Virginia, we can more cost efficiently cover sites located throughout the State. Our Scott Depot office is also conveniently located only 20 miles from the WVDEP Kanawha City Headquarters.

3. Proposed Project Management Plan: How your firm will approach the project

We propose that our Project Manager, Heather Metz meet with the WVDEP, OER Project Manager prior to beginning work to verify project tasks, objectives, and timelines. Triad recognized that working closely with the WVDEP, OER Project Manager throughout the course of the project is critical to the success of the project.

Once specific project sites are determined, Triad will identify any potential conflicts of interest (COI), and provide a COI disclosure to the WVDEP, OER Project Manager in accordance with USEPA COI criteria. A letter of disclosure will be provided to the WVDEP, OER within the required 30 days.

Following that, the specific Scope of Work will be determined by the type of Assessment that is needed for the site. However, our general approach will include the following:

Task 1 – File Review/Information Compilation

Triad will obtain and review copies of available WVDEP and USEPA project files, historical aerial photographs, topographic maps, Sanborn fire insurance maps, NRCS soil maps and NWI maps as applicable and available for the site.

Triad will compile a list of local, community, or county agencies or sources that may provide information pertaining to the site. Examples include local water departments, adjoining property owners, or former employees. Triad will also collect demographic information for the site and vicinity, including sensitive populations and area water supplies.

Triad will contact the property owner to obtain right of entry. Efforts to obtain site access will include telephone calls and submittal of the OER Right-of-Entry Form. If these efforts are unsuccessful, the Triad Project Manager will notify the WVDEP, OER Project Manager to determine the next course of action.

Task 2 – Site Reconnaissance

Triad will participate in a site visit within 30 days of receiving the Notice to Proceed letter from the WVDEP. The WVDEP Project Manager will be notified of and be included in the initial site visit.

Triad and the WVDEP, OER Project Manager will visit the sites to ascertain current site conditions. The WVDEP, OER Project Manager will be notified of the planned reconnaissance at least seven (7) days prior to the site visit.

During the site reconnaissance, particular attention will be given to potential source areas, staining or stressed vegetation, potential contaminant migration pathways, and on-site and off-site receptors.

If applicable, Triad could prepare a **Preliminary Assessment (PA)** to document the results of Tasks 1 and 2. As part of the PA, HRS site scores could also be calculated, data gaps identified, and recommendations determined. If a PA has already been completed, in lieu of preparing a PA, Triad would move to Task 3, Sampling and Analysis Work Plan (SAWP).

Deliverables:

- At least one meeting with WVDEP
- Draft and Final Preliminary Assessment (if applicable)

Task 3, Sampling and Analysis Work Plan

Triad will develop a Sampling and Analysis Work Plan (SAWP) following the format of *Sampling and Analysis Plan-Guidance and Template v.4 General Projects-04/2014* based on the results of the previous work done on the site and the site visit. The SAWP, analytical services procurement, and sampling protocols will be developed to meet the goals and objectives outlined in the appropriate federal and state guidelines as applicable. The SAWP will include a Field Sampling Plan and HASP.

The site-specific Field Sampling Plan (FSP) section of the SAWP will include:

- Site description, including location, historical and current uses, as well as property ownership.
- Objective of SAWP.
- A detailed description of sample locations, and a georeferenced map using NAD 1983 UTM Zone 17N Coordinates.
- Environmental media to be collected.
- Compounds and/or analytes and their required action limit concentrations to be measured, in each applicable media at each sample location.

- Use of Contract Laboratory Program (CLP) or DEP contract laboratory. If CLP is used, the FSP will be designed to meet the guidelines of *USEPA Region III, User's Guide for Acquiring Analytical Services, Revision 6, July 2007*. If it is determined after submission of the Analytical Request Form (ARF) that sample turnaround time is not practical for the project objectives, the WVDEP contract laboratory may be consulted to determine if they are able to meet the project objectives.
- Level of data validation required.
- Field sampling methods as per *USEPA Contract Laboratory Program Guidance for Field Samplers, November 2020*, and per *WVDEP Field Activities Standard Operating Procedures, January 2025*.
- The use of any on-site data generation as recognized by the USEPA Technology Innovation Office, specific to the contaminants of potential concern. The applications will be approved by the WVDEP and USEPA Region III Project Managers prior to sampling.

The WVDEP Quality Assurance Program Plan for the WVDEP OER CERCLA (Superfund) Program will be followed during the assessment.

The SAWP will also include a Health and Safety Plan (HASP) for the project, in accordance with the federal requirements of Title 29, Labor; Chapter 17, Occupational Safety and Health administration, Department of Labor; Part 1910, Occupational Safety and Health Standards; Subpart 120, Hazardous Waste Operations and Emergency Response (HAZWOPER) regulations. The HASP will include all Triad personnel and other site personnel (visitors, DEP staff, etc.).

The SAWP will reflect the use of the USEPA SCRIBE computer software program to manage field operations and sampling management during the site assessment activities. SCRIBE will also be used to import all data results, including all sample location data, analytical data, sample data, monitoring data (if applicable), and notes. The final SCRIBE database will be delivered to DEP within two (2) calendar weeks following the receipt of the validated analytical data.

Triad will submit a draft SAWP to the WVDEP, OER PM and the USEPA PM for review and comment. Based on any comments, the Draft will be revised, and Final SAP submitted for approval.

Deliverables:

- Draft and Final SAP, including FSP, QAPP, HASP
- One meeting with WVDEP, OER PM, additional as needed
- Approved project schedule (will include monthly invoicing)

Task 4, Site Assessment

Triad will implement the approved SAWP and perform the field investigations as per the approved SAWP, adhering to applicable USEPA and WVDEP guidance documents. These tasks will include:

- Scheduling USEPA CLP routine and/or special laboratory analytical services with the USEPA Region III Analytical Services and Quality Assurance Branch (ASQAB) Client Services Team (CST). Triad will coordinate all interactions with the USEPA Region III CST before, during and after the field sampling event. If it is determined that a WVDEP contract laboratory will be used, Triad will coordinate all scheduling before, during and after the field sampling event and provide the WVDEP contract laboratory unvalidated data to the USEPA ESAT contractor for validation.
- Initiating contact with the property owner(s) to obtain right-of-entry for field sampling. Ideally, this task will be conducted prior to the initial site visit.
- Ordering, storing, and purchasing sample coolers, containers, and preservative(s) required for the field sampling effort. Triad will be responsible for sample cooler shipping.
- Providing all other miscellaneous field materials and equipment including, but not limited to personal protective equipment (PPE), disposables, sample cooler packing materials, labels, chain of custody forms, and other requisite field sampling equipment.
- Providing decontamination materials including, but not limited to distilled, deionized, and potable water, detergent, reagents, and approved DOT storage containers and labels for on-site storage of decontamination materials.
- Providing approved DOT containers and labels for storage of on-site investigative-derived waste (IDW), as well as sampling the drums of IDW for disposal characterization and submit to a DEP contract laboratory for analysis as certified for the state of West Virginia.
- Interpreting analytical data for disposal and IDW management, as well as providing sample information, concentration, and regulatory limit table for DEP review.

- Reviewing the HASP with all team members prior to work beginning as well as maintaining a copy on site during field activities.
- Providing a laptop computer and printer at the site during the field activities to support the USEPA SCRIBE field operations and sample management software program.
- Certifying that team members conducting site activities where samples of waste materials, debris, and contaminated media are obtained will have initial 40-hour OSHA HAZWOPER and up to date 8-hour annual OSHA HAZWOPER refresher training.
- Documenting each field sampling point using a Global Positioning System (GPS) field unit, which shall be differentially corrected to a plus or minus five-meter accuracy.
- Providing photo documentation of conditions during field activities.
- Providing field notes describing detailed elements of the sampling event(s) including details pertaining to each sample collected, personnel on location, as well as deviations from the approved SAP (if any).
- Participating in at least one meeting with DEP OER.

Deliverables:

- IDW analytical data table/report, if applicable
- One meeting with WVDEP, OER PM, additional as needed

Task 5, Report

Following completion of Tasks 1-4, Triad will prepare a Site Inspection (SI), Site Inspection Reassessment (SIR), or Expanded Site Inspection (ESI), as appropriate for to the WVDEP, OER PM and USEPA PM for review and comment. The report will generally include, but not be limited to:

- Introduction
- Site Description and History
- Site Ownership and History
- Site Characteristics
- Source Characterization (including discussion of onsite and potential offsite sources)
- Pathway discussion sections
- Sensitive Target Populations
- Field observations and data
- Sampling operations

- Discussion of field quality control and data quality indicators
- Deviations from the approved SAP
- Shipping documentation
- Boring/well logs as applicable
- Certifications of Subcontractors
- Photo documentation
- Analytical summary tables, inclusive of appropriate action levels and background concentrations
- Laboratory analytical reports and validation reports
- Copies of signed ROE forms
- Copies of original field notes
- Environmental Setting data
- Conceptual Site Model
- Summary and recommendations
- Preliminary Human Health Risk Assessment
- Draft Confidential Recommendations Letter
- Confidential HRS Memorandum
- Quickscore scoresheets and corresponding documentation
- Maps depicting site location, sample locations, contaminant concentrations, 4- and 15-mile TDLs, population densities and wetland data

Deliverables:

- Draft and Final Site Inspection report including the preliminary HHRA
- Draft and Final Confidential Recommendation Letters
- Draft and Final Confidential HRS Memorandums
- SCRIBE database
- Two meetings with the WVDEP, OER PM, additional as needed

4. Key Personnel Available for the Proposed Work. Please include the firm's project manager for this work. Also include a review of OER's accessibility to this individual.

Heather Metz will serve as Project Manager and Primary Point of Contact for WVDEP in support of the Statewide SEMS contract. Heather is located in the Scott Depot office of Triad and approximately 20 miles from the WVDEP, OER office in Kanawha City and can be readily accessible by the following contact information:

Heather Metz, LRS
Office: 304-755-0721
Mobile: 304-544-1649
e-mail: hmetz@triadeng.com

Additional primary Triad Team members that are available to support your project include, but are not limited to: Shannon Johnson, Senior Scientist; Jason McCabe, Senior Scientist; Matt Wright, LRS, Project Geologist; Cadaris Woods, LRS, Project Scientist and Corporate Safety Manager; and Matt Kirchoff, Staff Scientist. Depending on site location, Triad has professional staff in other Offices that could be available to support or assist if needed.

5. Project Quality Control / Project Cost Control

The Triad team's past project success and repeat customers is due in large part to project control and coordination, project and budget reporting, and technical quality assurance. Our project control procedures commence with the initiation of work, establishment of responsibilities, staffing and schedule submissions, and approvals. We then establish and institute procedures for controlling each task and phase of the work.

Triad will submit a detailed Scope of Work and Budget to the WVDEP for review, comment, and approval. This document will serve as the guide for performing and monitoring the financial aspects of the project. The Budget will be broken down on a task by task basis to allow for frequent evaluation and monitoring. Triad will not exceed this Budget unless changes in scope or field conditions necessitated the change and not without prior approval from the WVDEP, OER Project Manager.

Triad utilizes an enterprise resource planning (ERP) software system that allows our company to automate and manage core business processes for optimal performance. Our ERP software coordinates the flow of data between our various offices and our business processes. This enables us to streamline operations across the company and to meet the unique needs of our growing business in our ever-evolving markets. We have the capability of linking our company's financials, operations, reporting, and human resources activities on one platform.

Maintaining a single platform for our processes enables us to connect all our data for better insights that help us to optimize our processes across our entire company, and allows for improved security, privacy, and sustainability. All three of these system attributes help us to build continuity and resiliency for Triad, our employees, and our clients, allowing our employees to provide better services to our clients and in creating long-term and strategic relationships.

All documents produced by Triad will undergo a secondary in-house QA/QC review by personnel experienced with the requirements of the project.

Attachment 3, SEMS Project Experience Summary



TRIAD ENGINEERING, INC.
SEMS PROJECT EXPERIENCE SUMMARY

Site Name:	Site Address:	Project Description:	ESA	QAPP	CLP	FORMS II Lite / Scribe	HRS
Airco Welding	Arroyo, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Alfab, Inc.	Smithville, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
American Cyanamid	Willow Island, WV	Site Inspection (SI)	X				X
Anchor Hocking	Clarksburg, WV	Preliminary Assessment (PA)	X				
Appalachian Timber Services	Sutton, WV	Site Inspection Reassessment (SIR)	X				X
Arthur Road Duplex	Reedsville, WV	Preliminary Assessment/Site Inspection (PA/SI)	X	X	X	X	X
Baker Mine Site	Bluefield, WV	Site Inspection Reassessment (SIR)	X				X
Beaumont Glass Company	Morgantown, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Big Scary Creek Landfill Site	Scott Depot, WV	Preliminary Assessment Site Inspection (PA/SI)	X	X	X	X	X
Brooke County Glass	Wellsburg, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Burke, Parsons, and Bowlby	Spencer, WV	Preliminary Assessment/Site Inspection (PA/SI)	X	X	X	X	
Capitol City Junk	Charleston, WV	Site Inspection (SI)	X	X	X	X	
Charles Town Coal Tar	Charles Town, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Chauncey PCB	Chauncey, WV	Site Inspection (SI)	X				X
Chemical Formulators	Nitro, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
CSX Train Derailment	Henderson, WV	Preliminary Assessment (PA)	X				
Datzell Viking Glass Company	New Martinsville, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Dana Transport	Nitro, WV	Site Inspection Reassessment (SIR)	X				X
Dow Chemical Company USE Dowell Division	Nitro, WV	Site Inspection (SI)	X				X
DWR Chemical	Pennsboro, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
E. E. Moore Paving, Inc.	St. Albans, WV	Site Inspection Reassessment (SIR)	X				X

TRIAD ENGINEERING, INC.
SEMS PROJECT EXPERIENCE SUMMARY

Site Name:	Site Address:	Project Description:	ESA	QAPP	CLP	FORMS II Lite / Scribe	HRS
Edna-PCB Transformer Site	Edna, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Elkem Metals	Alloy, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Figgie International, Inc.	Ranson, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Follansbee Well Field	Follansbee, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Fourco Glass	Clarksburg, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Fulton PCB	Wheeling, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Gardner's Salvage	Hancock Co, WV	Site Inspection Reassessment (SIR)	X				X
Gary Dobbs Farm	Cameron, WV	Preliminary Assessment (PA)	X				
Gary Harris Dump	Poca, WV	Site Inspection Reassessment (SIR)	X				X
GE Apparatus	Charleston, WV	Site Inspection Reassessment (SIR)	X		X	X	
Georges Creek Landfill	Malden, WV	Site Inspection (SI)	X	X	X	X	
Glendale TCE Site	Glen Dale, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Goodyear Pt. Pleasant Chemical	Pt. Pleasant, WV	Site Inspection Reassessment (SIR)	X				X
Halltown Paperboard Company	Halltown, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Hamer Lumber Co.- Laminating Division	Ronceverte, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				
Hannah Lumber Co. Site #1	Ragland, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Hannah Lumber Co. Site #2	Ragland, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Hannah Lumber Co. Site #3	Ragland, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Harper Road	Beckley, WV	Preliminary Assessment (PA)	X				X
Hinton Landfill	Hinton, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Holder Chemical	Ona, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X

TRIAD ENGINEERING, INC.
SEMS PROJECT EXPERIENCE SUMMARY

Site Name:	Site Address:	Project Description:	ESA	QAPP	CLP	FORMS II Lite / Scribe	HRS
Holmes and Madden Landfill	Charleston, WV	Site Inspection (SI)	X	X	X	X	
Jefferson Asphalt Products	Charles Town, WV	Site Inspection Reassessment (SIR)	X				X
Left Fork Processing	Rhodell, WV	Site Inspection Reassessment (SIR)	X				X
Libbey Owens Ford	Charleston, WV	Site Inspection (SI)	X	X	X	X	
Lin Electric Company	Bluefield, WV	Preliminary Assessment (PA)	X				X
Markay Chemicals	St. Albans, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Martin Oil	Buckhannon, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Mechling Hill Drum Dump	Follansbee, WV	Site Inspection Reassessment (SIR)	X				X
Mendenhall Mercury Site	Weirton, WV	Site Inspection (SI)	X				
Miller/Shaffer Property	Scarbro, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Mills Electroplating	Beckley, WV	Preliminary Assessment (PA)	X				X
Montgomery Iron & Scrap	Hugheston, WV	Site Inspection Reassessment (SIR)	X				X
New Cumberland Sanitation	New Cumberland, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Norfolk Westen Elevated Bridge	Kenova, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
NR&P Supply House	Minden, WV	Site Inspection Reassessment (SIR)	X				X
Ohio River M.P. 125	New Martinsville, WV	Preliminary Assessment (PA)	X				
Ohio River Mystery Spill M.P. 308.4	Huntington, WV	Preliminary Assessment (PA)	X				
Old Avtex Landfill	Nitro, WV	Site Inspection (SI)	X	X	X	X	X
Old Standard Quarry	Charles Town, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Otsego Capacitor	Otsego, WV	Site Inspection Reassessment (SIR)	X				X
Owens Illinois Plant #3	Fairmont, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Par Industries, Inc.	Nitro, WV	Preliminary Assessment/Site Inspection (PA/SI)	X	X	X	X	X

**TRIAD ENGINEERING, INC.
SEMS PROJECT EXPERIENCE SUMMARY**

Site Name:	Site Address:	Project Description:	ESA	QAPP	CLP	FORMS II Lite / Scribe	HRS
Parkersburg Industrial Park	Parkersburg, WV	Site Inspection Reassessment (SIR)	X				X
Pennsboro Glass	Pennsboro, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Princeton Enterprises	Clarksburg, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Pennzoil Transfer Station Turtle Creek	Madison, WV	Preliminary Assessment (PA)	X				X
Quality Carriers-Sodium Phenolate Spill	Dallas Pike, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Ravenswood PCE	Ravenswood, WV	Site Inspection (SI)	X	X	X	X	
Reedsville Scattered Foundry Waste	Reedsville, WV	Preliminary Assessment/Site Inspection (PA/SI)	X	X	X	X	X
Roseland Wood	Princeton, WV	Preliminary Assessment (PA)	X	X	X	X	X
Route 52/Washington St. Extension	Bluefield, WV	Site Inspection Reassessment (SIR)	X				X
Shady Side Road Junk Yard	Lower Falls, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Shaffer Equipment	Minden, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Shorty Graham Landfill	Parkersburg, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Sloan Glass	Culloden, WV	Site Inspection (SI)	X	X	X	X	
Smith Creek Dump	South Charleston, WV	Preliminary Assessment/Site Inspection (PA/SI)	X	X	X	X	
Sophia Battery Dump	Sophia, WV	Preliminary Assessment (PA)	X	X	X	X	X
South Charleston Landfill	Charleston, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Standard Ultramarine/Chemtron Dump Sites	Huntington, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Stauffer Chemical Gallipolis Ferry	Gallipolis Ferry, WV	Site Inspection Reassessment (SIR)	X				X
Sterling Faucet II Reedsville	Reedsville, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Swanson Plating	Morgantown, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Thiokol-Specialty Chemical Division	Hancock, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
Tyler County Asbestos	Sistersville, WV	Preliminary Assessment (PA)	X				

**TRIAD ENGINEERING, INC.
SEMS PROJECT EXPERIENCE SUMMARY**

Site Name:	Site Address:	Project Description:	ESA	QAPP	CLP	FORMS II Lite / Scribe	HRS
Union Carbide DNT	Institute, WV	Preliminary Assessment/Site Inspection (PA/SI)	X				X
Vaughn Run Solvent Dump	Washington, WV	Site Inspection Reassessment (SIR)	X				X
Venco Coke Fire	Moundsville, WV	Site Inspection Reassessment (SIR)	X				X
Vimasco	Nitro, WV	Site Inspection Reassessment (SIR)	X				X
W&G Electroplating	Fairmont, WV	Site Inspection Reassessment (SIR), Removal Assessment (RA)	X	X			X
Ware Lumber and Fence	Hacker Valley, WV	Preliminary Assessment (PA)	X				X
Watson-Haas Lumber	St. Marys, WV	Site Inspection Reassessment (SIR)	X				X
Waverly Train Derailment	Waverly, WV	Preliminary Assessment (PA)	X				
Waynes Automotive	Red House, WV	Site Inspection Reassessment (SIR)	X				X
Weirton Steel Chromic Acid Spills	Weirton, WV	Preliminary Assessment (PA)	X				X
West Virginia Malleable	Pt. Pleasant, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
White Park	Morgantown, WV	Site Inspection Reassessment (SIR)	X	X	X	X	X
White Park Bus Garage PCB Site	Morgantown, WV	Site Inspection Reassessment (SIR)	X				X
Yuma Camp PCB Site	Wilkinson, WV	Preliminary Assessment (PA)	X				

SEMS PROJECT EXPERIENCE LEGEND

Abbreviation	Description
ESA	Environmental Site Assessment (ESA)
QAPP	Quality Assurance Project Plan (QAPP) Experience
CLP	Contract Laboratory Program (CLP) Laboratory
FORMS/Scribe	Field Operations and Records Management System (FORMS) II Lite Software/Scribe Software
HRS	Hazard Ranking System (HRS)

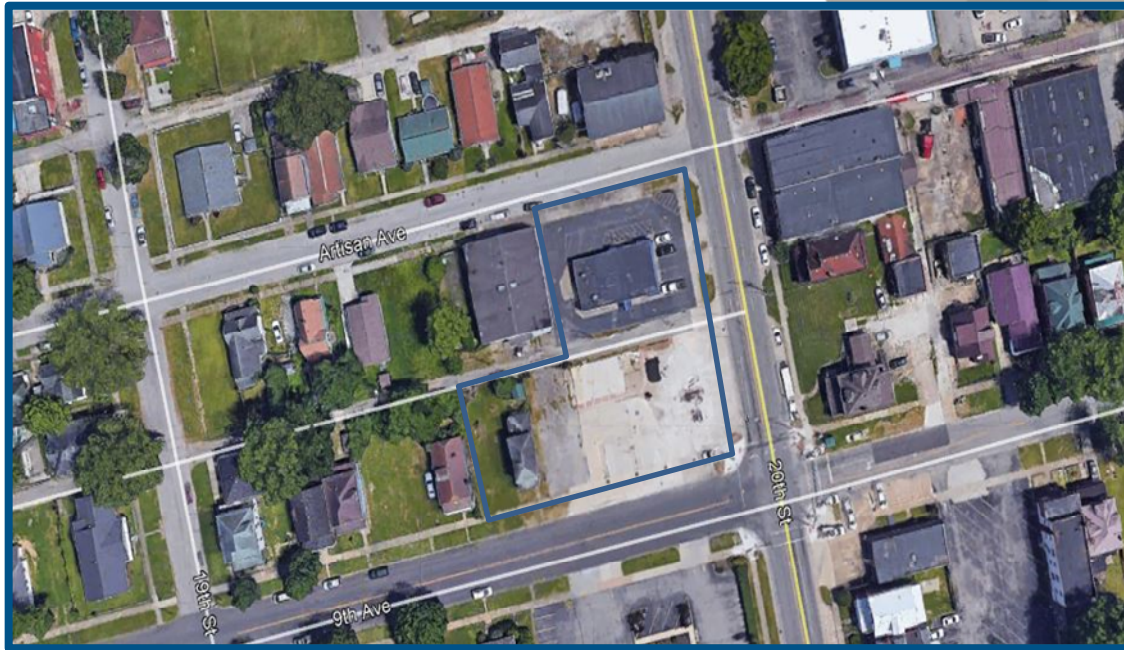
Attachment 4, Technical Writing Example



SITE ASSESSMENT WORK PLAN

Artistic Cleaners

821 20th Street
Huntington, Cabell County, West Virginia
VRP # 22002



Triad Project No. 04-21-0199

Prepared For:

City of Huntington
800 5th Avenue
Huntington, WV 25714

Prepared By:

Triad Engineering Inc.
10541 Teays Valley Road
Scott Depot, WV 25560

October 22, 2021



◆ TRIAD Listens, Designs & Delivers™

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1.0 PROJECT MANAGEMENT

1.1 Site Location and Description

Triad Engineering, Inc. (Triad) has prepared this *Site Assessment Work Plan (SAWP)* on behalf of the City of Huntington to perform site characterization activities at the Artistic Cleaners Site in accordance with the requirements and guidelines of the *Voluntary Remediation and Redevelopment Act (VRRRA)*; West Virginia Code of State Rules (CSR) 60-03. The West Virginia Department of Environmental Protection (WVDEP), Division of Land Restoration, Office of Environmental Remediation (OER) accepted the Site into the VRRRA program on September 2, 2021, and assigned VRRP Project number 22002. The WVDEP and City of Huntington entered into a Voluntary Remediation Agreement on September 23, 2021.

The Artistic Cleaners Site encompasses approximately 0.72 acres and consists of five tax parcels identified on the Huntington-Gideon Corp District 5, Tax Map 31, as Parcels 355, 356, 357, 358, and 359 on file at the Cabell County Courthouse. Parcel 355 is owned by the Huntington Urban Renewal Authority (HURA); Parcels 356, 357, and 359 are owned by the City of Huntington; and Parcel 358 is owned by the City of Huntington Land Bank. The location of the Site is depicted on the attached **Figure 1, Site Location Map** on the *Huntington, W.Va. 7.5-minute* topographic quadrangle map.

The Site and surrounding area were developed in the 1890's. The northern portion of the Site (821 20th Street) was occupied by residential structures until the commercial structure was constructed in approximately 1966. The commercial structure was occupied by a dry-cleaning facility from approximately 1969 to 2012. The southwestern portion of the Site (1942/1944 9th Avenue) was occupied by residential structures until approximately the 1970's (1942 9th Avenue) and 2016 (1944 9th Avenue). The southern portion of the Site (1954 9th Avenue) was occupied by residential structures until construction of a filling station between 1954 and 1962. The filling station was razed, and the underground storage tanks (USTs) removed in approximately 2012.

1.2 Previous Investigations

A Phase I ESA performed on the northern portion of the Site by Triad, dated May 13, 2019, identified the following recognized environmental concerns (RECs):

- The Site was a laundry facility from approximately 1985 through 2012. Yearly generator forms were completed characterizing the Site as a Conditionally Exempt Small Quantity

Generator (CESQG) reporting perchloroethylene and petroleum naphtha as wastes generated. Both types of wastes were reportedly stored in drums until Safety Kleen Corporation transported and disposed of the drums. It is unknown if spills or leaks have occurred at the Site. Triad did not observe evidence of leaks or spills during site reconnaissance.

- Per 1931 Sanborn map, a filling station, with three underground storage tanks (USTs) of unknown content and capacity, were located on the corner of Artisan Avenue and 20th Street, approximately 53 feet north from the Site. Based on the variability of groundwater flow in the area due to the influence of the Ohio River, especially during high water events, there is a possibility that the classification of upgradient or downgradient in this area is relative. It is unknown if petroleum contaminants have migrated from the former filling station onto the Site.
- Per 1931 Sanborn map, a filling station located approximately 200 feet southeast and upgradient from the Site, contained two USTs. Three USTs were depicted on the 1950 and 1954 Sanborn maps. A filling station is shown to be present at the same location in Sanborn maps for the years 1962 through 1966, although in a different configuration from prior year Sanborn maps and no USTs are labeled. A review of files requested from the West Virginia Department of Environmental Protection (WVDEP) detailed tank closure activities for an abandoned 550-gallon used oil UST that was discovered during a Phase II ESA performed by Environmental Services of America, Inc. (ENSA). Documents describe the used oil tank being left behind by the Pennzoil Company who had a verbal agreement with the owner to remove the tanks prior to purchase of the property; however, there is no documentation for the other suspected USTs previously located on Site which predates 1980. The abandoned 550-gallon used oil AST was removed in accordance with applicable state procedures in October 1995 and a closure report was completed in January 1996. Mild contamination of the Site was discovered, and the report noted conduits, including sewer drains and the City of Huntington sewer and utility lines being located at or along 9th Avenue and 20th Street. Conduits have the potential to act as preferential pathways of migration. The associated Leak file for the facility was reviewed by Triad. WVDEP issued a No Further Action (NFA) for the facility on December 14, 2001, based on a review of the information received from previously mentioned environmental investigations. Based on the seasonal fluctuation of groundwater flow and the location of conduits (e.g., preferential migration pathways) in the area, it is unknown if petroleum contaminants have migrated to the Site.

Triad conducted a Phase II ESA on the northern portion of the Site in November 2019 to investigate the potential for residual environmental contamination at the Site. This investigation consisted of collecting six subsurface soil samples and one groundwater sample that were analyzed for VOCs, semi-volatile organic compounds (SVOCs), and RCRA 8 metals. The following summarizes the laboratory analytical results:

- Tetrachloroethene was detected at a concentration exceeding its WVDEP migration to groundwater (MTG) value of 0.0023 milligrams per kilogram (mg/kg) in subsurface soil samples SB-2 (0.2 mg/kg), SB-3 (0.55 mg/kg), SB-4 (0.043 mg/kg), and SB-6 (0.92 mg/kg).
- Arsenic was detected at a concentration exceeding its WVDEP residential soil *de minimis* value of 0.43 mg/kg and MTG of 0.29 mg/kg in all subsurface soil samples collected. However, arsenic concentrations did not exceed its natural background level of 13 mg/kg in West Virginia soils.
- Barium was detected at concentration exceeding its WVDEP MTG value of 82 mg/kg in SB-4 (93 mg/kg) and SB-5 (84 mg/kg).
- Lead was detected at a concentration exceeding its WVDEP MTG value of 14 mg/kg in SB-4 (15 mg/kg).
- Selenium was detected at a concentration exceeding its WVDEP MTG value of 0.26 mg/kg in SB-4 (0.28 mg/kg) and SB-5 (1.6 mg/kg).
- Chloroform was detected at a concentration exceeding its WVDEP groundwater *de minimis* value of 0.22 micrograms per liter (ug/L) in GW-2 (0.76 ug/L).
- PCE was detected at a concentration exceeding its WVDEP groundwater *de minimis* value of 5 ug/L and residential vapor intrusion screening level (VISL) of 28.1 ug/L in GW02 (250 ug/L).
- TCE was detected at a concentration exceeding its WVDEP groundwater *de minimis* value of 5 ug/L and residential VISL of 2.06 ug/L in GW-2 (13 ug/L).

Based on the findings of the Phase II ESA, contaminants of potential concern (COPC) were identified in subsurface soil and groundwater at the Site. Therefore, additional investigations are recommended to fully characterize the nature and extent of COPC identified. Triad also recommends properly constructed monitoring well to be installed and sampled to confirm results from the groundwater screening samples.

A Phase I ESA Update performed by Triad to include the entire Site property, dated June 26, 2020, identified the following RECs:

- The northern portion of the Site (821 20th Street) was a laundry facility from approximately 1985 through 2012. Yearly generator forms were completed characterizing the Site as a CESQG reporting perchloroethylene and petroleum naphtha as wastes generated. Both types of wastes were reportedly stored in drums until Safety Kleen Corporation transported and disposed of the drums. A Phase II ESA was performed by Triad during November 2019. Based on the results of this investigation, TCE and PCE, dry-cleaning contaminants, were detected in groundwater indicating that the Site has been impacted by historic dry-cleaning activities.
- What appears to be three groundwater monitoring wells and a vault are located on the former gas station (southeastern) portion of the Site (1954 9th Avenue). A FOIA request was submitted to the WVDEP to obtain information regarding the former Sunoco/All In One Store facility. There is no record of monitoring wells being registered at this Site location. Based on information provided, six USTs were installed in 1956 and removed from the ground in 1989 and four USTs were installed in the early 1990s and removed in June 2013. There is no reported leak from either UST system. Based on the lack of information and the presence of the three wells and vault have been identified as a REC.
- An automotive repair facility, Protoon Auto Tune, was identified to the south and hydraulically upgradient of the Site. The facility reportedly operated as a general automotive repair shop from 1973 through 1977. Based on the use of petroleum-based materials and unknown materials management practices, Protoon Auto Tune would appear to represent a REC to the Site.

A Phase II ESA on the entire property was conducted on November 18 through 20 and December 9 and 11, 2020 by Triad. This assessment consisted of installation of four monitoring wells, collecting three subsurface soil samples and six groundwater samples which were analyzed for VOC, polynuclear aromatic hydrocarbons (PAH), and RCRA 8 metals.

The laboratory analytical results were compared to applicable regulatory criteria published by the WVDEP to determine if RECs were present at the Site. Based on the laboratory analytical results:

- Arsenic was detected at concentrations exceeding its WVDEP residential soil *de minimis* value in all subsurface soil samples collected. However, arsenic did not exceed its natural background level in West Virginia soils in any of the samples.
- PCE was detected at a concentration greater than its WVDEP groundwater *de minimis* value in all groundwater samples collected.
- TCE was detected at a concentration greater than its WVDEP groundwater *de minimis* value in each of the groundwater samples collected, with the exception of MW-4.

Based on the results of this Phase II ESA, PCE and TCE were detected in all of the groundwater samples collected at the Site. Additional investigations are warranted to further define the extent of the PCE and TCE contaminant groundwater plume. A vapor intrusion investigation also appears warranted. Triad also recommended entering the Site into the WVDEP VRP. Potential contamination exposure pathways are illustrated on the attached **Figure 2, Conceptual Site Model**.

1.3 Geologic Setting

The Site is underlain by the Missourian Series of the Pennsylvanian System, which consists of cyclic sequences of sand, gravel, silt, and clay. The primary soil mapping unit associated with the local area is Urban Land soil, which consists of relatively level areas where the ground surface is generally covered by more than 85% impervious surfaces. Urban Land soils are variable in texture and are most commonly encountered along the floodplains and terraces of the Ohio River.

1.4 Project Description

The site assessment activities described in this *SAWP* will consist of the collection of surface soil, subsurface soil, and groundwater samples that will be analyzed for VOC, PAH, and RCRA 8 metals. In addition, soil vapor samples will be collected and analyzed for VOC. The analytical data will then be compared to the current West Virginia *de minimis* risk-based standards (West Virginia Voluntary Remediation Program De Minimis Table, August 2021) for residential soil and groundwater to determine the presence of environmental contamination. If no West Virginia *de minimis* value exists for a detected compound, the data will be compared to the most recent EPA residential soil and tap water Regional Screening Levels (RSLs).

The supplemental site assessment activities will determine if residual environmental contamination is present in soil, groundwater, and vapor at the Site and determine if remedial

actions are warranted. If analytical results exceed their respective *de minimis* risk standards, then further environmental assessments and/or remedial action may be required at the Site.

The selection of sample locations, analyses, and media were based on current and historic conditions, future land-use as commercial use, the contaminants of potential concern (COPC), and identification of potential contaminant exposure pathways that could be associated with human health or ecological risk.

1.5 Project Timeline

The progress of this project will be tracked from its inception through implementation to ensure all sampling and analytical activities are performed in a correct and cost-effective manner. Each step in this process will be scheduled in an objective and realistic time frame to assure that adequate attention is devoted to the minimization of effort and the maximization of information. The attached **Table 1, *Project Timeline*** provides a project timeline for this project.

1.6 Measurement Quality Indicators

The measurement quality indicators for this project are included in the attached **Table 2, *Measurement Quality Indicators*** and **Appendix C *Analytical Method Information***.

2.0 FIELD SAMPLING PLAN (FSP)

2.1 Project Organization

The Project Manager (PM) and LRS for this project is Heather A. Metz, LRS. Decisions regarding project scope, sampling locations, and collection equipment, or other project related issues, will be made by the PM in consultation with the WVDEP, OER Project Manager.

The Quality Assurance Officer (QAO) for the project is Heather A. Metz, LRS. The level of Quality Assurance (QA), QA procedures, and overall **Quality Assurance Project Plan (QAPP)** development is the responsibility of the QAO. All decisions regarding the **QAPP** and related issues should be made by the QAO.

The Environmental Health and Safety (EH&S) Director for the project is Cadaris L. Woods. The EH&S Director is a resource for development of the site-specific **Health and Safety Plan (HASP)** and will be consulted on all health and safety issues that arise in the field and will be solely responsible for making final decisions associated with the **HASP**.

The Field Operations Manager (FOM) for the project is Shannon L. Johnson. Implementation of the **FSP** and the **QAPP** at the Site is the responsibility of the FOM. Field level decisions not affecting project quality will be made by the FOM. Real time assessment of the **QAPP** and recommendations for revisions will be made by the FOM to the QAO.

EnviroCore, subcontract to Triad, is responsible for drilling soil borings and installation of groundwater monitoring wells. EnviroCore will follow direction from the FOM.

ALS Environmental (ALS), laboratory subcontract to Triad, is responsible for analyzing soil and groundwater environmental samples collected during the site assessment. ALS will consult directly with the PM should any quality issues arise.

Integrated Analytical Labs (IAL), laboratory subcontract to Triad, is responsible for analyzing the vapor samples collected during the site assessment. ALS will consult directly with the PM should any quality issues arise.

Environmental Data Professional (eDataPro), subcontract to Triad, is responsible for providing laboratory analytical data validation services. eDataPro will consult directly with the PM should any quality issues arise.

The WVDEP, OER Project Manager for the project is David Long. The WVDEP, OER Project Manager reviews the reports submitted and provides final approval of site assessment activities to be conducted. The WVDEP, OER Project Manager also administers the VRP and performs oversight of the work being performed through the program. The Project Manager will work closely with the PM/LRS as the Site moves through the program.

The WVDEP Environmental Toxicologist is Ross Brittain. The Environmental Toxicologist will work closely with the WVDEP, OER Project Manager and LRS to evaluate and verify completion of remediation activities at the Site.

The VRP Applicant is Cathy Burns, with the City of Huntington. The PM/LRS will communicate directly with the Applicant regarding site access and status updates.

2.2 Special Training Requirements and Certification

All on-site field sampling and drilling subcontract personnel will possess current 40-hour Occupational Safety and Health Administration (OSHA) hazardous waste operations and emergency response (HAZWOPER) training, and eight-hour OSHA HAZWOPER annual refresher training. All on-site field sampling personnel will participate in the Triad medical monitoring program. Additionally, Triad will utilize a WVDEP certified laboratory to provide analytical services.

2.3 Sampling Rationale

The field sampling program described in the **FSP** is designed to characterize the AOPC. Environmental media to be sampled and analytical parameters and procedures were selected to provide validated laboratory data for use in risk assessment of human and ecological receptors.

2.4 Sample Type and Locations

Data collected in this project will be analyzed according to the specifications of the current USEPA *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition* (SW-846). The sample types, preliminary locations, and analyses are summarized in the attached

Table 3. The sample locations are depicted on **Figure 3, Sample Location Map** and **Figure 4, Aerial Photograph**. These locations have been selected to delineate the horizontal and vertical extent of contaminant impact identified during previous investigations; and provide information necessary to prepare a risk assessment. These locations are preliminary and may be revised by the FOM and PM at the time of sampling if indicated by Site conditions.

2.5 Sampling Procedures

The minimum sample volume, container type, preservative, and technical holding times for field samples are summarized in **Table 4, Field Sample Container Requirements**. Quality Control (QC) samples to be collected are summarized in **Table 5, Field and Matrix QC Samples**. Overall, sampling procedures will be performed in substantial compliance with the following:

2.5.1 Surface Soil

During site characterization activities, Triad will collect eight surface soil samples via direct push from the following preliminary locations:

- One sample from the northern side of the gas house, just south of the alley (SS-1);
- One sample from the northwestern corner of the Site (SS-2);
- One sample from the western side of the former dry-cleaning facility (SS-3);
- One sample from the northeastern portion of the Site (SS-4);
- One sample from the southern portion of the Site (SS-5); and
- Two samples from the former gasoline station dispenser islands (SS-6 and SS-7); and
- One sample from the southeastern corner of the Site (SS-8).

Surface soil sample collection and analytical methods are provided in **Table 6, Sampling and Analytical Methods Requirements** and the WVDEP *Field Activities Standard Operating Procedures* (March 4, 2021), including photoionization field detector (PID) field screening, soil sampling using direct-push drilling, and soil sampling method 5035, provided in **Appendix D, Standard Operating Procedures**.

2.5.2 Subsurface Soil

During site characterization activities, Triad will collect three subsurface soil samples via direct push from the following preliminary locations:

- One sample from the northern side of the gas house, just south of the alley (SB-10);
- One sample from the southern portion of the Site (SB-11); and

- One sample from the southeastern former gas station portion of the Site (SB-12).

Subsurface soil sample collection and analytical procedures are provided in **Table 6, Sampling and Analytical Methods Requirements** and the WVDEP *Field Activities Standard Operating Procedures* (March 4, 2021), including PID field screening, soil sampling using direct-push drilling, and soil sampling method 5035, provided in **Appendix D, Standard Operating Procedures**. In efforts to minimize VOC loss during field screening and sampling activities, Triad intends to install collocated direct push borings for subsurface soil VOC sampling.

2.5.3 Groundwater

During site characterization activities, Triad will collect seven groundwater samples from the following locations:

- Four samples from the existing groundwater monitoring wells (MW-1 through MW-4);
- Triad will install monitoring well MW-5 at the northeastern portion of the Site;
- Triad will install monitoring well MW-6 at the southern portion of the Site; and
- Triad will install monitoring well MW-7 at the southeastern former gas station portion of the Site.

The new monitoring wells will be installed and developed by a West Virginia Certified Monitoring Well Driller and constructed of 2-inch diameter PVC well screen and riser in accordance with the West Virginia Monitoring Well Design Standards 47 CSR 60. The top of the well riser will be surveyed using existing benchmarks to determine elevation. Groundwater levels will be measured at the time of sampling to evaluate groundwater flow direction. The monitoring wells will be developed using over pumping combined with surge and purge development techniques. Purge water will be contained in 55-gallon drums for later disposal. Groundwater sampling procedures are provided in **Table 6, Sampling and Analytical Methods Requirements** and the WVDEP *Field Activities Standard Operating Procedures* (March 4, 2021), including groundwater well sampling procedures, provided in **Appendix D, Standard Operating Procedures**.

2.5.4 Vapor

During site characterization activities, Triad will install four sub-slab soil gas wells via direct push from the following preliminary locations:

- One vapor sample from the northwestern corner of the Site (VP-1);
- One vapor sample from the western side of the former dry-cleaning facility (VP-2); and

- Two vapor samples from the former gas station portion of the Site (VP-3 and VP-4).

Vapor sampling procedures are provided in **Table 6, *Sampling and Analytical Methods Requirements*** and the WVDEP *Field Activities Standard Operating Procedures* (March 4, 2021), including soil gas sampling, provided in **Appendix D, *Standard Operating Procedures***.

2.6 Investigative Derived Waste

Triad shall manage investigated derived waste (IDW) during field operations in compliance with USEPA, *Management of Investigation-Derived Waste During Site Inspections (EPA/540/G-9/009)*. IDW shall be placed into 55-gallon steel drums or other suitable containers. Disposal of the IDW will be documented in the assessment report.

2.7 Paperwork Requirements

2.7.1 Sample labeling

After samples have been collected, they will be placed into certified pre-cleaned containers supplied by the laboratory. Each sample container will have a sample label generated by the sampling personnel. Each sample container label will have, at a minimum, the following information:

- Sample identification.
- Analysis requested.
- Date/Time sample collection.

2.7.2 Sample packaging and shipping

After the sample labels have been placed on each sample container, the outside of each container will then be wiped clean. If necessary, a strip of clear tape will be applied on the label to ensure the ink does not smear. Each sample will then be packaged and shipped in the following manner:

- Check lid/cap to ensure proper closure to eliminate leaks.
- Check to ensure label is intact and legible.
- Place the labeled sample container in a clear plastic bag and zip bag.
- Ensure the soil and groundwater samples are cool (4-6 degrees Centigrade) before being enclosed in bubble wrap and placed in the shipping container.
- Place the sample in a clean waterproof shipping container (i.e. a cooler).
- Place a temperature blank (40 ml vial filled with water) in the container with the samples.
- Place double-bagged ice on top of the soil and groundwater samples and the temperature

blank.

- Pack the shipping container with noncombustible packing material such as bubble wrap.
- Enclose a copy of the chain-of-custody in a clear plastic bag and tape to the underside of the shipping container lid.
- Tape the cooler shut using strapping tape over the hinges.
- Place custody seals that have been signed and dated across the top and sides of the cooler so that they will be broken at the signature section of the seal when the shipping container is opened.
- Place clear tape over the custody seals to prevent accidental damage during shipment.
- Place return address label clearly on the outside of the shipping container.
- If more than one shipping container is being sent to a laboratory, mark shipping containers as 1 of 2, 2 of 2, etc.
- If a laboratory courier or sample drop-off at the laboratory by Triad personnel is not possible, ship by overnight delivery through a commercial carrier, in accordance with Department of Transportation (DOT) and International Air Transport Association (IATA) regulations.
- Fill out an air bill for the laboratory so as to be received the next calendar day. Address the recipient as “sample custodian.”

2.7.3 Custody seals

Each sample shipping container will be sealed with strapping tape and with at least two custody seals. The custody seals will be placed so that they will be broken at the signature section of the seal when the shipping chest is opened. Each custody seal shall include the following information:

- Date of sample shipment (release of custody).
- Signature of FOM or authorized representative releasing custody.

2.7.4 Chain-of-custody (CoC)

CoC forms will be generated at the end of the work shift for the samples procured during that shift. The CoC form sent to the laboratory shall include the following information:

- Release Signature of FOM or authorized representative.
- Date and time relinquished.
- Project number.
- Sample numbers or identifications.
- Sample matrix.

- Type of sample (grab or composite).
- Analyses requested/turnaround time.
- Preservative information.
- Date and time of sample collection.
- Designation of laboratory QC samples.

Each chain-of-custody form will be distributed as follows:

- The original laboratory copy will be placed into a zip-lock® type bag, which will then be placed into the shipping container to accompany the sample containers to the laboratory.
- One copy to the Triad, PM.

2.7.5 Communicating shipping information

The following information will be communicated to the Laboratory PM for all shipping container shipments:

- Project identification.
- Number and matrices (water, soils, etc.) of samples shipped.
- Type of analysis required.
- Turnaround time.
- Overnight carrier (FedEx or UPS).
- Shipment date.
- Information on completions, changes, delays, continuations, etc.
- Suspected contaminants associated with the samples or site if applicable.

2.7.6 Field Documentation

The FOM will be responsible for maintaining a log book and/or sample sheets that document field activities. Criteria for the documentation include:

- Bound log book.
- Indelible ink used for entries.
- Entries should be factual, detailed, and objective.
- Date and time of all entries.

The FOM will document on a daily basis in the log book on-site personnel, visitors, and activities. Information to be recorded either in the field log book or sample sheets will include as applicable:

- Date and time of entry.

- Purpose of sampling.
- Name, address, and affiliation of personnel performing sampling.
- Name and address of the responsible party, if known.
- Type of sample, e.g.: surface soil, groundwater, etc.
- Description of sample containers.
- Description of samples.
- Chemical components and concentrations, if known.
- Number and size of samples taken.
- Analysis requested.
- Description and location of the sampling point.
- Date and time of sample collection.
- Difficulties experienced in obtaining sample if applicable.
- Visual references, such as maps or photographs of the sampling site. Include the film roll number, the frame number, and a written description of the picture for photographs.
- Field observation, such as weather conditions during sampling periods.
- Whether chain-of-custody forms have been filled out for the samples; chain-of-custody form numbers.
- Global Positioning System (GPS) related information (latitude and longitude) for the site and each sampling location.
- Laboratory name, address, and date shipped.

2.8 Analytical Procedures

The samples will be analyzed for the parameters identified in **Table 3, *Sampling and Analysis Summary***. The samples will be analyzed according to the most current method requirements specified in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition* (SW-846) and *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (January 1999). Sample container and laboratory holding times is summarized in **Table 4, *Field Sample Container Requirements***. Please note that naphthalene is required to be analyzed as both a VOC (8260) and semi-volatile organic compound (SVOC) (8270) for both soil and aqueous samples.

2.9 Quality Control Requirements

Field and sample matrix quality control will be performed as detailed in the *QAPP*, presented as section 3.0 of this report. Field QC samples will be collected during the work to assess sampling

precision as summarized in **Table 5, Field and Matrix QC Samples**.

2.10 Decontamination and Personal Protective Equipment (PPE)

PPE and field sampling equipment shall be decontaminated at the site to prevent or reduce the potential for cross-contamination. In general, the following guidelines will be followed:

- PPE in direct contact with the sample material (e.g. outer gloves) will be replaced between samples and between boring locations.
- Contaminated PPE will be placed into drums or other suitable containers located at the site, and disposed of as IDW. IDW management will be performed as per the approved *FSP*.

Field sampling equipment shall be decontaminated between samples as per the following procedure:

1. Initially remove physical contamination by any or all of the following abrasive cleaning methods: washing, brushing, and air/water blasting.
2. Wash equipment with a non-phosphate detergent.
3. Rinse with tap water.
4. Rinse with distilled/deionized water.
5. Rinse with 10% nitric acid if the sample will be analyzed for metals.
6. Rinse with distilled/deionized water.
7. Use a solvent rinse (e.g. pesticide grade hexane) if the sample will be analyzed for organics.
8. Keep equipment covered from dust or other particulate matter.
9. Air dry the equipment completely.

Selection of the solvent for use in the decontamination process is based on the contamination present at the site. Use of a solvent is required when organic analysis is applicable to the sample being collected. An acid rinse step is required if metals are to be analyzed. If a particular contaminant fraction is not to be analyzed, the nine-step decontamination procedure listed above may be modified for site specificity. The decontamination solvent used should not be among the COPCs at the Site. Suitable solvent rinses are as follows:

SOLVENT

SOLUBLE CONTAMINANTS

- | | |
|---|---|
| 1. Water | <ul style="list-style-type: none">- Petroleum hydrocarbons- Inorganic compounds- Salts- Some organic acids and other polar compounds |
| 2. Dilute Acids | <ul style="list-style-type: none">- Basic (caustic) compounds- Metals- Amines- Hydrazines |
| 3. Dilute Bases (e.g., soap and detergent) | <ul style="list-style-type: none">- Acidic compounds- Phenol- Thiols- Some nitro and sulfonic compounds |
| 4. Organic solvents (e.g., alcohols, ethers, ketones, aromatics, straight-chain alkanes (e.g., hexane)) | <ul style="list-style-type: none">- Nonpolar compounds (e.g., some organic compounds) and- common petroleum products (e.g., fuel, oil, kerosene) |

2.11 Assessment and Oversight

2.11.1 Assessment of field sampling and response actions

The FOM will constantly assess and evaluate the QA system and QC practices during the course of the project. If at any time it becomes apparent that these are not adequate to ensure collection of data of the quality required, the FOM may discontinue the project until sufficient revisions can be made. These revisions may be made in the field at the direction of the FOM and noted by the FOM in the field log book, or may be recommended to the PM or LRS for implementation. The Triad PM and/or LRS will review any such revisions with the WVDEP, OER PM.

2.11.2 Reports to management

If, in the opinion of the FOM, sufficient adjustment cannot be made to QC practices in the field, the FOM will report these findings to the Triad PM and/or LRS and discontinue data collection

under the current QA system. The Triad PM and LRS, in consultation with the FOM and WVDEP, OER PM, will revise the QA system as necessary to ensure that data of adequate quality are obtained.

3.0 QUALITY ASSURANCE PROJECT PLAN (QAPP)

3.1 Introduction

The objectives of the site characterization investigations are to determine the nature and extent of COCs at the Site, obtain validated laboratory data for human health and ecological risk assessment purposes, and to complete characterization of the Site so that a Certificate of Completion (COC) can be obtained for the Site under the West Virginia Voluntary Remediation Program (VRP).

3.2 Data Quality Objectives (DQOs)

Data collected during the field sampling activities will be of a quality such that it can be screened and compared to the following *de minimis* environmental standards and criteria:

- *WV De Minimis Levels, Table 60-3B* (Revised June 2020), residential soil and groundwater.
- WV Groundwater Quality Standards (46CSR12).
- EPA OSWER Vapor Intrusion Screening Level (VISL) Calculator (updated August 2020).

In accordance with the requirements of the VRRRA, field samples will be analyzed by a WVDEP certified laboratory using promulgated USEPA methodology such as those listed in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition* (SW-846) and *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (January 1999).. These methodologies specify Quality Assurance and Quality Control (QA/QC) procedures that are to be implemented by the approved laboratory performing the analyses. The methods also provide guidelines regarding detection capabilities and limits of sample quantification. If for any reason the sample quantitation limit cannot meet the *de minimis* standard, either due to technological limitations of the method or sample matrix interference, the sample method detection limit will be reported.

Due to the data collected during the field sampling activities being screened and compared to the *de minimis* environmental standards and criteria, each individual solid sample result, quantitation limit, and detection limit must be corrected for percent moisture content.

Triad has selected ALS Environmental (ALS), a WVDEP certified environmental laboratory, to perform the soil, groundwater, and vapor sample analyses.

A minimum of 10 percent of the laboratory analytical data will be validated against the guidelines of the analytical methods performed and the *National Functional Guidelines for Organic Superfund Methods Data Review (2017)* and *National Functional Guidelines for Inorganic Superfund Methods Data Review (2017)* as required under the VRP.

3.3 Quality Assurance Level Determination

The content and level of detail required in projects vary according to the intended use of the data. The type and quality of environmental data necessary for their intended use is as defined in the West Virginia *VRRA* legislative rule, as well as the USEPA guidance documents identified above in Section 3.2.

3.4 Data Acquisition

3.4.1 Sampling Rationale

Sampling procedures and locations are discussed in Sections 2.5 and 2.8 of the *Field Sampling Plan*.

3.4.2 Data Validation Process

A Stage 4 data validation review will be performed on a minimum of 10 percent of the data generated. The review will be conducted against the guidance provided in the *National Functional Guidelines for Organic Superfund Methods Data Review (2017)* and *National Functional Guidelines for Inorganic Superfund Methods Data Review (2017)*. Data validation must also meet the requirements of *Guidance for Labelling Validated Laboratory Analytical Data for Superfund Use*. Data validation consists of an analyte and sample specific process to determine the analytical quality of a specific data set as compared to the applicable analytical procedures and methods. The laboratory analytical data will be examined to determine the usability of the analytical results and compliance relative to the method requirements specified in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition (SW-846)*, and the data quality considerations specified in the *Laboratory Quality Manual*. Under no circumstances should the laboratory deviate from SW-846 recommended procedure and quality control unless given written permission by the Quality Assurance Officer (QAO).

3.4.3 Laboratory Quality Control Requirements

3.4.3.1 Detection Limit (DL)

A DL is a measure of the capability of an analytical method to distinguish samples that do not contain a specific analyte from samples that contain low concentrations of the analyte; the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. DLs are analyte, instrument, and matrix specific and may be laboratory dependent. Some of the more commonly used definitions are described below.

Instrument Detection Limit (IDL) - The lowest concentration or mass an instrument can detect above background instrument noise under ideal conditions. IDLs are typically applied to the analysis of metals. Sample preparation is not considered in the determination of an IDL.

Method Detection Limit (MDL) - A statistically derived estimate of the lowest concentration or mass detectable under method conditions at the concentration evaluated. A series of standards at an estimated limit of detection is analyzed multiple times (usually seven), a standard deviation of these seven replicate analyses is determined and the standard deviation is multiplied by the Student's t-distribution statistic at 6 degrees of freedom. Sample preparation is considered in the determination of an MDL.

Practical Quantitation Limit (PQL) - A measure of the lowest limit of detection under the conditions of a particular method. The PQL is often determined by multiplying the MDL by a factor between three and 10.

Reporting Limit (RL), Limit of Quantitation (LOQ), or Sample Quantitation Limit (SQL) - For a target analyte, the RL, LOQ, or SQL (these acronyms are synonymous) is instrument dependent and based on the lowest concentration point of the instrument's current calibration curve. It is also sample specific, as percent moisture, dilution factor, and sample preparation variables are to be included in the calculation of the final RL, LOQ, or SQL.

For this project, each compound of interest will be reported at its appropriate MDL and RL, LOQ, or SQL.

Where technologically feasible, the MDLs must meet the *de minimis* environmental standards and criteria listed in section 3.2 of this QAPP. If the MDLs are not technologically feasible by the laboratory, the laboratory must communicate this prior to sample receipt and reporting.

3.4.3.2 Instrument Calibrations

A calibration is a comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments. Laboratory instrument calibrations typically consist of two types: initial calibration verification (ICV) and continuing calibration verification (CCV).

Initial Calibration Verification (ICV) – ICV procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, a minimum of three to five analyte concentrations are used to establish instrument response over a concentration range. The instrument response over that range is commonly expressed as a correlation coefficient or response factor. Any detected compound whose response is below the calibration range of the instrument must be considered quantitatively estimated, qualified with a “J,” and reported as such to the data user.

Dilution - Any detected compound whose response is above the calibration range of the instrument must be considered quantitatively estimated and reanalyzed at an appropriate dilution to achieve a response within the calibration range of the instrument. If a dilution is not possible, the result is to be reported and qualified with an “E.” If multiple dilutions result in multiple compounds of interest falling within the calibration range of the instrument, all dilutions will be reported by the laboratory to the user of the data.

Continuing Calibration Verification (CCV) - A CCV usually includes measurement of one or more calibration standards. The response is compared to the initial measured instrument response. Continuing calibration is performed at least once per operating shift for laboratory analyses. Where required, the CCV standard must be a separate source (i.e. a different vendor, or if same vendor, a different lot number) from the ICV standard.

Instrument calibration procedures, both ICV and CCV, are to be analyzed according to the requirements of the USEPA approved methodologies performed. Any deviations from the above must be documented and reported to the user of the data.

3.4.3.3 Laboratory Control Samples

Laboratory control samples (LCS) are used to evaluate the accuracy of the laboratory's procedures. A LCS, or blank spike, is prepared and analyzed every one per 20 samples of the same media within the same preparation or analytical batch. Any LCS that does not meet the laboratory established recovery criteria must be prepared and analyzed again, along with any associated samples until acceptable recovery is achieved. Procedures for the preparation and analysis of the LCS are according to the requirements of the USEPA approved methods and must be the same as the samples to which the LCS is compared. Any deviations from the above must be documented by the laboratory and reported to the data user.

3.4.3.4 Method Blank

Method blank (MB) samples are used to evaluate the presence and/or effect of laboratory contamination. A MB must be analyzed every one per 20 samples of the same media within the same preparation or analytical batch. A method blank is prepared to represent the sample matrix as closely as possible and analyzed exactly like the samples for which it is associated. Any method blank that demonstrates contamination (i.e. any positive response of compounds of interest) must be prepared and analyzed again, along with any associated samples that demonstrated the same compounds of interest detected. The only acceptable deviation from this is if the compound sample concentration is greater than ten times the concentration detected in the method blank. Procedures for the MB are analyzed according to the requirements of the USEPA approved methods performed. Any deviations from the above must be documented and reported by the laboratory to the data user, with impacted results qualified with a "B."

3.4.3.5 Internal Standard

An internal standard (IS) is a standard unlikely to be found in environmental samples but has similar properties to the compounds of interest. The IS is added to the sample in a known amount and carried through the entire determination procedure as a reference for calibrating and controlling the precision and bias of the applied analytical method. Any sample for which an IS did not meet the USEPA approved method established recovery and retention time criteria, must be analyzed again. If the IS failure is duplicated, matrix interference is assumed and both results are to be reported by the laboratory to the data user.

3.4.3.6 Surrogate Standard

A surrogate standard of known concentration is added to environmental samples for quality

control purposes. A surrogate standard is unlikely to be found in environmental samples but has similar properties to the compounds of interest. Surrogate standards are intended to monitor recovery differences, problems during the extraction phase of the analysis, and for any potential matrix interferences. Any sample that a surrogate standard did not meet the laboratory established recovery criteria must be prepared and analyzed again. If the surrogate standard failure is duplicated, matrix interference is assumed and both results are to be reported by the laboratory to the data user.

3.4.4 Matrix Quality Control Samples

Matrix spike (MS) and matrix spike duplicate (MSD) samples, performed by the laboratory, are used to evaluate the accuracy and precision of the sample matrix for the organic analyses. A MS, MSD that did not meet the laboratory established accuracy or precision criteria is indicative of possible matrix interference. Only matrix quality control samples selected from media specific to this project are to be reported. Procedures for the MS, MSD are performed according to the same requirements of the USEPA approved methods.

3.4.5 Technical Holding Times

A sample's technical holding time is the period of time a sample may be stored prior to its required preparation and analysis by the laboratory. While exceeding the holding time does not necessarily negate the usability of the analytical results, it causes the qualifying of any data as not meeting the specified acceptance criteria. If the technical holding time of any sample is exceeded it is to be reported by the laboratory to the data user immediately. A summary of the technical holding times is presented in **Table 4, Field Sample Container Requirements**.

3.4.6 Sample Preservation

A sample's preservation requirements are media and analysis specific. Preservation is required at sample collection in order to preserve the contaminants in their original state prior to analysis by the laboratory. The laboratory is required to maintain the preservation of the samples once they are in the custody of the laboratory. If the sample is found to be outside the preservation required, it is to be reported by the laboratory to the data user immediately. A summary of the preservation requirements is presented in **Table 4, Field Sample Container Requirements**.

3.5 Field Quality Control Samples

3.5.1 Blanks

A blank is a sample subjected to the usual analytical or measurement process to establish a zero baseline or background value. It is sometimes used to adjust or correct routine analytical results. It is a sample that is intended to contain none of the analytes or compounds of interest. A blank can be used to detect contamination during sample collection, handling, or shipment. There are many types of blanks, each with a specific purpose including:

Equipment Blank - Monitor for potential contamination from decontamination procedures (refer to section 2.10) of field equipment or from other sources of equipment contamination like oil or other lubricants. To be collected in the field following standard decontamination procedures; one per 20 samples of the same media, analytical request, and equipment used. For example, if 21 soil samples are to be collected using stainless steel scoops for VOCs and PAHs, one would collect a total of two equipment blanks for both VOCs and PAHs following decontamination of the scoop by pouring deionized water over the equipment into the appropriate container(s).

Trip Blank - A clean sample of a matrix that is taken to the sampling site and transported to the laboratory for analysis without having been exposed to sampling procedures; typically submitted for aqueous VOC analysis only. One trip blank is required with each sample shipment.

Temperature Blank - An aqueous sample, typically submitted as water in a 40-ml VOC vial, is transported to the laboratory for temperature verification of the samples. One temperature blank is required with each sample shipment container.

3.5.2 Duplicate Samples

Duplicate samples are two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method, including sampling and analysis. There are several different types of duplicate samples that provide information on the precision of specific types of environmental data operations:

Field Duplicates - Independent samples that are collected as close as possible to the same point in time and space. They are two separate samples taken from the same source, stored in separate containers and analyzed independently. These types of duplicates are useful in

characterizing the precision of the sampling process.

Split Samples - Two or more representative portions taken from one sample in the field or in the laboratory and analyzed by different analysts or laboratories. Split samples are quality control (QC) samples that are used to assess analytical variability and comparability.

3.6 Assessments and Oversight

3.6.1 Performance and System Audits

3.6.1.1 Technical Performance Audits

Qualified Triad personnel will perform technical performance monitoring on an ongoing basis during the project, as field data are generated, reduced, and analyzed. These monitoring activities serve as a performance audit and are essentially ongoing due to the length of the project schedule. All numerical analyses such as manual calculations, mapping, and computer modeling, are documented and will be the subject of performance audits in the form of quality control review, numerical analysis, and peer review.

3.6.1.2 Laboratory System Audits

The WVDEP commercial laboratory certification program performs external system audits of the laboratory on a pre-defined basis. The system audit may consist of review of the following:

- Laboratory quality assurance manual
- Instrumentation and/or analytical systems for the analyses of interest
- Sample preparation methodologies
- Laboratory sample handling
- Sample receiving and custody procedures
- Data reduction and reporting procedures
- Data validation procedures
- Instrument calibration procedures
- Quality control program
- Other laboratory procedures that may impact laboratory analyses

3.6.2 Corrective Action

3.6.2.1 Field Corrective Action

The initial responsibility for monitoring the quality of field measurements and observation lies with the field personnel. The FOM is responsible for verifying that all QC procedures are being

followed. This requires that the FOM assess the correctness of field methods and their ability to meet the QA objectives. If a problem occurs that may jeopardize the integrity of the project or cause some specific QA objective to not be met, the field project personnel will report it to the FOM. The FOM will then report all such suspect problems to the Triad PM. The Triad PM documents the problem, consults with the QAO, LRS, and/or WVDEP, OER PM as applicable, develops a corrective action, and documents the results. The FOM will initiate the corrective action and identify and direct the appropriate personnel to implement the corrective action.

3.6.2.2 Laboratory Corrective Action

The initial responsibility for monitoring the quality of an analytical system lies with the analyst. In this pursuit, the analyst must verify that all standard operating procedures and quality control procedures are followed and that the results of analysis of instrument calibration and quality control samples are within acceptance criteria.

If his or her assessment reveals that any of the quality control acceptance criteria were not met, he or she immediately assesses the analytical system to correct the problem. The deficiency is reported to the appropriate supervisor, who notifies the laboratory QC Officer. Specific corrective actions to exceed acceptance criteria for the laboratory quality control checks are defined in the laboratory QA program.

3.6.3 Reports to Management

Reports to management encompass both routine reports and special reports, including written reports and memoranda documenting data assessment activities, results of data validations, audits, nonconformance, and corrective actions. The management hierarchy receiving some or all of the reports includes appropriate personnel from Triad such as the LRS, QAO, and PM and the WVDEP, OER PM.

3.7 Data Usability

The following sections describe the processes used to generate and check data and produce reports for both field sampling and laboratory analysis data. As discussed previously in the *QAPP*, ten percent of the laboratory analytical data will be validated.

3.7.1 Data Reduction

Data will be reduced either manually on calculation sheets or by computer on formatted printouts. The methodology and procedures implemented by Triad to determine the accuracy of data reduction are described in this section. The following responsibilities are delegated in the data reduction process:

- Technical personnel document and review their own work and are accountable for its correctness.
- Major calculations receive both a method and an arithmetic check by an independent checker. The checker is accountable for the correctness of the checking process.
- The QAO is responsible for ensuring that data reduction is performed in a manner that produced quality data through review and approval of calculations.

Hand calculations are to be legibly recorded on calculation sheets and in logical progression with sufficient descriptions. Major calculations are checked by an engineer or scientist of professional level equal to or higher than that of the originator. After completing the check, the checker will initial and date the calculation sheet immediately below the originator. Both the originator and checker are responsible for the correctness of calculations. A calculation sheet will contain the following, at a minimum:

- Project title and brief description of the task.
- Date performed.
- Initials of person who performed the calculation.
- Basis for calculation.
- Assumptions made or inherent in the calculation.
- Complete reference for each source of input data.
- Methods used for calculations.
- Results of calculations, clearly annotated.

Computer analyses include the use of models, programs, and data management systems. For published software with existing documentation, test case runs are performed periodically to verify that the software is performing correctly. Both systematic and random-error analyses are investigated and appropriate corrective action measures are taken.

3.7.2 Data Validation and Verification

The process through which data is accepted or rejected is based on specific data verification and validation criteria. These criteria are discussed below for both field and laboratory data. Personnel experienced with sampling and analytical protocols and procedures will perform the data validation in accordance with the established criteria and the intended use of the data. Data validation must also meet the requirements of *Guidance for Labelling Externally Validated Laboratory Analytical Data for Superfund Use*.

Field data verification and validation are used to eliminate or limit the use of field data that are not collected or documented in accordance with specified protocols outlined here or in the *FSP*. In some instances, the field data are used only for approximation purposes. In all cases, evaluations of field data are performed on two separate levels. First, all field data will be verified at the time of collection by following the QC checks outlined throughout the *FSP* and *QAPP*. Second, field data will be validated by the PM, or designee, who will review the field data documentation to identify discrepancies or unclear entries. Field data documentation will be validated against the following criteria, as appropriate:

- Sample location and adherence to the *FSP*.
- Adherence to procedures and protocols.
- Field instrumentation and calibration.
- Sample collection protocol.
- Sample volume.
- Sample preservation.
- Equipment QC samples collected and submitted.
- Field duplicate QC samples collected and submitted.
- Sample labels protocols.
- Sample documentation protocols.
- Chain-of-custody protocol.
- Sample shipment.

Under the review procedures, the following data validation criteria for the requested analyses are to be prepared by the laboratory for potential validation in an organized, legible, and tabulated manner:

- Sample paperwork, both preparatory and analysis.
- Chromatograms.
- Retention times.
- Peak integration and labels.
- Mass spectral library comparisons.
- ICV.
- CCV.
- LCS.
- Method Blank/Instrument Blank.
- MS/MSD/MD.
- Holding time.
- Surrogate recovery
- Internal standards recovery and retention time.
- Dilution factor.
- Moisture content.
- Confirmation Data.

3.7.3 Data Quality Assessment

Data quality assessments are prepared to document the overall quality of data collected in terms of the established DQOs and the effectiveness of the data collected and generation processes. The data assessment parameters calculated from the results of the field measurements and laboratory analyses will be reviewed to ensure that all data used in subsequent evaluations were scientifically valid, of known and documented quality, and, where appropriate, legally defensible. In addition, the performance of the overall measurement system will be evaluated in terms of the completeness of the project plans, effectiveness of field measurement and data collection procedures, and relevance of laboratory analytical methods used to generate data as planned. Finally, the goal of the data quality assessment is to present the findings in terms of data usability.

Generally, to achieve an acceptable level of confidence in the decisions that were made from the data, the degree to which the total error in the results derived from data collected and generated will be controlled. The methods and procedures used to implement and accomplish these QC objectives are as follows:

- Assess the quality of data values measured and generated to ensure that all were scientifically valid, of known and documented quality, and, where appropriate, legally

defensible. This is accomplished by assessing actual data values generated or measured against the established DQOs for parameters such as precision, accuracy, completeness, representativeness, and comparability, and by testing generated data against acceptance criteria established for these parameters.

The sensitivity is defined by the method detection limits (MDLs). Unless otherwise specified in the project-specific work plan, the analytical results are reported against the laboratory MDLs.

The achievement of MDLs depends on instrument sensitivity and matrix effects. Therefore, it is important to monitor the instrument sensitivity to ensure data quality through constant checks on instrument performance. The method detection limit is defined as the minimum concentration of a substance that can be measured with 99 percent confidence that the concentration is above zero. The MDL is calculated as follows:

$$\text{MDL} = s * t_{(n-1, 1-a=0.99)}$$

Where:

S = standard deviation of replicate analyses

t_(n-1, 1-a=0.99) = student's t-value for a one-sided 99% confidence level and standard deviation estimate with n-1 degrees of freedom

- Achieve an acceptable level of confidence in the decisions that were to be made from measurements and data by controlling the degree of total error permitted in the data through QC checks. Data that failed the QC checks or did not fall within the acceptance criteria established will be rejected from further use or qualified for limited use.

The major components of a data quality assessment are presented below and show the logical progression of the assessment leading to determination of data usability:

- **Data Validation Summary.** Summarizes the individual data validation reports for all sample delivery groups by analytical method. Systematic problems, data generation trends, general conditions of the data, and reasons for data qualification are presented.

- **Data Evaluation Procedures.** Describes the procedures used to further qualify data caused by such factors as dilution, reanalysis, matrix effect and duplicate analysis of samples. Examples of the decision logic are provided to illustrate the methods by which qualifiers are applied.
- **QC Sample Evaluation.** Evaluates QC samples such as field blanks, trip blanks, equipment rinsates, field replicates, and laboratory control samples to assess the quality of the field activities and laboratory procedures.
- **Assessment of Data Quality Objectives.** Assesses the quality of data measured and generated in terms of accuracy, precision, representativeness, and completeness through the examination of laboratory and field control samples in relation to objectives established.
- **Summary of Data Usability.** Summarizes the usability of data, based on the assessment of data conducted during the previous four steps. Sample results for each analytical method will be qualified as acceptable, rejected, estimated, biased high, or biased low.

3.7.4 Data Reporting

Field measurements and observations will be recorded in the field log book maintained by the FOM. Laboratory data is reported in standard formats that identify the specific sample, date, parameter, parameter value, detection limit, and various analytical parameters. Both field and laboratory data will be combined and summarized as appropriate in tables, graphs, and other formats that are appropriate to the type of data and conveyed information, to support the findings of the data collection program. In all cases, data will be clearly tabulated and presented in a consistent manner to support comparison of common sets of data. Finally, data will be presented so as to logically lead to and substantiate the conclusions and recommendations provided by the final report.

3.8 Reconciliation with Data Quality Objectives

All data generated for the project will be assessed for accuracy, precision, completeness, representativeness, and comparability. The methods for calculating accuracy, precision, and completeness, and for evaluating representativeness and comparability are summarized in USEPA guidance documents (EPA 1990a). Generally, data that does not meet the established acceptance criteria may be probable cause for re-sampling and re-analysis. However, in some cases, data that did not meet acceptance criteria are usable with specified limitations. Data that

are marked as usable with limitations are included in the project reports, but will be clearly marked as having limited usability.

3.8.1 Qualitative Quality Assurance Objectives

3.8.1.1 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that pertains to the proper design of the sampling program. The representativeness criterion is best satisfied by making certain that sampling locations are selected properly and a sufficient number of samples are collected.

This parameter is addressed in the project-specific work plans by collecting samples at locations specified in such work plans, and by following the procedures for sample collection/analyses that are described in the *FSP*. Additionally, analytical programs utilize procedures that are consistent with USEPA approved analytical methodology. QA/QC parameters that are utilized to aid representativeness of environmental samples are technical holding time and sample preservation. The technical holding time and sample preservation requirements, presented in **Table 4, *Field Sample Container Requirements***, are used in accordance with this *QAPP* to ensure that the environmental samples submitted to the laboratories remained representative of site conditions.

3.8.1.2 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. This goal is achieved through the use of the standardized techniques for sample collection and analysis presented in the *FSP*. The USEPA *Methods of Chemical Analysis for Water and Waste* or *Test Methods for Evaluating Solid Waste (SW846)* analytical methods are updated on occasion by the USEPA to benefit from recent technological advancements in analytical chemistry and instrumentation. In most cases, the method upgrades include the incorporation of new technology that improves the sensitivity and stability of the instrumentation or allows the laboratory to increase throughput without hindering accuracy and precision. The overall goal for analytical programs conducted in accordance with this *QAPP* is to provide comparable analytical data over time through the use of approved analytical techniques that remain consistent in their general approach and continued use of the basic analytical

techniques (i.e., sample extraction/ preparation, instrument calibration, QA/QC procedures, etc.). Through this use of consistent base analytical procedures and by requiring that updated procedures meet the QA/QC criteria specified in this *QAPP*, the analytical data from past, present, and future sampling events are comparable to allow for qualitative and quantitative assessment of site conditions.

3.8.2 Quantitative Quality Assurance Objectives

3.8.2.1 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event or investigation compared to the total data planned. Completeness of laboratory tests are expected to be 90 percent (90%) or better for investigations conducted in accordance with this *QAPP*. The reasons for any variances from 100 percent completeness will be identified and addressed, as required, in the appropriate data validation report. Completeness is calculated as follows:

$$\text{Completeness (\%)} = \frac{V}{P} \times 100$$

Where:

V = number of valid measurements

P = number of planned measurements

3.8.2.2 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. For investigations conducted in accordance with this *QAPP*, precision is defined as the relative percent difference (RPD) or the relative standard deviation (RSD) between duplicate sample results. The lower these values are, the more precise that data. These quantities are defined as follows:

$$\text{RPD (\%)} = 100 \times \frac{(S - D)}{(S + D)/2}$$

or:

$$\text{RSD (\%)} = 100 \times \frac{2(S - D)}{(S + D)}$$

$$\sqrt{2} \quad (S + D)$$

Where:

S = Analyte or compound concentration in a sample

D = Analyte or compound concentration in a duplicate sample

Or when there are more than two measurements:

$$\text{RSD (\%)} = 100 \frac{(s)}{\bar{0}}$$

Where:

s = Standard deviation of replicate measurements

$\bar{0}$ = Mean of replicate measurements

The duplicate samples utilized to evaluate precision include laboratory MD, MS, MSD, and field duplicates samples. The goal is to maintain a level of analytical precision consistent with the objectives of the sampling event. To maximize precision, consistent sampling and analytical procedures are to be followed as presented in the *FSP*. Control limits for field duplicate sample analyses are 40%. Control limits for aqueous samples should be no more than 30% and control limits for soil samples should not exceed 50%. Control limits for laboratory MS, MSD, and MD sample analyses are determined by the laboratory's internal QA plan (refer to **Appendix A, ALS Environmental Quality Assurance Manual**).

3.8.2.3 Accuracy

Accuracy measures the bias in an analytical system, or the degree of agreement of a measurement with a known reference value. This measure is defined as the difference between the average of reported values and the actual value. The project goal for Accuracy is approximately 20-25%. Accuracy is expressed as the percent bias for standard reference samples. The closer this value is to zero, the more accurate the data. This quantity is defined as follows:

$$\text{Bias (\%)} = \frac{(MC - KC)}{KC} \times 100$$

Where:

KC = Known analyte or compound (i.e. spike) concentration

MC = Measured analyte or compound concentration

In cases where accuracy is determined from spiked samples, such as the LCS, accuracy is expressed as the percent recovery. The closer the value is to 100, the more accurate the data. Recovery is calculated as follows:

$$\text{Recovery (\%)} = \frac{\text{MC}}{\text{SC}} \times 100$$

Where:

SC = Known analyte or compound (i.e. spike) concentration

MC = Measured analyte or compound concentration

Matrix spike percent recovery is calculated as follows:

$$\text{Recovery (\%)} = \frac{\text{MC} - \text{USC}}{\text{KC}} \times 100$$

Where:

SC = Known analyte or compound (i.e. spike) concentration

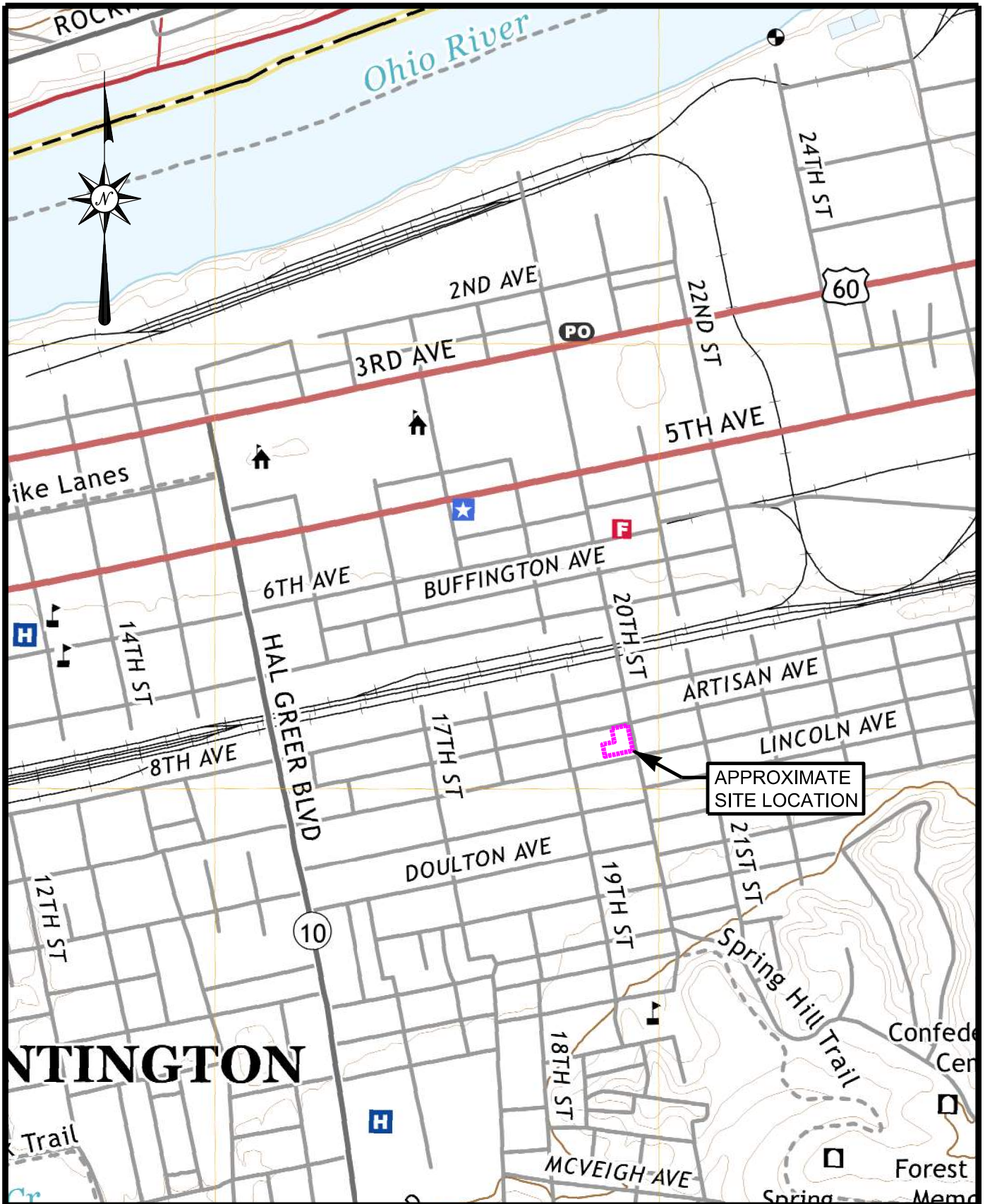
MC = Measured analyte or compound concentration

USC = Unspiked sample concentration

For investigations conducted in accordance with this *QAPP*, accuracy is defined as the percent recovery of QA/QC samples that are spiked with a known concentration of an analyte of interest. The QA/QC samples used to evaluate analytical accuracy included instrument calibration, internal standards, ICP serial dilution analysis, laboratory control samples, MS/MSD samples, and surrogate compound recoveries. Control limits for instrument calibration, internal standards, ICP serial dilution analysis, laboratory control samples, MS/MSD samples, and surrogate compound recoveries are provided in the applicable USEPA approved methods or determined by the laboratory's internal QA plan.

FIGURES

- Figure 1, Site Location Map
- Figure 2, Conceptual Site Model
- Figure 3, Sample Location Map
- Figure 4, Aerial Photograph



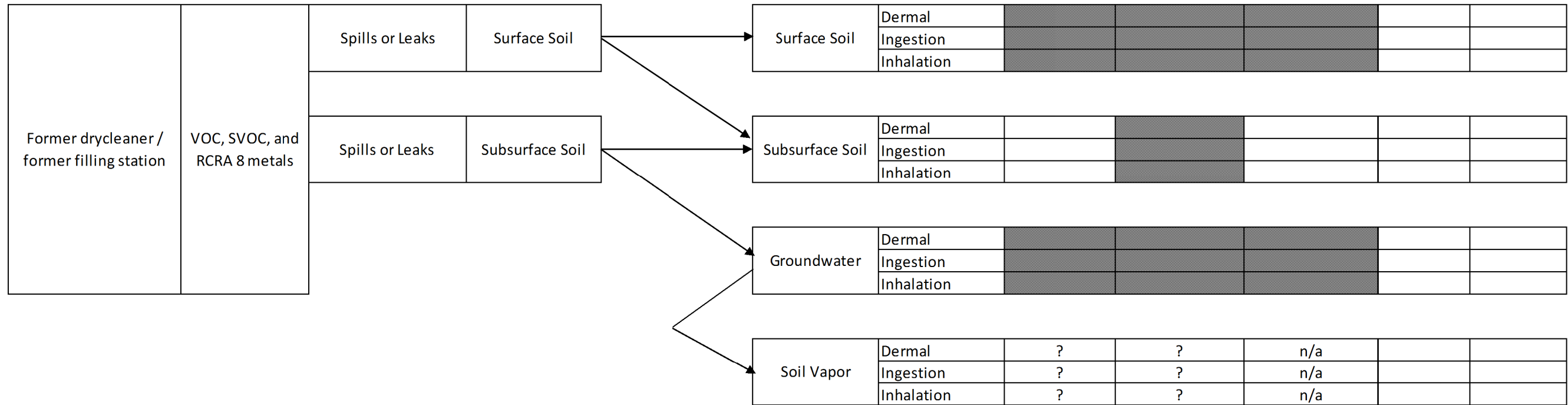
CADD FILE: Figure 1_site location.dgn	
DRAWN BY: MAD	CHECKED BY: SLJ
DATE: 09-27-2021	SCALE: 1" = 1000'

ARTISTIC CLEANERS
821 20th STREET
HUNTINGTON, CABELL COUNTY, WEST VIRGINIA
 Huntington, WV-OH USGS Quadrangle (2019)
SITE LOCATION MAP

PROJECT NO: 04-21-0199 FIGURE 1


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 SCOTT DEPOT, WV

Contaminant Source	Contaminants of Potential Concern (COPCs)	Release Mechanism	Impacted Media	Migration Pathways	Exposure Media	Exposure Routes	Human Receptors			Ecological Receptors	
							Site Worker	Construction & Utility Workers	Site Visitor/Trespasser	Terrestrial	Aquatic



LEGEND:

	Pathway is not complete: No data required.
n/a	Pathway is or may be complete, but insignificant or unlikely: No data required.
?	Pathway is or may be complete, and significance unknown.
■	Pathway is complete and risk is significant.

NOTES:

1. Exposure routes shown assume implementation of LUC prohibiting groundwater withdrawal.

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CADD FILE:
Figure 2_conceptual site model.dgn

PROJECT NO:
04-21-0199

DRAWN BY: MAD
CHECKED BY: SLJ
DATE: 10-21-2021
SCALE: 1" = 30'

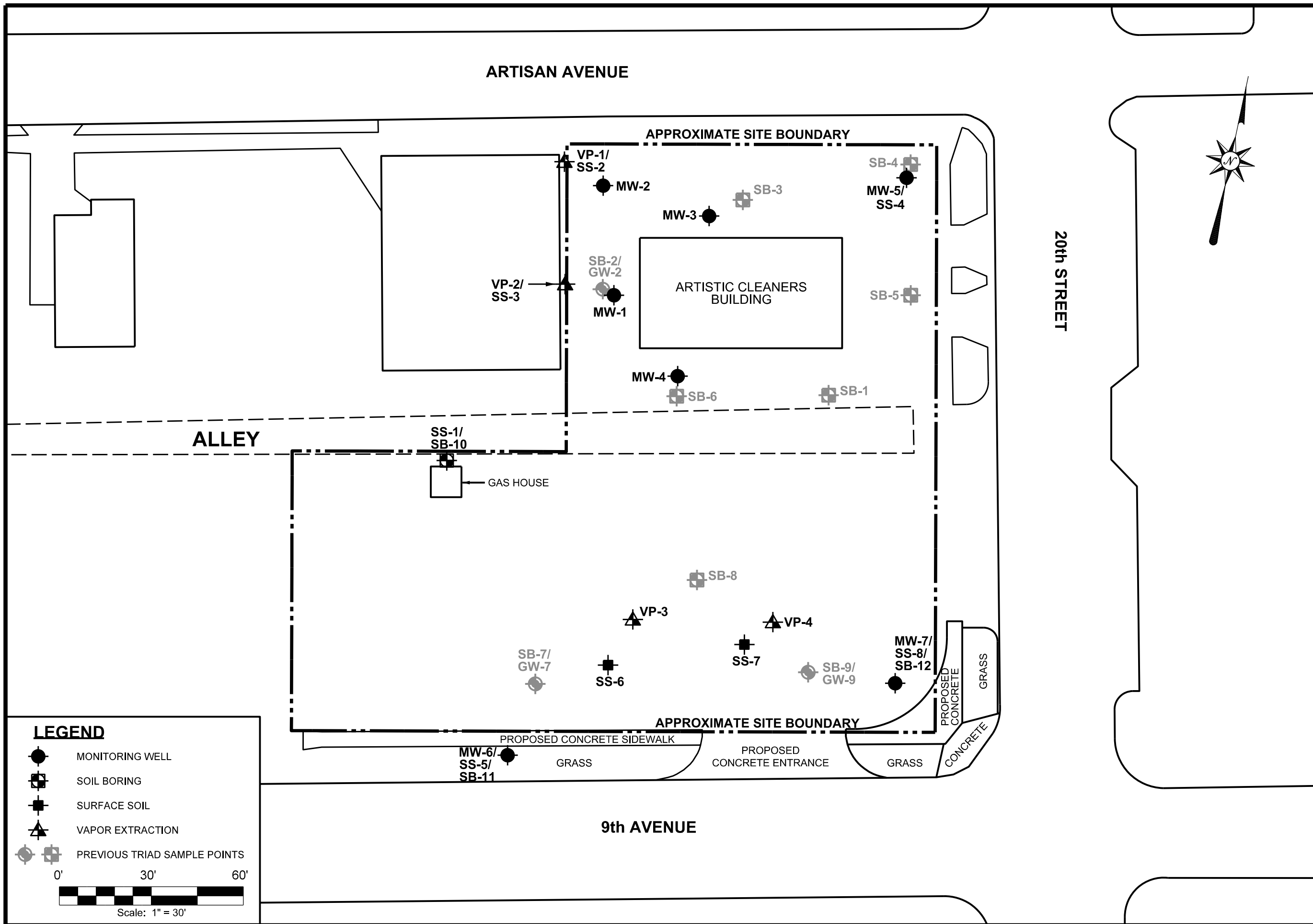
ARTISTIC CLEANERS
821 20th STREET
HUNTINGTON, CABELL COUNTY, WEST VIRGINIA

CONCEPTUAL SITE MODEL



FIGURE
2

PROJECT NO.: 04-21-0199



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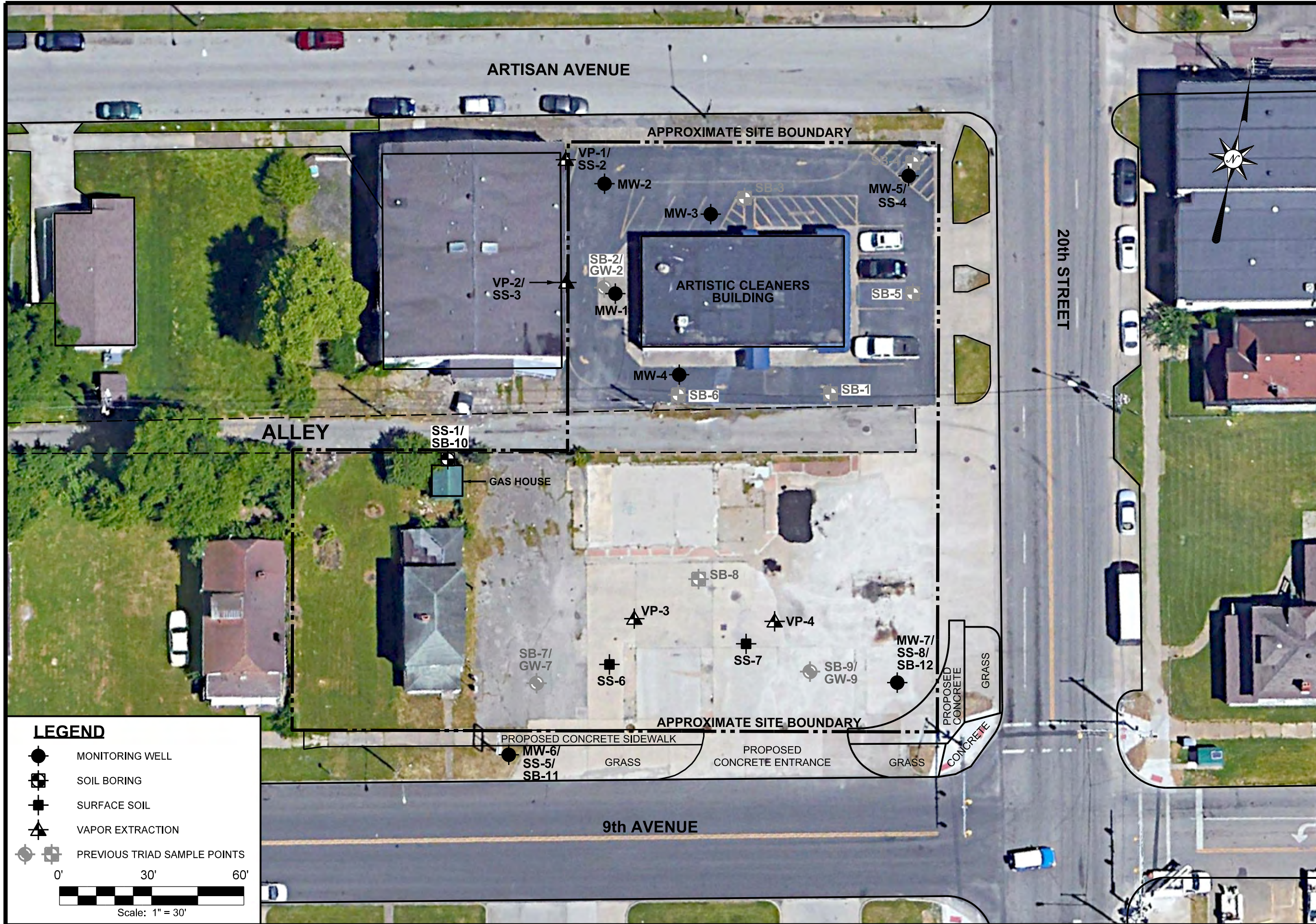
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		DATE: 09-27-2021		

ARTISTIC CLEANERS
 821 20th STREET
 HUNTINGTON, CABELL COUNTY, WEST VIRGINIA

SAMPLE LOCATION PLAN



FIGURE
3
 PROJECT NO.: 04-21-0199



LEGEND

- MONITORING WELL
- SOIL BORING
- SURFACE SOIL
- VAPOR EXTRACTION
- PREVIOUS TRIAD SAMPLE POINTS



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CADD FILE: Figure 4_aerial photo.dgn	PROJECT NO: 04-21-0199	DRAWN BY: MAD	CHECKED BY: SLJ	DATE: 09-27-2021	SCALE: 1" = 30'
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ARTISTIC CLEANERS
 821 20th STREET
 HUNTINGTON, CABELL COUNTY, WEST VIRGINIA

SAMPLE LOCATION PLAN

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FIGURE
4
 PROJECT NO.: 04-21-0199

TABLES

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- Table 2, Measurement Quality Indicators
- Table 3, Sampling and Analysis Summary
- Table 4, Field Sample Container Requirements
- Table 5, Field and Matrix QC Samples
- Table 6, Sampling and Analytical Methods Requirements

**Table 1, Project Timeline
 Artistic Cleaners
 821 20th Street
 Huntington, Cabell County, WV**

Activities	Dates	
	Activity Start Date	Activity End Date
Preparation of SAWP	9/13/2021	9/30/2021
WVDEP Review of SAWP	9/30/2021	10/20/2021
Revisions to SAWP (if required)	10/21/2021	10/22/2021
Conduct field investigation	10/25/2021	11/4/2021
Laboratory Analytical Testing	11/4/2021	11/18/2021
Perform Data Validation	11/18/2021	12/18/2021
Preparation of Draft Site Assessment Report	11/18/2021	12/18/2021
WVDEP Review of Draft Site Assessment Rep	12/18/2021	1/18/2022
Revisions to Site Assessment Report	1/19/2022	1/31/2022

**Table 2, Measurement Quality Indicators
Artistic Cleaners
821 20th Street
Huntington, Cabell County, WV**

Compound	Action Limit			Precision	Accuracy	Completeness
	Residential Soil (mg/kg)	Groundwater (ug/L)	Residential VISL Target Groundwater Concentration (ug/L)			
Volatile Organic Compounds (VOC)						
1,1,1-Trichloroethane	640	200	12,400	40% *	Refer to Appendix C	>= 90%
1,1,2,2-Tetrachloroethane	0.64	0.076	6.59	40% *	Refer to Appendix C	>= 90%
1,1,2-trichloro-1,2,2-trifluoroethane	910	10,000	380	40% *	Refer to Appendix C	>= 90%
1,1,2-Trichloroethane	1.2	5	9.82	40% *	Refer to Appendix C	>= 90%
1,1-Dichloroethane	3.8	2.8	12.4	40% *	Refer to Appendix C	>= 90%
1,1-Dichloroethene	240	7	297	40% *	Refer to Appendix C	>= 90%
1,2,3-Trichlorobenzene	NV	NV	NV	40% *	Refer to Appendix C	>= 90%
1,2,4-Trichlorobenzene	24	70	87.8	40% *	Refer to Appendix C	>= 90%
1,2-Dibromo-3-Chloropropane	0.0057	0.2	0.0648	40% *	Refer to Appendix C	>= 90%
1,2-Dibromoethane	0.039	0.05	0.332	40% *	Refer to Appendix C	>= 90%
1,2-Dichlorobenzene	380	600	5710	40% *	Refer to Appendix C	>= 90%
1,2-Dichloroethane	0.5	5	3.92	40% *	Refer to Appendix C	>= 90%
1,2-Dichloropropane	2.7	5	11.6	40% *	Refer to Appendix C	>= 90%
1,3-Dichlorobenzene	NV	NV	NV	40% *	Refer to Appendix C	>= 90%
1,4-Dichlorobenzene	2.8	75	5.57	40% *	Refer to Appendix C	>= 90%
2-Butanone	28,000	5,600	3890000	40% *	Refer to Appendix C	>= 90%
2-Hexanone	NV	NV	16,500	40% *	Refer to Appendix C	>= 90%
4-Methyl-2-Pentanone	3,400	1,200	1060000	40% *	Refer to Appendix C	>= 90%
Acetone	61,000	14,000	36800000	40% *	Refer to Appendix C	>= 90%
Benzene	1.2	5	2.7	40% *	Refer to Appendix C	>= 90%
Bromochloromethane	NV	NV	1,160	40% *	Refer to Appendix C	>= 90%
Bromodichloromethane	0.31	80.00	1.55	40% *	Refer to Appendix C	>= 90%
Bromoform	20	80	243	40% *	Refer to Appendix C	>= 90%
Bromomethane	7.3	7.5	24.8	40% *	Refer to Appendix C	>= 90%
Carbon Disulfide	740	810	1910	40% *	Refer to Appendix C	>= 90%
Carbon Tetrachloride	0.7	5	1.33	40% *	Refer to Appendix C	>= 90%
Chlorobenzene	290	100	786	40% *	Refer to Appendix C	>= 90%

**Table 2, Measurement Quality Indicators
Artistic Cleaners
821 20th Street
Huntington, Cabell County, WV**

Compound	Action Limit			Precision	Accuracy	Completeness
	Residential Soil (mg/kg)	Groundwater (ug/L)	Residential VISL Target Groundwater Concentration (ug/L)			
Chloroethane	2,100	21,000	NV	40% *	Refer to Appendix C	>= 90%
Chloroform	0.34	80	1	40% *	Refer to Appendix C	>= 90%
Chloromethane	120	190	349	40% *	Refer to Appendix C	>= 90%
cis-1,2-Dichloroethene	17	70	NA	40% *	Refer to Appendix C	>= 90%
cis-1,3-Dichloropropene	1.9	0.47	NA	40% *	Refer to Appendix C	>= 90%
Cyclohexane	120	1,400	1720	40% *	Refer to Appendix C	>= 90%
Dibromochloromethane	8.3	80	NV	40% *	Refer to Appendix C	>= 90%
Dichlorodifluoromethane	94	200	9.63	40% *	Refer to Appendix C	>= 90%
Ethylbenzene	6.2	700	6.85	40% *	Refer to Appendix C	>= 90%
Isopropylbenzene	270	450	2080	40% *	Refer to Appendix C	>= 90%
m,p-Xylene	NV	NV	703	40% *	Refer to Appendix C	>= 90%
Methyl Acetate	23,000	5,300	NV	40% *	Refer to Appendix C	>= 90%
Methylcyclohexane	NV	NV	NV	40% *	Refer to Appendix C	>= 90%
Methylene chloride	58	5	1,200	40% *	Refer to Appendix C	>= 90%
Methyl-Tert-Butyl Ether	50	14	722	40% *	Refer to Appendix C	>= 90%
Naphthalene	2.4	0.12	10.9	40% *	Refer to Appendix C	>= 90%
o-Xylene	NV	NV	985	40% *	Refer to Appendix C	>= 90%
Styrene (Monomer)	870	100	19,400	40% *	Refer to Appendix C	>= 90%
Tetrachloroethene	25	5	28.1	40% *	Refer to Appendix C	>= 90%
Toluene	820	1,000	35,200	40% *	Refer to Appendix C	>= 90%
Total Xylenes	260	10,000	759	40% *	Refer to Appendix C	>= 90%
trans-1,2-Dichloroethene	75	100	NV	40% *	Refer to Appendix C	>= 90%
trans-1,3-Dichloropropene	1.9	0.47	NV	40% *	Refer to Appendix C	>= 90%
Trichloroethene	1	5	2.06	40% *	Refer to Appendix C	>= 90%
Trichlorofluoromethane	790	1,100	NV	40% *	Refer to Appendix C	>= 90%
Vinyl Chloride	0.061	2	0.197	40% *	Refer to Appendix C	>= 90%
Polynuclear Aromatic Hydrocarbons (PAH)						
Acenaphthene	4,100	240	NV	40% *	Refer to Appendix C	>= 90%

**Table 2, Measurement Quality Indicators
Artistic Cleaners
821 20th Street
Huntington, Cabell County, WV**

Compound	Action Limit			Precision	Accuracy	Completeness
	Residential Soil (mg/kg)	Groundwater (ug/L)	Residential VISL Target Groundwater Concentration (ug/L)			
Acenaphthylene	4,200	240	NV	40% *	Refer to Appendix C	>= 90%
Anthracene	23,000	1,800	NV	40% *	Refer to Appendix C	>= 90%
Benzo(a)Anthracene	1.5	0.03	176	40% *	Refer to Appendix C	>= 90%
Benzo(a)pyrene	0.11	0.2	NV	40% *	Refer to Appendix C	>= 90%
Benzo(b)fluoranthene	1.1	0.25	NV	40% *	Refer to Appendix C	>= 90%
Benzo(g,h,i)perylene	1,800	600	NV	40% *	Refer to Appendix C	>= 90%
Benzo(k)Fluoranthene	11	2.5	NV	40% *	Refer to Appendix C	>= 90%
Chrysene	110	25	NV	40% *	Refer to Appendix C	>= 90%
Dibenzo(a,h)Anthracene	0.11	0.025	NV	40% *	Refer to Appendix C	>= 90%
Fluoranthene	2,400	800	NV	40% *	Refer to Appendix C	>= 90%
Fluorene	2,900	150	NV	40% *	Refer to Appendix C	>= 90%
Indeno(1,2,3-cd)Pyrene	1.1	0.25	NV	40% *	Refer to Appendix C	>= 90%
Naphthalene	2.4	0.12	10.9	40% *	Refer to Appendix C	>= 90%
Phenanthrene	23,000	1,700	NV	40% *	Refer to Appendix C	>= 90%
Pyrene	2,300	79	NV	40% *	Refer to Appendix C	>= 90%
RCRA 8 Metals						
Arsenic	0.68	10	NV	40% *	Refer to Appendix C	>= 90%
Barium	15,000	2,000	NV	40% *	Refer to Appendix C	>= 90%
Cadmium	37	5	NV	40% *	Refer to Appendix C	>= 90%
Chromium III	120,000	22,000	NV	40% *	Refer to Appendix C	>= 90%
Lead	400	15	NV	40% *	Refer to Appendix C	>= 90%
Mercury, Total	3.1	2	NV	40% *	Refer to Appendix C	>= 90%
Selenium	390	50	NV	40% *	Refer to Appendix C	>= 90%
Silver	390	94	NV	40% *	Refer to Appendix C	>= 90%

West Virginia Voluntary Remediation Program De Minimis Table August 2021.

Residential VISL, 13°C, TCR 10⁻⁶, HQ-1

NA No value available

* If not otherwise specified in Appendix A, Quality Assurance Manual.

Table 3, Sampling and Analysis Summary
Artistic Cleaners
821 20th Street
Huntington, Cabell County, WV

Environmental Media	VOC	PAH	RCRA 8 Metals
Surface Soil			
Northern side of the gas house, south of the alley	1	1	1
Northwestern corner of the Site	1	1	1
Western side of the former dry-cleaning facility	1	1	1
Northeastern portion of the Site	1	1	1
Southern portion of the Site	1	1	1
Former gas station portion of the Site	3	3	3
Subsurface Soil			
Northern corner of the gas house, in the alley	1	1	1
Southern portion of the Site	1	1	1
Former gas station portion of the Site	1	1	1
Groundwater			
Existing groundwater monitoring wells	4	4	4
Northeastern portion of the Site	1	1	1
Southern portion of the Site	1	1	1
Former gas station portion of the Site.	1	1	1
Vapor			
Northwestern corner of the Site	1	0	0
Western side of the former dry-cleaning facility	1	0	0
Former gas station portion of the Site	2	0	0
Total	22	18	18

Table 3, Sampling and Analysis Summary (continued)
Artistic Cleaners
821 20th Street
Huntington, Cabell County, West Virginia

Environmental Media	Number of Samples Collected and Analyses		
	VOC	PAH	RCRA 8 Metals
Soil			
surface soil	8	8	8
subsurface soil	3	3	3
Subtotal	11	11	11
Aqueous			
groundwater	7	7	7
Subtotal	7	7	7
Vapor			
vapor	4	0	0
Subtotal	4	0	0
Total	22	18	18

**Table 4, Field and Matrix QC Samples
Artistic Cleaners
821 20th Street
Huntington, Cabell County, WV**

QC Sample	Number of Samples						Total QC Samples Collected
	Field Samples			QC Samples			
	Aqueous	Soil	Vapor	Aqueous	Soil	Vapor	
Field QC Samples:							
a.) Field Duplicate							
VOC	7	11	4	1	1	1	3
PAH	7	11	0	1	1	0	2
Metals	7	11	0	1	1	0	2
b.) Equipment Blank (Rinsate)							
Direct-push equipment	N/A	8	N/A	1	N/A	N/A	1
c.) Trip Blank							
VOC	7	11	4	3	0	0	3
Matrix QC Samples							
a.) Matrix Spike and Matrix Spike Duplicate (MS/MSD)							
VOC	7	11	4	1	1	1	3
PAH	7	11	0	1	1	0	2
b.) Matrix Spike and Matrix Duplicate (MS/DUP)							
Metals	7	11	0	1	1	0	2
TOTAL							18

Notes:

Number of field QC samples to be collected based on the following:

Field duplicate based on 1 QC sample per 20 field samples per environmental media.

Equipment blank based on 1 QC sample per 20 field samples per environmental media.

1 sample container containing water will be placed in each cooler as a temperature blank.

1 Trip Blank sample will be placed in each cooler containing VOCs (it is estimated that there will be one VOC cooler per day of sampling)

Table 5, Sampling and Analytical Method Requirements
Artistic Cleaners
821 20th Street
Huntington, Cabell County, West Virginia

Matrix	Parameter	Number of Samples	Sampling Procedure	Sample Preparation/Extraction Method Number	Analytical Method Number
Soil	VOC	11	In accordance with the WVDEP Field Activities Standard Operating Procedures (dated March 4, 2021) and included in Appendix D.	5035	8260B
Aqueous		7		5030B	8260B
Vapor		4		TO-15	TO-15
Soil	PAH	11		3550B	8270C
Aqueous		7		3510C	8270C/SIM
Soil	Metals	11		3051A/6010/7471	6010B/7471A
Aqueous	Metals - Dissolved	7		3010A/6010/7470	6010B/7471A

**Table 6, Sample Containers, Preservation and Holding Times
Artistic Cleaners
821 20th Street
Huntington, Cabell County, WV**

Sample Matrix	Analysis	Method	Minimum Sample Volume	Sample Container	Preservative	Technical Holding Time
Soil	Volatile Organic Compounds (VOC)	5035/ 8260B	2 - 40 ml	40 ml glass vial with Teflon lined cap	Cool, 4°C, Sodium bisulfate	14 days
			1 - 40 ml	40 ml glass vial with Teflon lined cap	Cool, 4°C, Methanol	
			1 - 2 oz	2 oz. clear wide-mouth glass with Teflon lined cap	Cool, 4°C	
	Polynuclear Aromatic Hydrocarbons (PAH)	8270	4 oz.	4 oz. clear wide-mouth glass with Teflon lined cap	Cool, 4°C	14 days
	RCRA 8 Metals	6010B/7471A	8 oz.	8 oz. clear wide-mouth glass with Teflon lined cap	Cool, 4°C	6 months (28 days Hg)
Aqueous	Volatile Organic Compounds (VOC)	8260B	2 - 40ml	40 ml VOC vial with Teflon lined septum	Cool, 4°C, HCl to pH<2	14 days
	Polynuclear Aromatic Hydrocarbons (PAH)	8270/SIM	1-Liter	1 Liter amber glass with Teflon lined cap	Cool, 4°C	14 days
	Dissolved RCRA 8 Metals	6010B/7471A	1-Liter	2 Liter HDPE bottle with Teflon lined cap	Nitric acid to pH<2, Cool, 4°C	6 months
Vapor	Volatile Organic Compounds (VOC)	TO-15	1-Liter or 6-Liter	Summa canister	None	30 days

APPENDIX A

ALS Environmental Quality Assurance Manual



QUALITY ASSURANCE MANUAL

ALS Environmental – South Charleston Facility
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QUALITY ASSURANCE MANUAL

Doc ID:	ALS-SC-QAM	Rev. Number:	R03	Effective Date:	05/01/2019
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Approved By: Jeff Glaser Date: 5/1/19
Laboratory/Technical Director - Jeff Glaser

Approved By: Chad Stoike Date: 5/1/19
QA Manager - Chad Stoike

Archival Date:	_____	Doc Control ID#:	_____	Editor:	_____
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QA MANUAL CROSS REFERENCE TABLE

ALS QAM and/or SOP	ISO 17025:2005 Section	TNI Vol 1 2009 Module/Section
2	4.1	2/4.1
3	4.2	2/4.2
4 / SC-QS-014	4.3	2/4.3
5 / SC-GEN-006	4.4	2/4.4
6 / SC-GEN-007	4.5	2/4.5
7 / SC-GEN-010	4.6	2/4.6
8	4.7	2/4.7
9 / SC-ADM-004	4.8	2/4.8
15 / SC-GEN-005	4.9	2/4.9
16.6	4.10	2/4.10
16 / SC-QS-003	4.11	2/4.11
16.5	4.12	2/4.12
17 / SC-QS-014	4.13	2/4.13
18	4.14	2/4.14
19 / SC-QS-017	4.15	2/4.15
2, 12, 13, 14	5.1	2/5.1
20	5.2	2/5.2
10	5.3	2/5.3
12, 13	5.4	2/5.4
10	5.5	2/5.5
13	5.6	2/5.6
11	5.7	2/5.7
11	5.8	2/5.8
14	5.9	2/5.9
21	5.10	2/5.10



1) Introduction and Scope

The Quality Assurance Manual (QAM) outlines the quality system used at the South Charleston laboratory of ALS Environmental (ALS Group USA Corp. dba ALS Environmental). This manual defines the policies, procedures, and documentation that: (1) assure analytical services meet a defined standard of quality, (2) provide data of known documented quality, and (3), where applicable, demonstrates regulatory compliance.

The QAM sets the standard under which all laboratory operations are performed including the laboratory's organization, objectives, and operating philosophy. The QAM has been prepared to assure compliance with the 2009 TNI Environmental Laboratory Sector Standard, Volume 1, Management and Technical Requirements for Laboratories Performing Environmental Analysis (EL-V1-M1 through M7-ISO-2009), which is consistent with the ISO/IEC 17025:2005 requirements that are relevant to environmental testing services. In addition, the policies and procedures outlined are established to be compliant with the various accreditation and certification programs listed in Appendix J.

1.1 Scope of Testing

ALS Environmental is a professional analytical service laboratory providing analytical services for a variety of matrices including, but not limited to, aqueous, solid, hazardous waste, and air. Analytical services are based upon EPA approved methods and/or other promulgated protocols. Refer to Appendix J for a list of analytical capabilities and corresponding accreditation status.

1.2 Management of the Quality Assurance Manual

The Quality Assurance Manager is responsible for maintaining the QAM. The QAM is reviewed annually by the QA Manager and laboratory personnel to ensure it still reflects current practices and meets the requirements of any applicable regulations or client specifications.

The QAM is considered confidential within the ALS Environmental and may not be altered in anyway except by approval of the Laboratory Director and QA Manager. If it is distributed to external users, it is for the purpose of reviewing the management system and may not be used for any other purpose without written permission.

1.3 A list of commonly used definitions and acronyms used in this manual is included in Appendix A.

2) Organization

The ALS Environmental South Charleston facility is a commercial laboratory located at 1740 Union Carbide Drive, South Charleston, WV and performs a variety of testing services and activities to meet the needs of laboratory clients. The laboratory systems are designed to also meet the requirements of applicable certification and accreditation bodies.

2.1 Laboratory Organizational Structure

The laboratory is a legally identifiable organization, and a division of a publicly owned corporation, ALS Group USA Corp. dba ALS Environmental. The US tax ID number is available upon request. ALS Group USA Corp. is a wholly owned subsidiary of ALS Limited (ASX: ALQ), formerly A Campbell Brothers Limited Company.

2.2 Avoiding Conflict of Interest through Organizational Structure



- 2.2.1 Through application of the policies and procedures outlined in this QAM and use of a defined organizational structure, the laboratory assures that it is impartial and that personnel are free from undue commercial, financial, or other undue pressures that might influence their technical judgment.
 - 2.2.2 Policies are in place to prevent outside pressures or involvement in activities that may affect competence, impartiality, judgment, operational integrity, or the quality of the work performed at the laboratory.
 - 2.2.3 Management and technical personnel have the authority and resources to carry out their duties and have procedures to identify and correct departures from the laboratory's management system.
 - 2.2.4 Personnel understand the relevance and importance of their duties as related to the maintenance of the laboratory's management system. Ethics and data integrity procedures ensure that personnel do not engage in activities that diminish confidence in the laboratory's capabilities. Procedures and policies are also established to ensure confidentiality is maintained.
- 2.3 An organization chart is provided in Appendix B that shows the operational structure and reporting relationships in the laboratory. Additional information regarding responsibilities, authority and interrelationship of personnel who manage, perform or verify testing is included in Section 3 of this QAM.

3) Management

3.1 Quality Policy Statement

The laboratory's Quality System is documented in this manual and the associated Standard Operating Procedures (SOPs). Together they describe the policies, objectives, principles, organizational authority, responsibilities, accountability, and means of implementation for ensuring quality in the work processes, products, and services. The objective of the quality system is to generate data of known and documented quality that meets specified requirements and provide for its continuous improvement. The laboratory's policy in support of this objective is to: (1) utilize good laboratory practices, (2) maintain documented quality standards, (3) uphold the highest level of service, and (4) comply with applicable Standards of accreditation (e.g. TNI). The laboratory ensures that personnel are free from any commercial, financial, or other undue pressures that might adversely affect the quality of work. This policy is implemented and enforced through the management's commitment to the principles and practices outlined in this manual. The primary responsibility for quality rests with each individual within the laboratory organization. Accordingly, every laboratory employee must ensure that the generation and reporting of quality analytical data is a fundamental priority. Every laboratory employee is required to familiarize him or herself with the quality documentation and to implement the policies and procedures in their work. All employees are trained annually on the ethical principles and procedures surrounding the generation of data. The laboratory maintains a strict policy of client confidentiality and holds all employees to this policy.

3.2 Management Requirements

Laboratory management ensures that the laboratory's policies and objectives for quality are documented by reference or by inclusion in the QAM, and that the QAM is: (a) communicated to, (b) made available to, (c) understood by, and (d) implemented by,



all personnel concerned. Where the QAM documents specific laboratory requirements, a separate SOP or policy is not required.

3.3 Quality Assurance Manual

The Quality Assurance Manual is maintained current and up-to-date by the quality assurance department. All employees must complete a read-receipt form stating they 1) have read the Quality Assurance Manual, 2) understand the contents, and 3) will adhere to the stated policies. The completed read-receipt form is kept on file by the quality assurance department.

3.4 Management Responsibility and Authority

3.4.1 The laboratory management team includes the Laboratory Director, Laboratory Supervisor(s), and the Quality Assurance Manager. This group has overall responsibility for technical operations and the authority needed to generate/maintain the defined level of quality stated in the Quality Policy (above) and is upheld through the application of documented policies and procedures.

3.4.2 Management is responsible for the assignment of responsibilities, authorities, and interrelationships of the personnel who manage, perform, or verify work affecting the quality of environmental tests. Management is responsible for defining the minimal level of education, qualifications, experience, and/or skills necessary for completion of the assigned responsibilities.

3.4.3 Management bears specific responsibility for maintenance of the Quality System. This includes defining roles and responsibilities of personnel, approving documents, and providing training.

3.4.4 Management ensures technical competence of personnel operating equipment, performing tests, evaluating results, and signing reports by limiting authority to those who are appropriately trained and/or supervised. Training is kept up to date as described in Section 20 of this document.

3.4.5 Laboratory management must make available all necessary equipment required for the correct performance of the scope of environmental testing presented in this QAM. Only trained and authorized personnel can operate equipment.

3.4.6 Management also bears responsibility for ensuring that audit findings and/or corrective actions are addressed and completed within required time frames. Designated alternates are appointed by management during the absence of the Laboratory Director, Operations Manager, or the Quality Assurance Manager, and always if the absence is more than 15 days.

3.5 Job Descriptions and Qualifications (qualifications of key personnel are given in Appendix B)

3.5.1 Laboratory Director

The Laboratory Director is responsible for all laboratory activities as the highest-level manager. He/she provides administrative, operational, and Technical leadership through planning, allocation, management of personnel, and management of resources. He/she approves the QAM, provides resources for implementation of the QA program, and serves as Technical Director. The Laboratory Director position requires a BS or BA degree in Science, Engineering, or Management with five years supervisory experience in environmental laboratory operations.



3.5.2 Lab Supervisor

The Laboratory Supervisor reports directly to the Laboratory Director and is responsible for day-to-day supervision of laboratory operations. He/she assures production of reliable data through the monitoring of analytical procedures, corroborating analysis performed, and approving staff capability. He/she certifies that personnel with appropriate educational and/or Technical background perform all tests for which the lab is accredited according to SOP specifications. He/she reviews, schedules, and oversees the implementation of new methodologies. In the absence of the Operations Manager, the Laboratory Director or Quality Assurance Manager must maintain these duties. The Operations Manager position requires a BS or BA degree in Science, Engineering, or Management with five years experience in environmental laboratory operations.

3.5.3 Quality Assurance Manager

The Quality Assurance (QA) Manager is responsible for ensuring that the quality system is documented, implemented, and adhered to in the course of laboratory operations. He/she has direct access to the Laboratory Director and is independent of daily laboratory operations. He/she is tasked with:

- Day-to-day implementation of the quality program,
- oversight of quality control processes, including establishing control limits,
- maintaining the Quality Assurance Manual,
- maintaining quality assurance records,
- acquiring and maintaining laboratory accreditations.
- evaluating data,
- performing assessments without managerial influence,
- conducting internal audits,
- arranging for external audits,
- monitoring corrective actions, and
- notifying management of any deficiencies and/or opportunities for improvement in laboratory operations.

The QA Manager performs or coordinates a QA Management System review annually according to SOP SC-QS-017, *QA Management Review*. He/she has the authority to place a stop work order on any non-compliant work area. In the absence of the QA Manager, the QA Deputy or Operations Manager must maintain these duties. The QA Manager position requires a BS or BA degree in Science, Engineering, or Management with a minimum of five years experience in environmental laboratory operations and two years experience in quality system management.

3.5.4 Project Manager(s)

Project Managers (PM) are responsible for ensuring that analyses performed by the laboratory meet all project, contract, and/or client-specified requirements. The PM is tasked with 1) relaying project requirements to the staff, 2) review of sample log-in information, 3) monitoring/communicating project progress, and 4) reviewing/issuing final reports to the client. In the absence of the Project Manager, the Project Manager Supervisor (or designate) must maintain these duties. The PM position requires a BS or BA in Science, Engineering, or Management with five years applicable experience.



3.5.5 Safety Manager

The Safety Manager reports to the Laboratory Director and is responsible for administration of the laboratory's safety program. He/she is tasked with 1) implementing safety policies, 2) reviewing accidents and/or incidents, 3) monitoring hazardous waste disposal, and 4) conducting routine safety inspections. In the absence of the Safety Officer, the Laboratory Director (or designate) must maintain these duties. The Safety Officer position requires a high school diploma and two years applicable laboratory experience.

(Note: In lieu of formal education requirements, three years experience can be considered equivalent to one year formal education.)

3.6 Data Integrity System

Management functions include implementation of a data integrity system. The data integrity system employed at ALS Environmental is an integrated approach designed to ensure the production of defensible and quality data. The overall system consists of a three-tier approach as documented in laboratory SOP SC-QS-015, *Data Integrity System*.

The ALS Environmental policies and requirements for Ethics and Data Quality are described in the corporate SOP CE-GEN-001, Laboratory Ethics and Data Integrity. The employee Ethics and Data Quality Agreement from the SOP is provided in Appendix C.

System policy is based upon criteria specified by ISO 17025, US EPA, TNI, and (if required) project specific criteria. System programs to support this policy include approved Standard Operating Procedures, employee training, internal/external assessments, and annual management review. Within each system program, critical components of data integrity are employed. These components include defined data quality objectives, data generation procedures, data verification, and data validation. Specifics of these components are detailed in individual documents. Prior to final release, validated data is compared to data quality objectives in order to assure its worthiness.

The laboratory has the resources and authority to operate a management system that is capable of identifying departures from that system and from procedures during testing, and initiates actions to minimize or prevent departures.

3.7 Client Confidentiality

As a function of managing client projects and conducting testing, it is recognized that the laboratory will obtain, or be provided, information which may be confidential in nature. Management ensures that each area of client interaction is treated as confidential according to following criteria.

- 3.7.1 The laboratory confidentiality policy is to not divulge or release any information to a third party without proper authorization.
- 3.7.2 All electronic data are kept confidential, based on technology and laboratory limits, as required by client or regulatory specifications.
- 3.7.3 Procedure(s) for maintaining confidentiality requirements are documented in SOP SC-GEN-004, *Client Confidentiality*.

4) Document Control

- 4.1 The purpose of document management is to preclude the use of invalid and/or



obsolete documents. The following guidelines are used for document management.

4.2 Document Type

The laboratory manages three types of documents: 1) controlled, 2) approved, and 3) obsolete. All documents that affect the quality of laboratory data are managed appropriate to the scope and depth required.

4.2.1 A controlled document is one that is internally generated, uniquely identified, issued, and maintained as part of the quality system. Controlled documents are uniquely identified with: 1) effective date, 2) revision number, 3) page number, 4) total number of pages, and 5) the signatures of the issuing authority (i.e. management).

4.2.2 An approved document is one that has been released or acknowledged externally via secure electronic means by the issuing authority. Examples of approved documents include EPA, ASTM, and AWWA methodologies.

4.2.3 An obsolete document is one that has been superseded by a more recent version or that reflects a discontinued practice. Obsolete controlled documents are maintained according to SOP SC-QS-011, *Record Archival*.

4.3 Document Approval, Review, and Distribution

4.3.1 Approval

All documents that affect the generation and reporting of laboratory data must be approved, at a minimum, by the Laboratory Director (or Operations Manager), QA Manager, and appropriate Department Supervisor. The Laboratory Director and QA Manager, at a minimum, must approve all documents that affect quality assurance, administrative, general, and health/safety programs. Other approvals may be required as documented in SOP SC-QS-014, *Document Control & Laboratory Records*.

4.3.2 Review

Documents are reviewed periodically to ensure their contents are in compliance with current quality system requirements and accurately reflect current operations. In particular, SOPs are reviewed annually to ensure they continue to reflect actual practice.

4.3.3 Distribution

Approved copies of all controlled documents are stored on the shared server in a secure (Adobe) format and are available to all personnel.

The QA department maintains a hardcopy set of controlled documents in case of server disruption. The QA department also maintains the original copy of the controlled document in a protected environment.

Specific procedures for the distribution of documents are documented in SOP SC-QS-014, *Document Control & Laboratory Records*.

4.4 Document Management

4.4.1 The QA Manager (or designee) must maintain a master list of controlled documents referencing the document's identification. The master list is updated whenever documents are revised, retired, or become obsolete.

4.4.2 Specific procedures for document management are specified in SOP SC-QS-014,



Document Control & Laboratory Records.

4.5 Changes to Documents

4.5.1 Hardcopy Documents

- All document changes are reviewed prior to promulgation and approved as documented in Section 4.2.1.
- All modifications, additions, and/or changes must be incorporated into a new hardcopy revision.
- The QA Manager (or designee) is responsible for maintaining hardcopy format as documented in Section 4.2.3.

4.5.2 Electronic Documents

- All changes to document hardcopy must be stored electronically in a secure format and be made available to all employees.
- Obsolete electronic formats are removed from service and placed in an archived folder.
- The QA Manager (or designee) is responsible for maintaining electronic formats.

4.5.3 Procedures

Procedural processes for modifications and changes to controlled documents are specified in SOPs SC-QS-014, *Document Control & Records*, and SC-GEN-001, *SOP Preparation & Management*.

4.6 Obsolete Documents

All obsolete documents are removed from electronic distribution, or otherwise prevented from unintended use, and archived. Procedural processes for archival of obsolete documents are specified in SOP SC-QS-011, *Record Archival*.

4.7 Electronic Signatures

4.7.1 It is a policy of ALS Environmental to allow the use of electronic signatures. For data reporting an electronic signature may be applied to the report by an approved report signatory and is binding to the same extent as a handwritten wet signature.

4.7.2 To authenticate the electronic signature the identity of the signatory is verified before their electronic signature can be created. Each electronic signature shall be unique to a single individual and shall not be used by any other individual. These signatures are established using only defined procedures within the software and are verified using the two distinct components of username and password. Each use of the electronic signature requires entry of the username and the password. The report may not be changed once the signature has been applied.

4.7.3 Additionally, as a form of 'signature' used for LIMS, email, and certain internal documentation processes (e.g. acknowledgements, attestations, audit trails, etc.), and other electronic tools the user's system login credentials are used to



verify and authenticate the identity of the user. Following login, these credentials are used to identify and document the user.

5) Review of Requests, Tenders and Contracts

- 5.1 All work must be reviewed prior to acceptance in order to assure that: 1) requirements are clearly defined, 2) the laboratory has adequate resources, and 3) the test method is applicable to project specifications. This process ensures that all work is given adequate attention without shortcuts that might compromise data quality. Contracts for new work can be presented as formal bids, proposals, signed documents, or by verbal/electronic inquiry.
- 5.2 Procedure for the Review of Work Requests
 - 5.2.1 Review of work requests is conducted according to the guidelines specified in SOP-SC-GEN-006, *Resource Review*.
 - 5.2.2 The Project Manager (or Sales Representative in case of bid) and Laboratory Director determines if the laboratory has the necessary accreditations and resources to meet the work request.
 - 5.2.3 The Project Manager (or Sales Representative) will:
 - Provide the perspective client with the requested bid information if laboratory capability/capacity meets project requirements, or
 - Inform the perspective client of any potential conflict or inability to complete the work per specification, and
 - Resolve any differences between the initial request and final contract prior to sample receipt or commencement of work.
 - 5.2.4 Changes to the Scope of Work initiated after commencement of work must be subjected to the same review process.
- 5.3 Allowed Deviation from Standard Operating Procedures
 - 5.3.1 When a client requests a modification to an SOP the Project Manager handling that project must discuss the proposed deviation with the laboratory supervisor and obtain their approval to accept the project. The Project Manager is responsible for documenting the approved or allowed deviation from the SOP.
 - 5.3.2 When a client request necessitates a deviation or departure from company policies or procedures involving any non-technical function, the allowed deviation must be approved by the laboratory or the laboratory director. Frequent departure from policy is not encouraged. However, if frequent departure from any policy is noted, the laboratory director will address the possible need for a change in policy.
- 5.4 Documentation of Review
 - 5.4.1 Executed contracts are copied in secure format and stored on the shared server. Originals are maintained in a secure area designated by the Laboratory Director.
 - 5.4.2 Additional records are maintained by the Project Manager including pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract.



6) Subcontracting of Tests

- 6.1 A subcontract laboratory is defined as a laboratory external to the South Charleston, WV facility which performs analyses for the laboratory. When subcontracting analytical services, the laboratory assures work requiring accreditation is placed with an appropriately accredited laboratory or one that meets applicable statutory and regulatory requirements for test performance.
- 6.2 Procedure for Subcontracting
 - 6.2.1 Subcontracting is conducted according to the procedures documented in SOP SC-GEN-007, *Sample Sub-Contracting*.
 - 6.2.2 The client must be notified of the laboratory's intent to subcontract prior to sample receipt. Acknowledgement of client acceptance must be maintained with the bid or work order information.
 - 6.2.3 The laboratory, to which samples are subcontracted, must maintain all appropriate accreditations relative to client requirements.
 - 6.2.4 Project managers must maintain a list of approved subcontracted laboratories within LIMS and, whenever possible, obtain copies of their respective quality assurance protocols.
 - 6.2.5 Final reports must identify all test results from subcontracted laboratories.
 - 6.2.6 Identification of sub-contracted laboratories within ALS Environmental must be documented in final reports.

7) Purchasing Services and Supplies

- 7.1 The laboratory ensures that purchased supplies and services affecting the quality of environmental tests are of the required or specified quality by using approved suppliers and products. Upon receipt, traceability of reagents, chemicals, and standards is maintained throughout the entire analytical process.
- 7.2 Purchasing Supplies and Services
 - 7.2.1 Purchasing of supplies and services is conducted as described in SOP-SC-GEN-010, *Procurement*.
 - 7.2.2 Procedures for the receipt, storage, and tracking of reagents, chemicals, and standards are documented in SOP-SC-QS-001, *Reagent & Standard Tracking*.
 - 7.2.3 Purchased chemicals must be reagent grade or higher as specified, and the specifications for specific reagents, chemicals, and standards must be documented in the applicable method SOP.
 - 7.2.4 A list of approved vendors must be maintained within LIMS.
 - 7.2.5 The Department Supervisor(s) must ensure that supplies are of the appropriate quality and/or purity prior to ordering.

8) Service to the Client

The laboratory collaborates with clients and/or their representatives to clarify their requests and ensure laboratory performance related to the work. Requests are reviewed to establish the nature of the request and the laboratory's ability to comply with the request within the confines of statutes or regulations, without risk to the confidentiality of other clients.



8.1 Client Support

- 8.1.1 Communication with the client, or their representative, is maintained to provide proper instruction and modification for testing. Technical staff is available to discuss any technical questions or concerns the client may have. The client, or their representative, may be provided reasonable access to laboratory areas for observation or evaluation of testing.
- 8.1.2 Delays or major deviations to the testing are communicated to the client immediately by the assigned Project Manager.
- 8.1.3 The laboratory will provide the client with all requested information pertaining to the analysis of their samples. An additional charge may apply for additional data/information not requested or agreed upon prior to sample analysis.

- 8.2 The laboratory seeks negative and positive feedback from clients, using mechanisms such as follow-up inquiries after project completion, surveys, and email solicitation. Feedback provides acknowledgement of performance, input on service, possible corrective or preventive actions, and opportunities for continuous improvement.

9) Complaints

- 9.1 Complaint resolution is an integral component of the laboratory quality system with the purpose of improving the laboratory's quality, integrity, and service. All complaints, whether external (customer) or internal in origin, are documented and investigated. Complaint resolution is conducted according to the following criteria.
- 9.2 Procedures for Handling Customer Complaints
 - 9.2.1 The Project Manager or Laboratory Director must ensure that all customer complaints are documented and forwarded to the QA department. This also applies to requests for report and/or data verification.
 - 9.2.2 The QA Manager in conjunction with the Operations Manager and the appropriate Department Supervisor(s) must investigate and resolve the complaint.
 - 9.2.3 The QA Manager must initiate a corrective action report for any investigation that indicates laboratory error.
 - 9.2.4 Procedure(s) for handling customer complaints are documented in SOP SC-ADM-004, *Complaint Resolution*.

10) Facilities and Equipment

- 10.1 Laboratory facilities are designed and organized to facilitate testing of environmental samples. Environmental conditions are monitored to ensure that they meet method specifications, do not invalidate results, and do not adversely affect the required quality of any measurement. Access to, and use of areas affecting the quality of the environmental tests is controlled by restriction to authorized personnel only.



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- 10.2 Separate work areas are designated by application within the facility. Each workspace is complimented by dedicated air handling systems, central gas supply, appropriate instrumentation with computer hardware, and a secure data management system. The volatile organic work area is segregated from other work areas in order to minimize background contamination. The floor design provides separate secure storage of samples, solvents, materials inventory, and hazardous waste.
- 10.3 The laboratory security features provide for sample integrity and storage. Access to the facility is limited to the front door and the receiving door. During working hours, all are monitored. Guests are escorted/monitored while in the facility.
- 10.4 Procedures for temperature monitoring are documented in SOP SC-EQ-002, *Thermometer Calibration and Temperature Monitoring*. Separate storage areas are maintained for samples requiring volatile organic analysis.
- 10.5 The facility floor plan is provided in Appendix D of this manual. A listing of equipment is provided in Appendix E.
- 10.6 General Equipment Procedures
- 10.6.1 Routine preventative maintenance procedures are document in SOP-SC-EQ-004, *Preventative Maintenance*. Preventative maintenance for common laboratory instrumentation can be found in Section 16. Most major equipment is covered either under warranty, service contract, or serviced by defined outside contractors.
- 10.6.2 Laboratory personnel maintain equipment and instruction manuals for use.
- 10.6.3 Procedures for validating laboratory equipment to ensure that it meets laboratory and method specifications prior to placing into service are described in SOP-SC-QS-005, *Validation of New Instrumentation and New Methods*.
- 10.6.4 Procedures for ensuring test equipment (hardware and software) are protected from adjustments that can invalidate test results are documented in SOP-SC-IT-003, *IT System Security*.
- 10.6.5 Equipment that has been shown or is suspected to be defective is:
- Removed from service
 - Isolated or clearly labeled as “Out of Service”
 - Repaired or replaced
 - Validated prior to returning to service
 - If shown that previous tests have been affected, procedures for non-conforming work must be followed.
- 10.6.6 Maintenance logbooks are assigned to each piece of equipment per SOP-SC-EQ-004, *Preventative Maintenance*. A LIMS module documents the following instrument information:
- Instrument identity
 - Date acquired and placed in service
 - Condition, if known (new, used, refurbished)
 - Applicable service contract (if any)
- 10.7 Support Equipment
- 10.7.1 Support equipment includes, but is not limited to: balances, ovens, water baths, freezers, refrigerators, incubators, temperature measuring devices,



volumetric dispensing devices, and thermal/pressure sample preparation devices.

- 10.7.2 All support equipment must be maintained in proper working order, and all raw data records must be retained to document equipment performance.
- 10.7.3 All support equipment must be calibrated or verified annually using NIST traceable references where available.
- 10.7.4 Balances, ovens, refrigerators, freezers, and water baths must be checked daily prior to use to ensure operation within defined criteria.
- 10.7.5 Mechanical volumetric dispensing equipment must be checked for accuracy quarterly.
- 10.7.6 Glass micro-liter syringes and Environmental Express Hot Block™ digestion tubes have certificates attesting to the established accuracy are retained.
- 10.7.7 For chemical tests that use autoclaves, the temperature, cycle time, and pressure is documented by use of chemical indicators or temperature recorders and pressure gauges.
- 10.7.8 For microbiological analyses, records for autoclaves used in the laboratory document the following:
 - Temperature demonstration of sterilization continuous monitoring device or maximum registering temperature
 - For each sterilization cycle the record date, contents, maximum temperature reached, pressure, cycle time, and analysts initials
 - Quarterly check of autoclave timing device
 - Annual maintenance check to include a pressure check and calibration of temperature device
- 10.7.9 Various other types of support equipment have requirements based upon application. Refer to the individual method SOPs for specifics.

11) Sample Management

From sample receipt to analytical completion, sample management is critical to maintaining quality measurements. Appendix F contains a list of sample containers, preservatives, and holding times for common analytical procedures. The following procedures are utilized to maintain sample integrity during the analytical process.

11.1 Sample Receipt and Acceptance

- 11.1.1 Procedures for sample receipt and acceptance are documented in SOP-SC-SM-001, *Sample Receipt & Log-In*. Chain of custody procedures are established to document sample custody transfer at the time of sample receipt, using chain-of-custody (COC) forms accompanying the samples. Custody seals are sent by the lab if the sampling containers are ordered from the laboratory, and during sample receipt it is also noted if custody seals were present. Shipping records are maintained with the chain of custody records.
- 11.1.2 The following preservation checks are performed and documented upon receipt.
 - 11.1.2.1 Thermal preservation



- For samples that require preservation at 4°C, the acceptable range is “from just above freezing to 6°C”.
- Each sample is tested for thermal preservation upon receipt.
- Samples that are delivered to the lab by local courier as they are collected may not have reached a fully chilled temperature. This is acceptable if there is evidence that chilling has begun and a short period of time exists between collection and receipt. On the laboratory receipt form, record if ice is present and the current temperature.

11.1.2.2 Residual chlorine (from chlorinated source)

- Verify sufficient sodium thiosulfate is present (sufficient to neutralize 5mg/L chlorine for drinking water and 15 mg/L chlorine for wastewater).
- Chlorine residual is checked in the field and documented.

11.1.2.3 pH checks

- The pH of samples requiring acid and/or base preservation is checked upon sample receipt or, in the case of volatiles, upon completion of analysis.

11.1.3 If the applicable checks performed upon sample receipt indicate the criteria are not met the sample is placed “on hold” until either the decision to proceed is agreed upon with the client and documented, or the decision to reject is confirmed with the client and documented. The condition is noted on the Chain of Custody form and laboratory receipt form. Affected data are qualified or narrated in the report.

11.1.4 The sample acceptance policy is provided to all field crews and is documented as an attachment in the above referenced SOP. Sample submission sheets from the field are maintained by the applicable Project Manager and scanned in a secure format onto the shared server.

11.2 Sample Identification

Samples are uniquely identified in a permanent electronic record to maintain sample integrity and to document receipt of all sample containers. Samples are assigned sequential numbers that cross reference specific information. This information is maintained in the LIMS database and includes:

- Client or project name
- Date and time of sampling
- Date and time of receipt at lab
- Unique laboratory identification number
- Unique field identification
- Initials of recorder
- Analyses requested
- Comments regarding rejection (if any).

11.3 Sample Storage and Transport

11.3.1 Samples are held in a secure environment with restricted access and the storage conditions are continually monitored and the conditions recorded.



11.3.2 Samples are stored apart from standards, reagents, or other potentially contaminating sources such that cross-contamination is minimized. All portions of samples, including extracts, digestates, and leachates are maintained separately pending analysis.

11.3.3 Samples that are transported under the responsibility of the laboratory are done so safely and according to method specific storage conditions.

11.4 Field Sampling

11.4.1 If field sampling is completed by laboratory personnel, sampling is based upon appropriate statistical methods, whenever practical. Sampling methods may also be those requested by the client.

11.4.2 Sampling is performed according to the applicable sampling SOP. Records are maintained of the sampling procedure, the environmental conditions, sampling location, and identity of field personnel.

11.5 Procedures for sub-sampling within the laboratory are documented in SOP-SC-QS-008, *Sub-Sampling and Sample Homogenization*.

11.6 Sample Disposal

Samples are disposed of according to Federal, State, and local regulations. Procedures for sample disposal are documented in SOP-SC-SAF-001, *Waste Disposal Procedures*.

12) Analytical Procedures

12.1 Analytical Methods

12.1.1 ALS Environmental employs methods and analytical procedures from a variety of external sources. The primary method references are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IVA, IVB, and online updates; USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, EPA 40CFR parts 136 and 141, and Supplements; and *Standard Methods for the Examination of Water and Wastewater*. References for these methods are given in Section 23. Other published methods, such as state methods, program-specific methods, or in-house methods may be used.

12.1.2 Several factors are involved with the selection of analytical methods to be used in the laboratory. These include the method detection and/or reporting limits, the expected concentration of the analyte being measured, method selectivity, accuracy and precision of the method, the type of sample being analyzed, and the regulatory compliance objectives.

12.1.3 The implementation of methods by the laboratory is described in Standard Operating Procedures (SOPs) specific to each method.

12.2 Standard Operating Procedures

Standard Operating Procedures are written procedures that describe in detail how to conduct laboratory processes, and are of two types: 1) analytical SOPs, which have specifically required details, and 2) general use SOPs which document administrative, quality, or broad spectrum laboratory procedures. SOPs are used to ensure consistent application and performance of laboratory procedures. SOPs, regardless of type, are maintained such that:

- SOPs are accessible to all personnel, and



- Each SOP has a unique identifier, revision number, effective date, and approval signatures.

The laboratory maintains SOPs for all accredited test methods, and for procedures that support these test methods. Appendix G documents SOPs that are currently in use. Support procedures include, but are not limited to, quality assurance, information Technology, sample management, health/safety, and general laboratory practices. SOPs are prepared and managed in accordance with the specifications documented in SC-GEN-001, *SOP Preparation & Management*.

- 12.3 All methods must be validated before they are put into use. Initial test method validation includes establishing a valid calibration protocol, Demonstration of Capability (DOC), determination of the Method Detection Limit and/or Limit of Detection (LOD), and the Limit of Quantitation (LOQ).
- 12.3.1 Before performing a DOC study an appropriate calibration range must be established and calibration conducted which meets acceptance criteria. The calibration range is within the linear range of the analysis (or instrument) and is established by analyzing a series of standards, one of which is at or below the expected LOQ. The calibration range or method-specific calibration procedures may be described in test method. Refer to Section 13 for details.
- 12.3.2 The Demonstration of Capability (DOC) is a procedure to establish the ability of the analyst to generate data of acceptable accuracy and precision. In general, this procedure requires the preparation and analysis of a known concentration of each analyte spiked in four separate aliquots of laboratory pure matrix. These samples are carried through the entire preparation and analytical procedure. The resulting recovery and the standard deviation (or RSD) are determined and compared to specified limits to verify that precision and bias are acceptable.
- 12.3.2.1 For analytes that do not lend themselves to spiking, e.g., TSS, the DOC may be performed using quality control samples. For analytes for which spiking is not an option and for which quality control samples are not readily available, the procedure published in 40 CFR Part 136, Appendix A, test methods, is one way to perform this demonstration.
- 12.3.2.2 The DOC data is also evaluated to ensure that the selectivity of the method is adequate. The laboratory evaluates selectivity through procedures defined in the test method SOPs such as use of dual columns, interference checks, and analysis of required QC samples.
- 12.3.3 The MDL, LOD, and LOQ are established following the corporate SOP CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation* and in the SOP-SC-QS-006, *Determination of Method Detection Limits, Quantitation, and Reporting Limits*.
- 12.3.3.1 The MDL is used to establish the lower limit of detection, as defined by the USEPA, 40 CFR Part 136, Appendix B. The LOD is an estimate of the minimum amount of a substance that an analytical process can reliably detect, and is typically equivalent to the MDL. The LOD defines a range below the LOQ where detections must be reported with the data qualifier "J", indicating the value reported is



an estimated value. The LOD is analyte and matrix-specific. No results are reported below the LOD.

12.3.3.2 The LOQ defines the lower limit for an analyte where data may be reported without qualification. For most methods it is established to be no lower than the lowest non-zero calibration standard. On a final analytical report, the LOQ may be labeled as the method quantitation limit (MQL) or practical quantitation limit (PQL).

12.3.4 Laboratory-Developed or Non-Standard Method Validation - All laboratory developed, modified standard methods, or non-standard methods require planned method development and validation following established protocols.

12.4 Ongoing Proficiency

12.4.1 Ongoing DOC's are performed when either an analyst repeats the DOC annually or generates acceptable results when analyzing performance evaluation samples. The data for the DOC procedure is evaluated by either the section supervisor or the QA Department.

12.4.2 Ongoing demonstrations of capability are documented in the training file of each analyst or maintained by the QA department as a separate document.

12.4.3 LOD verification samples are performed to verify that procedure sensitivity is maintained such that LODs are achievable. Periodic LOQ verification ensures that quantified results are within accepted limits of precision and bias.

13) Measurement Traceability and Calibration

13.1 Measurement quality comes in part from the traceability of standards to certified materials, reagents of known purity, and support equipment accuracy. ALS Environmental addresses these components through the following policies.

13.2 Standards

13.2.1 Commercially available standards are purchased from approved vendors and must be traceable to certified materials. Certificates of analysis (when available) must be retained for all standards.

13.2.2 All standards are logged upon receipt and assigned unique identifiers. Procedures for traceability of standards are documented in SOP-SC-QS-001, *Reagent and Standard Tracking*.

13.2.3 Storage requirements are specified by the manufacturer or in the method SOP. Expiration dates are established as described in the corporate SOP CE-QA012, *Quality of Reagents and Standards*.

13.2.4 Standards/reagents received without a Certificate of Analysis and/or all modifications (i.e. dilutions, additions, etc.) must be tested and approved for use by the Supervisor prior to implementing into operations.

13.3 Chemicals and Gases

13.3.1 All chemicals must be reagent grade or higher. The expiration periods and storage requirements are provided in the method SOPs. Solvents must be HPLC or pesticide residue grade, acids for metals digestions must be trace metal grade, and gases must be high purity or higher.

13.3.2 If other than reagent grade or high purity, the purity of chemicals or gases is



specified in the method SOP.

13.3.3 All chemicals must be tested and approved for use by the Department Supervisor prior to implementing into normal department operations.

13.4 Calibration

13.4.1 Balances

13.4.1.1 Balances are calibrated and verified annually by a certified outside vendor.

13.4.1.2 Balance calibration and performance is verified daily utilizing NIST traceable weights within the working range of weights to be determined on each balance.

13.4.1.3 Procedures for traceability of analytical balances are documented in SOP-SC-EQ-001, *Use and Maintenance of Balances*.

13.4.2 Thermometers

13.4.2.1 Thermometers are calibrated annually against a NIST certified reference thermometer.

13.4.2.2 Infrared based measurement systems are calibrated yearly against a NIST certified reference thermometer.

13.4.2.3 Procedures for traceability of temperature measurements are documented in SOP-SC-EQ-002, *Thermometer Calibration and Temperature Monitoring*.

13.4.3 Instrument Initial Calibration

13.4.3.1 Initial instrument calibration (and continuing calibration verification) is a critical part of ensuring data of known and documented quality. In general, all initial calibrations are according to method specified criteria and documented in the applicable SOP. The SOP specifies calibration requirements, frequency, acceptance criteria, and requires the use of a second source calibration standard for verification. The following general guidelines must be followed for all multi-point initial calibrations:

- Unless specified otherwise by the method SOP, a minimum of five calibration levels must be used.
- The lowest calibration level must be equal to or less than the PQL. The lowest or highest calibration level can be dropped if non-linear. However, the PQL or UQL must be adjusted accordingly.
- Quantitation of results must be determined from the initial calibration curve (most recent) unless the test method requires the use of the continuing calibration (i.e. quantitation from the CCV).
- Reported results falling below the PQL must be qualified and documented in the case narrative.
- Results greater than the UQL must be diluted or must be considered qualified as "estimated" if reported. If the latter, this must also be documented in the case narrative.



13.4.3.2 Raw data records must be retained to allow reconstruction of instrument specific initial calibrations.

13.4.4 Continuing Instrument Calibration Verification

13.4.4.1 The validity of the initial calibration must be verified prior to sample analysis through analysis of continuing or daily calibration verification (CCV) standards. Method SOPs specify the calibration criteria, frequency, and acceptance limits. The following general guidelines apply to continuing calibration verifications.

- Continuing calibration verification must be performed at the beginning, periodically through the analytical run, and end of each analytical batch except for instances where an internal standard is used.
- For methods employing internal standards, continuing verification must be performed at the beginning of the analytical batch.
- Continuing calibration verifications must be performed at SOP specified time intervals.
- Continuing calibration verifications must be performed for all analytical systems that have calibration verification requirements.
- Calibration must be verified for each compound, element, or other discrete chemical species.

13.4.4.2 Sufficient raw data records must be retained to reconstruct the continuing calibration verification to the initial calibration.

14) Assuring the Quality of Results

The quality of results is assured through the use of various control and internal data assessment practices. These include use of defined SOPs, sample batch definition, Quality Control (QC) analyses performed in conjunction with all sample analyses, use of established control limits for accuracy and precision, and having established procedures for internal data review and validation. These practices are described in the following sections.

14.1 As discussed in Section 12, SOPs are established to provide details of performing the test method in the laboratory. From the perspective of assuring quality, the use of SOPs ensures a test is performed consistently and promotes data comparability. SOPs include key elements of equipment operation and materials quality, analysis selectivity, calibration, and other key components of data quality, consistency, comparability, and representativeness. SOPs include written procedures for conducting QC analyses, including acceptance criteria and corrective action, as further described in this section.

14.2 Essential Quality Control Procedures

14.2.1 Batching



- 14.2.1.1 A sample batch is comprised of up to 20 samples of the same matrix and processed on the same working shift. All samples and QC samples within a batch are processed using the same procedures and same reagents or materials. Exceptions required by method or program are included in analytical SOPs.
- 14.2.1.2 The standard QC samples included in each sample batch include a method blank (MB), laboratory control samples (LCS), and matrix spike/matrix spike duplicate (MS/MSD). For certain analyses, sample duplicates (DUP) may be used in place of an MSD for a measure of precision. Results for QC samples falling outside defined limits indicate that analytical data for samples within the same batch may be suspect. In general, samples must be re-processed (re-extraction/digestion and analysis) or that the data must be qualified and narrated. Any exceptions to this or circumstances requiring special treatment of data are located in the individual method SOPs.

14.2.2 Method Blank (MB)

- 14.2.2.1 The MB serves as the negative control for the sample batch. The MB is carried through all analytical steps which are performed on samples. Results for the MB should be less than the MDL and must be less than the PQL.

Note: For certain types of testing, such as microbiological, negative controls may include such things as sterility or culture checks. These controls atypical of standard method blanks are described in the method SOP.

- 14.2.2.2 When blank contamination is determined, the cause must be investigated and corrective action taken to eliminate the problem.
- 14.2.2.3 All samples associated with blank contamination must be reprocessed (preparation and analysis). Exceptions to this can be found in the corrective action section of the individual test SOPs.
- 14.2.2.4 Data for samples that cannot be reprocessed must be appropriately qualified or flagged when reported. Samples that are blank corrected must be narrated.

14.2.3 Laboratory Control Samples (LCS)

- 14.2.3.1 The Laboratory Control Sample (or Blank Spike) serves as the positive control for the sample batch. The LCS is carried through all analytical steps which are performed on samples. Results are used for monitoring accuracy of results for the sample batch. The LCS is prepared from an analyte free matrix with a known amount of analyte added. An LCS Duplicate (LCSD) may be performed if insufficient sample is available for MSD or DUP analysis.

Note: For certain types of testing, such as microbiological, positive controls may include such things as culture checks. These controls atypical of a standard LCS are described in the method SOP.

- 14.2.3.2 An LCS must be analyzed at the frequency specified by the SOP and acceptance criteria must be defined or referenced within the



analytical SOP. Example calculations are included in each of the method SOPs.

- 14.2.3.3 The LCS result must meet the defined criteria. If accuracy is not achieved, the cause must be investigated and corrective action taken to eliminate the problem.
- 14.2.3.4 All samples associated with a failed LCS are reprocessed (preparation and analysis). Any exceptions to this can be found in the corrective action section of the individual method SOPs.
- 14.2.3.5 Samples associated with a failed LCS that cannot be reprocessed must be appropriately qualified or flagged when reported.

14.2.4 Matrix Spike (MS)

- 14.2.4.1 Matrix spikes are environmental samples with a known amount of analyte added. These QC samples are used to assess the effect of the matrix on method performance. Matrix Spike Duplicates (MSD) are performed to assess the precision of the analysis. The MS/MSD is/are carried through all analytical steps which are performed on the parent sample used for spiking.
- 14.2.4.2 Matrix spike (and MSD) samples must be analyzed at the frequency specified by the SOP and acceptance criteria must be defined or referenced within the analytical SOP. Example calculations are included in each of the method SOPs.
- 14.2.4.3 Accuracy of matrix spike samples should meet the defined criteria. All samples associated with failed matrix spike results must be reprocessed (preparation and analysis) if the LCS also did not meet acceptance criteria. Exceptions to this can be found in the corrective action section of the individual method SOPs.
- 14.2.4.4 Samples associated with failed matrix spike results that cannot be reprocessed must be appropriately qualified or flagged when reported.

14.2.5 Surrogate Spikes

- 14.2.5.1 Surrogates are substances with chemical properties and behaviors similar to the analytes of interest that are used to assess method performance in individual samples. Where applicable, the use of surrogates is specified in the reference method and SOP, and is generally used for organics analyses.
- 14.2.5.2 Surrogates are added to all samples and quality control samples prior to sample preparation. Surrogates are also included in all initial and continuing calibration standards.
- 14.2.5.3 Recovery criteria is defined or referenced within the analytical SOP. Example calculations are included in each of the method SOPs.
- 14.2.5.4 For MB and LCS analyses the surrogate recovery must fall within defined criteria. The surrogate recovery in field samples must fall within defined criteria unless bias resulting from matrix interference or dilution is demonstrated.
- 14.2.5.5 All samples associated with failed surrogate recovery in the MB



and/or LCS must be reprocessed (preparation and/or analysis). Refer to the method SOPs for specific corrective action procedures including any special circumstances for reporting of data.

14.3 Control Limits

14.3.1 Accuracy and precision acceptance criteria (i.e. control limits) are based upon method specifications, program or project specifications, control charting, or a combination thereof. Procedures for control limits are given in the corporate SOP CE-QA009, *Control Limits*.

14.3.2 Accuracy and precision criteria are reviewed and updated at least annually, or as necessary based on significant changes made to the analysis, or as a result of internal audit findings. Since control limits may therefore change intermittently, a current list of control limits may be obtained from the laboratory upon request.

14.4 Data Review

14.4.1 The laboratory reviews all data generated in the laboratory for compliance with method, laboratory, and client requirements. All data review is documented through the use of data checklists. Procedures for data review are documented in SOP-SC-QS-009, *Data Review and Validation*.

14.4.2 The primary analyst reviews 100% of all raw data for acceptability of quality control measures and accuracy of the final result(s).

14.4.3 A peer analyst reviews 100% of all raw data including manual data entry, data calculations, and electronic transfers of data.

14.4.4 Final reports are reviewed by the project manager for comparison to historical data and client specification prior to release.

14.4.5 Departures from specified policy and procedure are documented on data quality checklists and narrated.

14.4.6 The quality assurance department must perform an independent review of raw data generation, quantitative calculations, and method performance through a combination of internal audits, client inquiries, non-conformance reports, and/or data package compilation.

14.4.7 Additional data quality indicators (DQI) that may be used to evaluate the analytical data produced are listed below. Acceptance criteria for these items must be agreed upon by both the laboratory and client or end user of the data on a project-by-project basis.

14.4.7.1 **Comparability:** a qualitative expression of the measure of confidence that two or more data sets may contribute to a common analysis. Comparability is achieved by utilizing the same preparation and/or analysis methods for the set of data being evaluated.

14.4.7.2 **Completeness:** a measure of the amount of valid data obtained from a measurement system, expressed as a percentage of the number of valid measurements that have been collected. Typical completeness goals are 90% for soil samples and 95% for water samples.

14.4.7.3 **Representativeness:** the measure of the degree to which data



suitably represent a characteristic of a population, a process condition, or an environmental condition. Representativeness is measured by comparing data from the same samples, sample location, or sampling grid. It takes into account other DQIs, such as bias and precision, to determine if the data is a good estimate of the population being sampled.

- 14.5 Estimation of Uncertainty – An estimation of uncertainty consists of the sum (combining the components) of the uncertainties of the numerous steps of the analytical process, including, but not limited to, sample plan variability, spatial and temporal sample variation, sample heterogeneity, calibration/calibration check variability, extraction variability, and weighing variability. To the degree where the laboratory has a control over these processes, the laboratory estimates uncertainty using the standard deviation calculated from routine Laboratory Control Samples (LCS). Procedures for estimating uncertainty are documented in SOP-SC-QS-022, *Measurement Uncertainty*.
- 14.6 Data Control
- 14.6.1 Procedures for the validation of software applications associated with data acquisition, calculation, and reporting are document in SOP-SC-IT-001, *LIMS Data Integrity and Verification*.
- 14.6.2 Procedures for ensuring that reported data are free from transcription and calculation errors are documented in SOP-SC-QS-009, *Data Reduction, Review, and Validation*.
- 14.6.3 Procedures for ensuring proper batch QC data evaluation are documented in SOP-SC-QS-020, *Batch QC Data Evaluation*.
- 14.6.4 Procedures for manual integration are documented in SOP-SC-QS-016, *Manual Integration Policy*.
- 14.6.5 Procedures for ensuring computer and software validation as well as data integrity, confidentiality, and security are documented in SOP-SC-IT-002, *Computer Software Installation and Maintenance*.

15) Control of Non-Conforming Environmental Testing Work

- 15.1 Non-conforming work is defined as work that does not meet specified acceptance criteria or project requirements. Non-conformances can include unacceptable quality control results, departures from SOPs, or method modifications. The policy for control of non-conforming work is to identify the non-conformance, determine its impact relative to data integrity/quality policy, and take appropriate action.
- 15.2 All employees have the authority to stop work on samples when any aspect of the process does not conform to laboratory requirements. Requests for departures from standard laboratory procedures are reviewed, approved, and documented by the Laboratory Director, Operations Manager, Department Supervisor(s), or QA Manager. The following criteria apply to the control of non-conforming work.
- 15.3 Evaluation & Management of Non-Conforming Work
- 15.3.1 Guidelines for evaluating batch QC parameters are documented in SOP SC-QS-020, *Batch QC Data Evaluation*.
- 15.3.2 Specific information is documented in each applicable analytical SOP as to QC criteria, corrective action, and acceptable deviations.



- 15.3.3 Procedures for the management of non-conforming work are detailed in SOP SC-GEN-005, *Departures from Documented Procedures*.
- 15.3.4 The laboratory must evaluate the significance of all non-conformances. If data integrity issues are indicated or suspected, corrective action must be taken prior to reporting or continuation of analytical work.
- 15.3.5 If non-conformances are discovered after work completion and reporting, the client must be notified of the impacted data.
- 15.4 The laboratory allows the release of non-conforming data only with approval by the appropriate Department Supervisor and Project Manager (or their designee) on a case-by-case basis. Such releases are contingent upon contractual or regulatory specifications.
 - 15.4.1 Work associated with contractual specifications or analytical SOPs that document “no deviations allowed” must achieve criteria. In such cases, allowing departures from analytical data control are not permitted.
 - 15.4.2 When sample data or QC results which include non-conforming data are to be reported, information on the circumstances should be provided in a report narrative. Data must be appropriately qualified or flagged when reported. A list of standard data qualifiers is listed in Appendix H.

16) Corrective Action, Preventive Action, and Improvement

- 16.1 Corrective action is the action taken to eliminate the cause(s) of an existing nonconformity, defect, or other undesirable situation in order to prevent its recurrence. Deficiencies cited in external assessments, internal quality audits, data reviews, complaint resolution, and/or managerial reviews are documented and require corrective action. Corrective action procedures for failed acceptance criteria relative to initial and continuing calibrations, quality control samples, and instrument performance are documented in the analytical SOPs.
- 16.2 Procedure for Corrective Action
 - 16.2.1 Procedures and guidelines for the corrective action process are specified in SOP SC-QS-003, *Non-Conformance & Corrective Action Reporting*.
 - 16.2.2 The Laboratory Supervisor, QA Manager, and/or Laboratory Director are responsible for initiating applicable corrective actions.
 - 16.2.3 All deficiencies must be investigated. A corrective action plan must be developed, documented and implemented if the deficiency is determined to be procedural or systemic.
- 16.3 Selection/Implementation of Corrective Actions
 - 16.3.1 Once a non-conformance is noted, the event must be reviewed to determine if it is indicative of a procedural or systemic deficiency resulting from a primary cause. Root cause analysis principles are encouraged and should be used where suitable.
 - 16.3.2 If a procedural or systemic deficiency is indicated, a Nonconformance and Corrective Action Report (NCAR) must be initiated and the root cause identified.
 - 16.3.3 In the event of uncertainty regarding the best approach for analysis/correction of the cause, the Department Supervisor, QA Manager, Operations Manager, or Laboratory Director will collaborate on the best course of action.



16.4 Verification and Monitoring of Corrective Action

16.4.1 The Department Supervisor(s) ensures that corrective actions are discharged within the agreed upon time frame. The QA Manager also verifies that implementation and documentation of the corrective action is complete.

16.4.2 To assure that the corrective actions are effective and remain implemented, the ongoing verification of corrective actions may be included in internal audits.

16.5 Preventive Action

16.5.1 Preventive action aims at minimizing or eliminating occurrences of data quality anomalies or other laboratory issues before they occur through procedural improvement, scheduled maintenance, and data review. The following preventive action measures are taken at the laboratory.

- Review of QC data to identify quality trends
- Regularly scheduled staff quality meetings
- Annual budget reviews
- Annual managerial reviews
- Running computer system modifications in tandem with the old system to assure at least one working system

16.5.2 All employees have the authority to recommend preventative action procedures. Management is responsible for reviewing all preventative action recommendations and implementing same where deemed appropriate.

16.5.3 Preventive maintenance of equipment and instrumentation is an important component of preventive action. Routine instrument preventive maintenance is included in SOPs and outlined in the following table.

16.6 Improvement

The laboratory strives to continually improve operations, processes, and quality systems. Identifying areas for improvement, or larger improvement initiatives, is a result of monitoring the certain aspects of the laboratory's management and quality system. This includes annual managerial reviews, evaluating on-going performance indicators and balanced scorecards, internal and external audit results, review of data, and the effectiveness of corrective and preventive actions. Improvement is also a consideration in periodic budgeting and planning processes.



Equipment and Instrumentation Preventive Maintenance

Instrument	Activity	Frequency	Service
Refrigerators and Coolers	Record temperature	Daily	
	Clean coils	Annually	
Vacuum Pumps	Clean and change pump oil	Every 6 months or as needed	
Fume Hoods	Face velocity measured	Annually	Service Contract
	Sash operation	As needed	
	Certified	Annually	
Autoclave	Check Door Gasket	Quarterly	
	Replace Door Gasket	Annually or as needed	
	Check Timing Device	Quarterly	
	BT Sure® Sterilization Check	Monthly	
Ovens	Clean	As needed or if temperature outside limits	
Analytical Balances	Check alignment	Before daily use	Field Service
	Check calibration	Before daily use	
	Clean pans and compartment	After every use	
	Certified	Annually	
Printers	Change toner	As needed	
	Clean printer internal parts	As needed	
	Change pick-up roller wheels	As needed	
Copier	Change toner	As needed	
	Routine maintenance	As needed	



17) Control of Records

- 17.1 Records are a subset of documents such as daily temperatures logs, instrumental run logs, analytical spreadsheets, and computer printouts that allow for the historical reconstruction of laboratory activities relating to sample handling, processing, and analysis. Records can be on various forms of media including electronic and hard copy. Record management and archival are conducted according to the following criteria.
- 17.2 Records Management and Storage
 - 17.2.1 Guidelines for the management of records are documented in SOP SC-QS-014, *Laboratory Record Procedures*.
 - 17.2.2 Guidelines for archiving records are described in SOP SC-QS-011, *Record Archival*. Archived records are indexed to include the storage identification, archived material identification, and date range of archived material.
- 17.3 Procedures for evidentiary sample custody (if applicable) are documented in SOP SC-SM-001, *Sample Receipt & Log-In Procedures*.

18) Audits

- 18.1 Audits assess the laboratory performance and verify compliance with accreditation, certification, project, and method requirements. Audits also provide management with an on-going assessment of the quality system. They are also instrumental in identifying areas where improvement in the quality system can increase the reliability of data.
- 18.2 Audits are of four main types: internal, external, performance, and system. In the event that analytical anomalies are identified upon completion of any audit, clients must be notified within two working days (48 hours) of any deviations that cast doubt on the accuracy of previously issued reports.
- 18.3 Internal Audits
 - 18.3.1 Internal audits are conducted by the QA department throughout the year and must encompass all areas of the laboratory operation. Internal audit procedures are documented in SOP SC-QS-012, *Internal Audits*. These audits primarily focus on technical areas, method compliance, and quality systems compliance within day-to-day operations.
 - 18.3.2 Internal audits are also periodically conducted by the Corporate QA Manager or designee. These audits focus primarily on the quality program implementation and quality systems and evaluate these against established accreditation, program, and internal quality system standards.
 - 18.3.3 Internal audits are regularly reported to management. Any deficiencies identified are corrected and corrective action verified by the QA Manager.
- 18.4 External Audits
 - 18.4.1 Most commonly, external audits and assessments of the laboratory are performed by certification/accreditation bodies to evaluate compliance with the applicable program or Standard. Audits may also be performed by clients, or their representatives, in support of project needs. It is the laboratory's policy to encourage, cooperate and assist with all external audits, whether performed by clients or an accrediting authority.



18.4.2 Management must ensure that all applicable areas of the laboratory are accessible to auditors and that the appropriate personnel are available to assist in the audit.

18.4.3 The QA department must ensure that any noted deficiencies or findings requiring corrective actions are adequately addressed. This normally involves collaboration with the Supervisor(s), Laboratory Director, and applicable laboratory staff. The QA department assigns appropriate corrective action(s) to each item and tracks actions to closure. This includes handling all pertinent correspondence with the auditing entity and providing documentation.

18.5 Proficiency Test Samples

The laboratory participates in proficiency test (PT) programs approximately every six (6) months. Results are evaluated independently by an approved provider.

18.5.1 Samples submitted for Proficiency Testing must be treated as typical samples in the normal production process.

18.5.2 The laboratory cannot communicate with other laboratories and does not attempt to obtain the assigned values of any PT sample from the provider.

18.5.3 The laboratory institutes corrective action procedures for failed PT samples and the root cause is identified. Root cause is the condition or event that, if corrected or eliminated, would prevent the recurrence of the deficiency.

18.6 System Audits

18.6.1 A quality system evaluation must be performed annually by the QA Manager.

18.6.2 Findings from this evaluation must be submitted to the Laboratory Director and must include findings from internal audits, external audits, performance evaluation results, and client assessments.

18.6.3 The Corporate QA Manager or designee will also periodically perform a more in-depth systems audit. This audit will focus on all elements of the quality system, including those in this QAM and described in programmatic SOPs, and evaluate these against established quality system standards.

19) Management Review

19.1 Top management reviews the management system on an annual basis and maintains records of review findings and actions. The following Management Review topics are reviewed to ensure their suitability and effectiveness:

- the suitability of policies and procedures;
- reports from managerial and supervisory personnel;
- the outcome of recent internal audits;
- corrective and preventive actions;
- assessments by external bodies;
- the results of interlaboratory comparisons or proficiency tests;
- changes in the volume and type of the work;
- customer feedback;
- complaints;
- recommendations for improvement;
- other relevant factors, such as quality control activities, resources, and staff training.



- 19.2 Specific procedures regarding the Management Review are described in the SOP SC-QS-017, *QA Management Review* and in the corporate SOP CE-QA005, *Laboratory Management Review*. Findings and follow-up actions from management reviews are recorded. Management will determine appropriate completion dates for action items and ensure they are completed within the agreed upon time frame.

20) Personnel

- 20.1 All personnel are responsible for complying with all quality and data integrity policies and procedures that are relevant to their area of responsibility. All personnel who are involved in activities related to sample analysis, evaluation of results or who sign test reports, must demonstrate competence in their area of responsibility. Appropriate supervision is given to any personnel in training and the trainer is accountable for the quality of the trainees work. Personnel are qualified to perform the tasks they are responsible for based on education, training, experience and demonstrated skills as required for their area of responsibility.
- 20.2 The laboratory provides goals for education, training and skills of laboratory staff. These goals are outlined in job descriptions. Training needs are identified at the time of employment and when personnel are moved to a new position or new responsibilities are added to their job responsibilities. Ongoing training, as needed, is also provided to personnel in their current jobs. The effectiveness of the training must be evaluated before the training is considered complete.
- 20.3 Job descriptions are available for all positions that manage, perform, or verify work affecting data quality. An overview of top management's responsibilities is included in Section 3 - "Management".
- 20.4 Job descriptions include the specific tasks, minimum education and qualifications, skills, and experience required for each position Provide overview using components from the TNI Standard. Include how job descriptions are used.
- 20.5 General Training
- 20.5.1 Employees are trained and competent in their assigned tasks before they contribute to functions that can affect data quality. It is management's responsibility to assure personnel are trained.
- 20.5.2 All personnel must be appropriately trained and demonstrate competency in their assigned tasks before they can contribute independently to functions that can affect data quality. Training records are used to document management's approval of personnel competency.
- 20.5.3 Procedures for employee training, including initial training, demonstration of competency, and ongoing training are described in SOP SC-QS-013, *Employee Training*.
- 20.6 Data Integrity and Ethics
- 20.6.1 Data integrity is the result of multiple processes, as described in SOP SC-QS-015, *Data Integrity System*. These processes assist in the production of valid data of known and documented quality. Data integrity and ethics procedures in the laboratory include documented data integrity procedures, initial training, on-going training, and signed/dated document of understanding for all laboratory employees. Department supervisors uphold data integrity by supporting integrated QA procedures, providing staff training, approving training results, and continuously monitoring their department's performance.



- 20.6.2 Employees are required to understand, through initial and ongoing ethics training, that any infractions of the laboratory data integrity procedures will result in an investigation and could lead to immediate termination, or civil/criminal prosecution. Guidelines for laboratory ethics, accountability, and responsibility are documented in SOP SC-GEN-002, *Laboratory Ethics*.
- 20.6.3 The mechanism for confidential reporting of ethics and data integrity issues is comprised of: 1) unrestricted access to senior management, 2) a documented policy that personnel must not be treated unfairly for reporting any instances of ethics or data integrity breaches, and 3) anonymous reporting. Any potential data integrity issue is handled confidentially until a follow-up evaluation, full investigation, or other appropriate action has been completed and the issues clarified. Inappropriate activities are documented, including disciplinary actions, corrective actions, and notifications of clients, if applicable.

21) Reporting of Results

- 21.1 The result of each test must be reported accurately, clearly, unambiguously, and objectively. Data are reported without qualification if they are: 1) greater than the practical quantitation limit, 2) lower than the upper quantitation limit, and 3) without compromised sample or method integrity.
- 21.2 Report formats are designed to meet the client’s data reporting requirements and accurately report each test performed and to minimize potential for misunderstanding or misuse. Test reports may include various levels of supplemental information such as QC data reporting or inclusion of raw data to produce validation-level reports, as requested by the client.
- 21.3 Procedures for the producing and formatting of test results are documented in SOP-SC-ADM-005, *Report Formatting*.
- 21.4 Reporting Results from Subcontractors
 - 21.4.1 Test results obtained from tests performed by subcontractors outside the ALS network must be clearly identified on the test report.
 - 21.4.2 Test results from subcontractors outside the ALS network must be reported in writing or electronically with a copy of the subcontractor’s report attached.
- 21.5 All test results transmitted by telephone, fax, telex, e-mail, or other electronic means must comply with the requirements of SOP-SC-GEN-004, *Client Confidentiality*.
- 21.6 Amendments to a test report after it has been issued must be in accordance with the specifications listed in SOP SC-ADM-005, *Report Formatting*.

22) Summary of Changes and Document History

Revision Number	Effective Date	Document Editor	Description of Changes
01.0	05/15/2013	L. Wolf/C. Stoike	Initial approved version
02.0	08/01/2016	C. Stoike	11.1.2.1 - Specify every sample is checked.
03.0	04/15/2019	L. Cooper	Appendix B, G, J - Updated Appendix F - Micro added



23) References for Quality System Standards, External Documents, Manuals, and Test Procedures

The following list represents key references for the laboratory quality program and systems. Also listed are the references for test methods used by the laboratory. SOPs referenced throughout this QAM are listed in Appendix G. Other normative documents related to the QA program implementation are included in Appendix I.

- TNI Standard - Environmental Laboratory Sector, Volume 1, *Management and Technical Requirements for Laboratories Performing Environmental Analysis*, EL-V1-2009.
- International Standard - *General Requirements for the Competence of Testing and Calibration Laboratories*, ISO/IEC 17025:2005(E)
- Selected USEPA Approved Methods, 40 CFR, Part 136, Table 1B; including changes incorporated in the *Methods Update Rule (MUR)* published March 12, 2007 and May 18, 2012.
- USEPA Methods published in Appendix A, B and C of 40 CFR, Part 136.
- *Standard Methods for the Examination of Water and Wastewater*, 18th through 22nd Editions, (1995-2011) and SM On-Line.
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, through Updates III (December 1996) and Update IV (February 2007), and new published methods online at <http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm>.
- Selected USEPA Drinking Water methods published by the USEPA Office of Ground Water and Drinking Water
 - *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, (Revised March 1983).
 - *Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA/600/R-93/100 (August 1993).
 - *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91/010 (June 1991) and Supplements.
 - *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, EPA 600/4-82-057.
 - *Methods for the Determination of Organic Compounds in Drinking Water*, EPA/600/4-88/039 and Supplements.
- Selected APHA, AWWA, and ASTM methods.
- *DoD Quality Systems Manual for Environmental Laboratories*, Version 4.2, 10/25/2010
- *Manual for the Certification of Laboratories Analyzing Drinking Water*, 5th Edition, EPA 815-B-97-001 (January 2005).
- USEPA Methods for Microorganisms
 - *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*, EPA/600/4-90/027F (1993).
 - *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*. EPA/600/4-89/001 (1989).



APPENDIX A – Glossary

DEFINITIONS

Accreditation Body: The territorial, state or federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation.

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Field of Proficiency Testing (FoPT): Analytes for which a laboratory is required to successfully analyze a PT sample in order to obtain or maintain accreditation, collectively defined as: matrix, technology/method, analyte.

Primary Accreditation Body (Primary AB): The accreditation or certification body responsible for assessing a laboratory's total quality system.

Proficiency Testing (PT): A means to evaluate a laboratory's performance under controlled conditions relative to a given set of criteria, through analysis of unknown samples provided by an external source.

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents.

Accreditation/Certification: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.

Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of up to 20 environmental samples of the same matrix prepared or analyzed as a group in the same 24 hour period. An analytical batch can include prepared samples originating from various preparation batches and can exceed 20 samples.

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards.

Chain of Custody: A record that documents the possession of a sample from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method.

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more useful form.



Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Time: The maximum time that can elapse between two specified activities, typically between sampling and the beginning of preparation or analysis.

Laboratory Control Sample (or Blank Spike): A sample matrix, free from the analytes of interest, spiked with known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure, and used to establish analytical control of the batch.

Limit of Detection (LOD): A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility.

Limit of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

Matrix: The substrate of a test sample.

Matrix Duplicate: A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method: A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis.

Quality Assurance: A system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.

Raw Data: The analytical output, records, and documentation generated during sampling and analysis. This includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC results, chromatograms, instrument outputs, and handwritten records.

Reference Material: Material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or at a given location.

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.



Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system.

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.

Standard Operating Procedures (SOPs): A written document that details the process for conducting an operation, analysis, or action, with thoroughly prescribed techniques and steps.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In calibration, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.

ACRONYMS

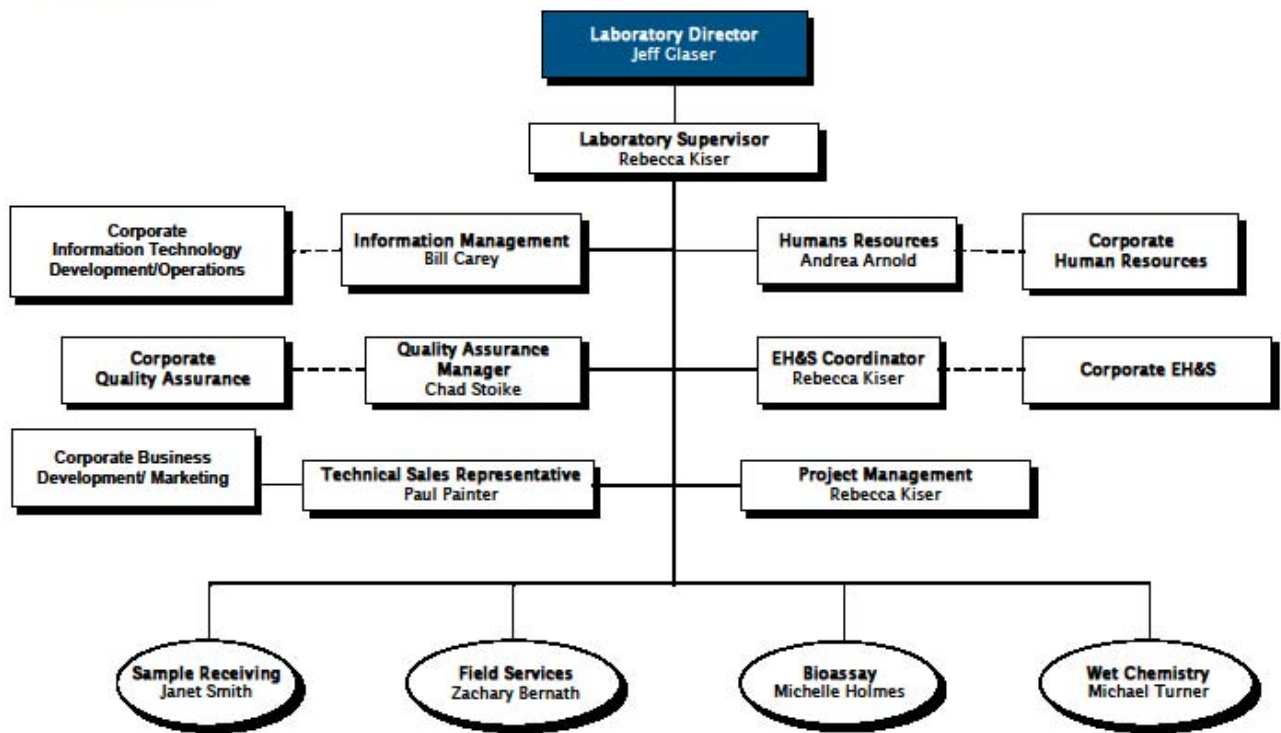
AB	Accrediting Body
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BLK	Blank
°C	degrees Celsius
ICAL	Initial Calibration
CAS	Chemical Abstract Service
CCV	Continuing calibration verification
COC	Chain of custody
DOC	Demonstration of Capability
EPA	Environmental Protection Agency
GC/MS	Gas chromatography/mass spectrometry
ICP-MS	Inductively coupled plasma-mass spectrometry
ICV	Initial calibration verification
IDC	Initial Demonstration of Capability
ISO/IEC	International Organization for Standardization/International Electrochemical Commission
LCS/LFB	Laboratory control sample/Laboratory fortified blank
MDL	Method Detection Limit
mg/Kg	milligrams per kilogram
mg/L	milligrams per liter
MRL	Minimum Reporting Level
MS	Matrix spike (MSD - Matrix Spike Duplicate)
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
ODC	Ongoing Demonstration of Capability
PQL	Practical Quantitation Limit
PT	Proficiency Test(ing)
QA	Quality Assurance
QC	Quality Control
QAM	Quality Assurance Manual
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SOP	Standard Operating Procedure
TNI	The NELAC institute
ug/L	micrograms per liter
VOC	Volatile organic compound
WET	Whole effluent toxicity



APPENDIX B – Organization Charts and Key Personnel Qualifications



South Charlestown, West Virginia Laboratory
April 15, 2019



Revised 8/1/2016



Jeff Glaser

1740 Union Carbide Drive | South Charleston, WV 25303 | +1 616 582-5202



Laboratory Director

2013 - Present

Responsible for all operations for the Holland, MI environmental laboratory, including strategic planning, financial performance, business development, laboratory analysis, field services, project management, and customer service. Involved in all aspects of laboratory operations including: analytical testing and reporting, sales & marketing, quality control/quality assurance and laboratory safety.

Previous Experience

ALS Environmental
Holland, MI

Technical Director, '10 - '11

Main responsibilities included: review of analytical methods for adherence to published procedures, analytical efficiency, and quality control; evaluation. Recommended new instruments, methods, and procedures; assisted with method development and implementation of new technologies; reviewed and revised standard operating procedures; reviewed technical requirements for potential clients and new projects; and continued improvement of laboratory operations.

TriMatrix Laboratories, Inc.
Grand Rapids, MI

Vice President Laboratory Operations, '98-'10

Responsible for operation and management of all laboratory departments, including sample preparation, wet chemistry, metals, semi-volatiles, and volatiles. Main functions included hiring, supervision, training, and evaluation of laboratory personnel; formulation, review, and updating of standard operating procedures; new method development; capital equipment acquisition, and final review of all CLP-like data packages prior to submission to clients. Also served as the primary resource for all Department of Defense laboratory regulations, including review and implementation of the DoD Quality Systems Manual for the laboratory.

TriMatrix Laboratories, Inc.
Grand Rapids, MI

Organics Manager, '96-'98

Responsible for the operation and management of the Organic Laboratory, including sample preparation, semi-volatiles and volatiles. Main functions included supervision and training of personnel, formulation of standard operating procedures, quality control and final approval of all organic laboratory data, compilation of data validation packages for CLP deliverables.

TriMatrix Laboratories, Inc.
Muskegon, MI

Laboratory Manager, '94-'96

Served 21 months as the Laboratory Manager of Muskegon facility before purchase and consolidation of Earth Technologies and TriMatrix laboratory operations, Instrumental in the initial start-up and formation of TriMatrix Laboratories, Inc. Responsible for all aspects of laboratory performance.

Great Lakes Environmental Laboratories
Muskegon, MI

Laboratory Supervisor, '92-'94

Responsible for supervision of all laboratory personnel on a daily basis. This included prioritizing workloads, training of personnel, and review of all raw data for adherence to QA/QC requirements. Functioned as an integral part of laboratory management team, providing input on budget proposals, sales strategies and goals, instrument purchases, definition of quality assurance plans, and laboratory expansion.

Education

Michigan State University,
East Lansing, MI
B.S. Biochemistry
1987



Rebecca Kiser

1740 Union Carbide Drive • South Charleston, WV 25303 • +1304-356-3168



Education

West Virginia State
College
Charleston, WV
BS, Biology, 1996

Laboratory Supervisor and Project Manager

2012 - Present

Responsible for technical project management, ensuring overall data quality and compliance with customer requirements. Provide technical support to clients regarding laboratory application to projects. Additionally, acts as a consultant to clients regarding industrial/environmental compliance issues; serving as liaison between clients and regulatory agencies. Responsible for direct technical project management annually providing technical and regulatory interpretation assistance, as well as project organization of work received and reported by the laboratory. Also, current responsibilities include employee and workload management.

Previous Experience

Standard Laboratories
South Charleston, WV
Same as above

Environmental Supervisor '10-'11

AC&S Inc.
Nitro, WV

Assistant Laboratory Manager,
'01-'10

Primary responsibilities include assisting with the management of all laboratory departments, scheduling, productivity, reporting and evaluation of analytical methodologies, project planning, budgeting, and Quality Assurance/Quality Control protocol oversight. Other responsibilities include conducting facility compliance reviews; providing departmental support for equipment purchases; resolving personnel issues; determining resource allocation; and providing supervision, training, and leadership to key laboratory staff

AC&S Inc.
Nitro, WV

Aquatic Toxicity Supervisor, '96-'10

Primary responsibilities include supervision and oversight of the Aquatic Toxicity department. This includes new method development, staff training, workload management, and instrument maintenance/troubleshooting. Duties include departmental compliance with QA/QC and Safety policies. Responsible for analysis, interpretation and report generation for aquatic toxicity analyses performed by the laboratory.

AC&S Inc.
Nitro, WV

Organic Analyst, '96-'01

Primary responsibilities included performing specific methods for the analyses of organic analytes under the rigorous guidelines of the laboratory's standard operating procedures. Also responsible for reviewing data produced for adherence to the laboratory's quality assurance program's requirements.



Chad Stoike

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QA Manager

2014 - Present

Responsible for the implementation and management of the laboratory's quality assurance program including current NELAP and state accreditations, the addition of new or expanded accreditations, review/maintenance of performance data, employee training, and customer inquiries. Review, recommend, and validate emerging analyses and/or technologies for laboratory utilization.

Previous Experience

Education

Grand Valley State
University - Allendale,
MI
B.S. - Chemistry, 2005,
Honors Graduate

ALS Environmental
Holland, MI

**Quality Assurance Assistant,
2012-2014**

Assisted in the implementation and management of the laboratory's quality assurance program including NELAP and state accreditations, the addition of new or expanded accreditations, review/maintenance of performance data, employee training records, and customer inquiries.

ALS Environmental
Holland, MI

**Metals Department Supervisor,
2007-2012**

Responsible for employee and workload management, acquisition, processing and validation of legally defensible data, ICPMS, CVAA and CVAF analysis and maintenance, while promoting strict adherence to prescribed methodologies within a safety conscious environment.

e-Lab Analytical
Holland, MI

**Quality Assurance Assistant,
2006-2007**

Maintained Standard Operating Procedure documentation. Assisted in the internal quality system review process. Performed an intensive data review in support of the laboratory compliance program.

e-Lab Analytical
Holland, MI

**Wet Chemistry Technician,
2005-2006**

Performed general chemistry techniques in accordance with laboratory Standard Operating Procedures. Technologies include Ion Chromatography, Flow-Injection Analysis, Solid Phase Extraction, titrations, distillations, and gravimetric determinations.



APPENDIX C – Ethics and Data Integrity Employee Agreement

ETHICS AND DATA INTEGRITY AGREEMENT

I state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at ALS.

I agree that in the performance of my duties at ALS:

1. I shall not intentionally report data values that are not the actual values obtained;
2. I shall not intentionally report the dates, times and method citations of data analyses that are not the actual dates, times and method citations of analyses;
3. I shall not intentionally represent another individual's work as my own;
4. I shall not intentionally report data values that do not meet established quality control criteria as set forth in the Method and/or Standard Operating Procedures, or as defined by company policy.
5. I agree to inform ALS of any accidental or intentional reporting of non-authentic data by other employees.
6. I have read this ethics and data integrity agreement and understand that failure to comply with the conditions stated above will result in disciplinary action, up to and including termination.
7. I agree to adhere to the following protocols and principals of ethical conduct in my work at ALS. All work assigned to me will be performed using ALS approved methods and procedures and in compliance with the quality assurance protocols defined in the ALS Quality System.
8. I will not intentionally falsify nor improperly manipulate any sample or QC data in any manner. Furthermore, I will not modify data values unless the modification can be technically justified through a measurable analytical process or method acceptable to ALS. All such modifications and their justification will be clearly and thoroughly documented in the raw data and appropriate laboratory record, and will include my initials or signature and the date.
9. I will not make false statements to, or seek to otherwise deceive ALS staff, managers or clients. I will not knowingly, through acts of commission, omission, erasure or destruction, improperly report any test results or conclusions, be they for client samples, QC samples, or standards.
10. I will not condone any accidental or intentional reporting of unauthentic data by other ALS staff and will immediately report such occurrences to my Supervisor, Lab Director, Quality Assurance Manager, or Human Resources. I understand that failure to report such occurrences may subject me to immediate discipline, including termination.
11. If a supervisor, manager, director or other member of the ALS leadership group requests me to engage in or perform an activity that I feel is compromising data validity or defensibility, I have the right to not comply with the request. I also have the right to appeal this action through an ALS local Quality Staff, Corporate Quality Assurance or Human Resources.
12. I understand that if my job includes supervisory responsibilities, I will not instruct, request or direct any subordinate to perform any unethical or non-defensible laboratory practice. Nor will I discourage, intimidate or inhibit a staff member who may choose to appropriately appeal my supervisory instruction, request or directive that may be perceived to be improper, nor retaliate against those who do so.
13. I understand that employees who report violations of this policy will be kept free from intimidation and recrimination arising from such reporting.

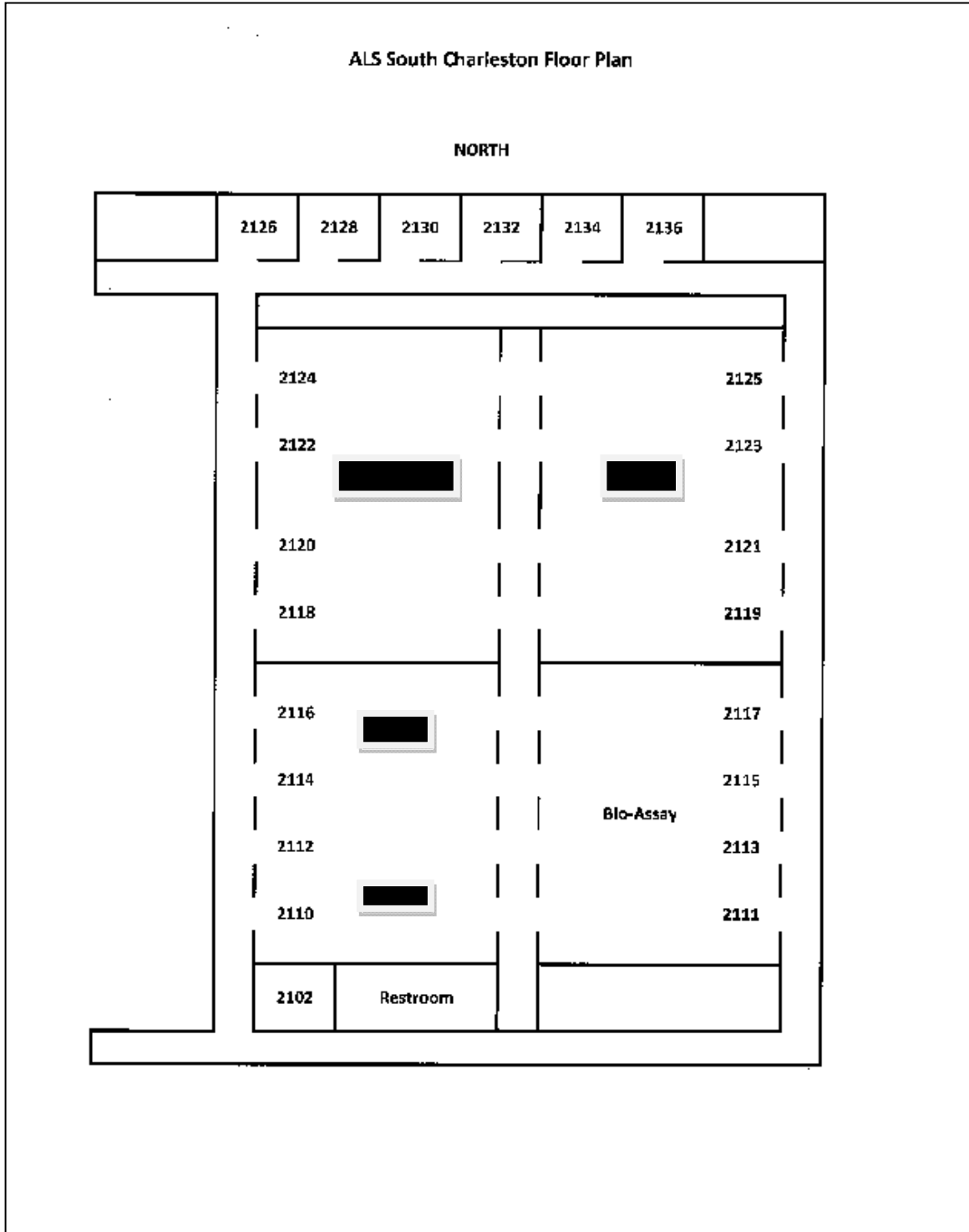
I have read, and understand the above policy and realize that failure to adhere to it may result in disciplinary action, up to and including termination. Compliance with this policy will be strictly enforced with all personnel employed by the company.

Employee Name _____ Signature _____

ALS Location _____ Date _____



APPENDIX D – Laboratory Floor Plan





APPENDIX E – Analytical Equipment

<u>ITEM</u>	<u>MODEL #</u>	<u>SERIAL #</u>
<u>BIOASSAY EQUIPMENT:</u>		
Barnstead E-Pure	D4641	562940245193
Air Pump	E49138	657H
Fisher Stir Plate	111001005	C18855120528360
Barnstead Incubator	844	2018080191062
Thermo Scientific Incubator	844	2018090216255
Dickson Data Logger	SM420	08227238
Dickson Data Logger	SM420	09336143
Dickson Data Logger	SM420	1146166
AND Balance (analytical)	HR-202	13200830
Frigidaire Refrigerator	LFTR1814LW9	BA22848124
YSI D.O. Meter	5000	96M0614AB
Thermo Scientific Conductivity Meter	Orion 3 Star	A11220
Oakton pH Meter	pH 110	1530644
Symphony Convection Oven	414004-566	0411305118U019



APPENDIX F – Containers, Preservation and Holding Times

Parameter	Containers ¹	Preservative	Holding Time ²
Acidity / E305.1	P, G - 250 ml	>0°C to ≤6°C	14 days (collection to analysis)
Alkalinity / SM 2320B – E310.1	P, G - 250 mL	>0°C to ≤6°C	14 days (collection to analysis)
Ammonia as N	P, G – 500 mL	>0°C to ≤6°C; H ₂ SO ₄ to pH<2	28 days (collection to analysis)
Biological Oxygen Demand (BOD)	P, G – 1000 mL	>0°C to ≤6°C	48 hours (collection to analysis)
(Carbonaceous) Biological Oxygen Demand (CBOD)	P, G – 1000 mL	>0°C to ≤6°C	48 hours (collection to analysis)
Bromide	P, G – 500 mL	None required	28 days (collection to analysis)
(Total Organic) Carbon (TOC) / SW 9060	P, G – 250 mL	>0°C to ≤6°C; SCO ₃ or H ₂ SO ₄ to pH<2	28 days (collection to analysis)
Chemical Oxygen Demand (COD)	P, G – 500 mL	>0°C to ≤6°C; H ₂ SO ₄ to pH<2	28 days (collection to analysis)
Chloride	P, G – 500 mL	None required	28 days (collection to analysis)
Color	P, G – 500 mL	>0°C to ≤6°C	48 hours (collection to analysis)
Conductivity (Spec. Conductance)	P, G – 250 mL	>0°C to ≤6°C	28 days (collection to analysis)
(Reactive) Cyanide	P, G – 4 oz wm	None required	14 days (collection to analysis)
Cyanide (Total and Amenable to Chlorination)	P, G - 1000 mL	>0°C to ≤6°C; NaOH to pH>12; 0.6g ascorbic acid	14 days (collection to analysis)
Cyanide (Total or Reactive) / Soil	P, G – 100 g in 250-ml wm bottle.	>0°C to ≤6°C	14 days (collection to analysis)
Fluoride	P – 250 mL	None required	28 days (collection to analysis)
Hardness	P, G – 250 mL	SCO ₃ or H ₂ SO ₄ to pH<2	6 months (collection to analysis)
Microbiology (Coliforms, E. Coli)	P – 100 mL	Na ₂ S ₂ O ₃ Refrigerate/ice if unable to analyze within 1 hour of collection	8 to 24 hours* *8 hours max for NPDES compliance
Nitrate as N	P, G – 250 mL	>0°C to ≤6°C	48 hours (collection to analysis)
Nitrate-Nitrite as N	P, G – 250 mL	>0°C to ≤6°C; H ₂ SO ₄ to pH<2	28 days (collection to analysis)
Nitrite as N	P, G – 250 mL	>0°C to ≤6°C	48 hours (collection to analysis)
(Total Kjeldahl) Nitrogen	P, G – 250 mL	>0°C to ≤6°C; H ₂ SO ₄ to pH<2	28 days (collection to analysis)
Oil and Grease	G – 1000 mL wm	>0°C to ≤6°C; H ₂ SO ₄ to pH<2	28 days (collection to analysis)
pH (hydrogen ion)	P, G – 250 mL	None required	analyze immediately
(Total) Phenols (wet method)	G / amber – 1000 mL	>0°C to ≤6°C; H ₂ SO ₄ to pH<2	28 days (collection to analysis)
(ortho-) Phosphate	P, G – 250 mL	Filter immediately; >0°C to ≤6°C	48 hours (collection to analysis)
(Total) Phosphate	P, G – 250 mL	>0°C to ≤6°C; H ₂ SO ₄ to pH<2	28 days (collection to analysis)
Residue (Total Solids)	P, G – 500 mL	>0°C to ≤6°C	7 days (collection to analysis)



Parameter	Containers ¹	Preservative	Holding Time ²
Residue (Dissolved Solids) (TDS)	P, G – 500 mL	>0°C to ≤6°C	7 days (collection to analysis)
Residue (Suspended Solids) (TSS)	P, G – 500 mL	>0°C to ≤6°C	7 days (collection to analysis)
Residue (Settleable)	P, G – 1000 mL	>0°C to ≤6°C	48 hours (collection to analysis)
Residue (Total Volatile) (TVS)	P, G – 500 mL	>0°C to ≤6°C	7 days (collection to analysis)
Residue (Volatile Suspended) (TVSS)	P, G – 500 mL	>0°C to ≤6°C	7 days (collection to analysis)
Silica	P – 500 mL	>0°C to ≤6°C	28 days (collection to analysis)
Chromium VI SM 3500 Cr D/SW846-7196A	P, G – 250 mL	>0°C to ≤6°C	24 hours (collection to analysis)
Chromium VI (soil) 3060A/7196A	P, G – 4 oz wide mouth	None	30 days (collection to extraction) 7 days (extraction to analysis)
Mercury by 7470A	P, G – 500 mL	SCO ₃ to pH<2	28 days (collection to analysis)
Mercury by 7471A(soil)	P, G – 4 oz wm bottle	>0°C to ≤6°C	28 days (collection to analysis)
Metals by 6020A/200.8 (except Chromium IV and Hg)	P, G – 1000 mL	SCO ₃ to pH<2	6 months (collection to analysis)
Metals by 6020A (soil)	P, G – 50 g	None	6 months (collection to analysis)
TCLP Mercury	P, G – 1000 mL	>0°C to ≤6°C	28 days (collection to extraction) 28 days (extraction to analysis)
TCLP Metals (except Mercury)	P, G – 1000 mL	>0°C to ≤6°C	180 days (collection to extraction) 180 days (extraction to analysis)
Dioxins (TCDD)	G – 2 x 1L amber	>0°C to ≤6°C; 0.008% Na ₂ S ₂ O ₃ if Cl ₂ is present	7 days (collection to extraction) 40 days (extraction to analysis)
Organochlorine Pesticides in Soil 8081A	G, 4 oz wide mouth	>0°C to ≤6°C	7 days (collection to extraction) 40 days (extraction to analysis)
Organochlorine Pesticides – water 8081A/EPA 608	Amber G, 2 x 1L	>0°C to ≤6°C; adjust pH to 4-5	7 days (collection to extraction) 40 days (extraction to analysis)
PCBs in Soil 8082	G, 4 oz wide mouth	>0°C to ≤6°C	7 days (collection to extraction) 40 days (extraction to analysis)
PCBs in water 8082 / EPA 608	Amber G; 2 x 1L	>0°C to ≤6°C; adjust pH to 4-5	7 days (collection to extraction) 40 days (extraction to analysis)
Petroleum Hydrocarbons (DRO) Water – TX 1005, WA-EPH, MA-EPH, WI-DRO, AK-DRO	G – 2 x 1L amber	>0°C to ≤6°C; HCl to pH<2	14 days (collection to extraction) 14 days (extraction to analysis)
Middle (C ₁₀ -C ₂₀) and Heavy (C ₂₀ -C ₃₄) Distillates Water by 8015C – Ohio VAP	G – 2 x 1L amber	>0°C to ≤6°C	7 days (collection to extraction) 40 days (extraction to analysis)
Petroleum Hydrocarbons (DRO) Water – TX 1005, WA-EPH, MA-EPH, WI-DRO, AK-DRO	G, 4 oz wide mouth	>0°C to ≤6°C; store in the dark	14 days (collection to extraction) 14 days (extraction to analysis)
Middle (C ₁₀ -C ₂₀) and Heavy (C ₂₀ -C ₃₄) Distillates Water by 8015C – Ohio VAP	G, 4 oz wide mouth	>0°C to ≤6°C; store in the dark	14 days (collection to extraction) 14 days (extraction to analysis)
Polynuclear Aromatic Hydrocarbons (PAHs) by 8270C (soil)	G, 4 oz wide mouth	>0°C to ≤6°C; store in the dark	14 days (collection to extraction) 14 days (extraction to analysis)



Parameter	Containers ¹	Preservative	Holding Time ²
Polynuclear Aromatic Hydrocarbons (PAHs) by 8270C (water)	Amber G; 2 x 1L	>0°C to ≤6°C	7 days (collection to extraction) 40 days (extraction to analysis)
Semi-Volatiles (BNAs) by 8270C in soil	G, 4 oz wide mouth	>0°C to ≤6°C	7 days (collection to extraction) 40 days (extraction to analysis)
Semi-Volatiles (BNAs) by 8270C/625 in water	Amber G, 2 x 1L	>0°C to ≤6°C	7 days (collection to extraction) 40 days (extraction to analysis)
Semi-Volatiles (TCLP)	G, 4 oz wide mouth	>0°C to ≤6°C	14 days (collection to TCLP extraction) 7 days (TCLP extraction to BNA extraction) 40 days (BNA extraction to analysis)
Total Organic Halogens (TOX) / 9020	Amber G, 250mL	>0°C to ≤6°C; H ₂ SO ₄ to pH<2	28 days (collection to analysis)
Volatiles (water) 8260B & 8015C GRO/Ohio VAP Light Distillates C ₆ -C ₁₂	G – 3 x 40 mL with no headspace	>0°C to ≤6°C; HCl to pH<2	14 days (collection to analysis)
Volatiles (TCLP)	G, 2 x 4 oz wide mouth	>0°C to ≤6°C	14 days (collection to TCLP extraction) 7 days (TCLP extraction to analysis)
Volatiles by 8260B (low level soil by 5035A, where soil likely contain VOCs < 200 ppb)	Collect sample using approved coring device (EnCore, etc) or field preserve 5 gram sample in pre-tared 40 ml VOA vial, containing 5ml of organic free water, 1g sodium bisulfate & stir bar	>0°C to ≤6°C	48 hrs to transfer contents of core device to a 40 ml VOA vial, containing 5ml of organic free water, 1g sodium bisulfate & stir bar; analyze transferred sample 14 days from collection
Volatiles by 8260B & 8015C (includes GRO and Ohio VAP Light Distillates C ₆ -C ₁₂) (high level soil by 5035A, where soil contain VOCs >200 ppb)	Collect sample using approved coring device (EnCore, etc) or field preserve samples in pre-tared 60 ml glass bottles with methanol	>0°C to ≤6°C	48 hrs to transfer contents of core device to a 40 ml VOA vial, containing 10 ml of purge and trap grade methanol; analyze methanol preserved sample 14 days from collection
Alpha, Beta, and Radium	P, G – 1000 mL	SCO ₃ to pH<2	6 months (collection to analysis)

¹ (P) Polyethylene/Plastic; (G) Glass

² Recommended Holding Times from 40CFR136 and/or USEPA SW-846.



APPENDIX G – Standard Operating Procedures*

SOP Number	Rev #	SOP Title	Effect Date
		General Operations	
SC-GEN-001	1	Preparation of Standard Operating Procedures	4/30/2013
SC-GEN-002	1	Laboratory Ethics, Accountability, & Responsibility	4/30/2013
SC-GEN-003	1	Glassware Cleaning	4/30/2013
SC-GEN-004	1	Client Confidentiality & Electronic Data Transfer	4/30/2013
SC-GEN-005	1	Departures from Documented Procedures	4/30/2013
SC-GEN-006	1	Resource Review	4/30/2013
SC-GEN-007	1	Subcontract Sample Submittal	4/30/2013
SC-GEN-008	1	QC Criteria Development	4/30/2013
SC-GEN-009	1	Management/Control of Standard Operating Procedures	4/30/2013
SC-GEN-010	1	Procurement of Services & Materials	4/30/2013
		Quality Assurance	
SC-QS-001	1	Chemical Purchase, Receipt, Storage, & Tracking	4/30/2013
SC-QS-002	1	Report Revisions	4/30/2013
SC-QS-003	1	Non-Conformance & Corrective Action Reporting	4/30/2013
SC-QS-004	1	Control Charting	4/30/2013
SC-QS-005	1	Validation of New Instruments & Methods	4/30/2013
SC-QS-006	1	Method Detection and Method Quantitation Limits	4/30/2013
SC-QS-007	1	Reagent Water	4/30/2013
SC-QS-008	1	Sub-Sampling and Sample Homogenization	4/30/2013
SC-QS-009	1	Data Reduction, Review, & Validation	4/30/2013
SC-QS-010	1	Laboratory Calculations & Significant Figures	4/30/2013
SC-QS-011	1	Record Archival	4/30/2013
SC-QS-012	1	Internal Audits	4/30/2013
SC-QS-013	1	Employee Training	4/30/2013
SC-QS-014	1	Laboratory Record Control Procedures	4/30/2013
SC-QS-015	1	Data Integrity System	4/30/2013
SC-QS-016	1	Manual Integration Policy	4/30/2013
SC-QS-017	1	Quality Assurance Management Review	4/30/2013
SC-QS-018	1	Sporadic Marginal Exceedance	4/30/2013
SC-QS-019	1	Chromatographic Calibrations	4/30/2013



SC-QS-020	1	Batch QC Evaluation	4/30/2013
SC-QS-021	1	Spectrophotometric Calibrations	4/30/2013
SC-QS-022	1	Estimation of Uncertainty	4/30/2013
		Information Technology	
SC-IT-001	1	Data Integrity & Verification	4/30/2013
SC-IT-002	1	Software Installation & Maintenance	4/30/2013
SC-IT-003	1	IT Security	4/30/2013
SC-IT-004	1	Test Code Management	4/30/2013
SC-IT-005	1	Electronic Time Changes	4/30/2013
		Safety	
SC-SAF-001	1	Waste Disposal Procedures	4/30/2013
SC-SAF-003	1	Lockout / Tagout	4/30/2013
		Aquatic Toxicology	
CULT001	1	Prep of EPA Mod. Hard Synthetic Freshwater	4/30/2013
CULT002	1	<i>Pimephales promelas</i> Culturing	4/30/2013
CULT003	1	<i>Artemia sp.</i> Culturing	4/30/2013
CULT004	1	<i>Ceriodaphnia dubia</i> Culturing	4/30/2013
TEST001	1	<i>P. promelas</i> Acute Reference	4/30/2013
TEST002	1	<i>P. promelas</i> Acute Test	4/30/2013
TEST003	1	<i>C. dubia</i> Chronic Reference	4/30/2013
TEST004	1	<i>P. promelas</i> Chronic Reference	4/30/2013
TEST005	1	<i>C. dubia</i> Chronic Test	4/30/2013
TEST006	1	<i>P. promelas</i> Chronic Test	4/30/2013
TEST007	1	<i>C. dubia</i> Acute Test	4/30/2013
TEST008	1	<i>C. dubia</i> Acute Reference	4/30/2013
MISC001	1	Glassware cleaning procedure	4/30/2013
MISC002	1	Procedure for measuring light intensity	4/30/2013
MISC003	1	Effluent Sampling and Shipment for Chronic Bioassays	4/30/2013
		Wet Chemistry	
SC-WC-001	1	Phosphorus	5/15/2013
SC-WC-006	3	BOD – CBOD	5/1/2019
SC-WC-014	1	Alkalinity	4/30/2013
SC-WC-016	1	pH Measurement	4/30/2013



SC-WC-018	2	Nitrite by Colorimetry	5/1/2019
SC-WC-019	1	Chloride by Titration	4/30/2013
SC-WC-022	1.1	Specific Conductance	7/01/2013
SC-WC-023	1	Residual Chlorine	4/30/2013
SC-WC-025	1	Turbidity	4/30/2013
SC-WC-026	1	Dissolved Oxygen	4/30/2013
SC-WC-027	1	Hardness	4/30/2013
SC-WC-030	1	Settleable Solids	5/15/2013
SC-WC-039	1	Sulfite by Titration	5/1/2019
SC-WC-050	1	Color	5/1/2019
		Equipment	
SC-EQ-001	1	Balance Use and Maintenance	4/30/2013
SC-EQ-002	2	Thermometers and Temperature Monitoring	5/1/2019
SC-EQ-003	1	Calibration of Volumetric Apparatus	4/30/2013
SC-EQ-004	1	PM and Maintenance Records	4/30/2013
		Microbiology	
SC-MB-001	1	Autoclave Maintenance	4/30/2013
SC-MB-002	1	Sterilization Procedures	4/30/2013
SC-MB-003	2	Fecal Coliform by Membrane Filter	5/1/2019
SC-MB-004	2	Total Coliforms by Membrane Filter	5/1/2019
SC-MB-005	2	Fecal Coliform by MPN	5/1/2019
SC-MB-006	2	Total Coliform by MPN	5/1/2019
SC-MB-007	4	E coli by m-ColiBlue24	5/1/2019
		Sample Management	
SC-SM-001	3	Sample Receipt	5/1/2019
SC-SM-002	1	Bottle Orders	5/30/2013
SC-SM-003	1	LIMS Log-In Procedures	5/30/2013
		Field Sampling	
SC-FIELD-001	1	Surface Water Sampling	5/30/2013
SC-FIELD-002	1	Ground Water Sampling	5/30/2013
SC-FIELD-003	1	Soil and Sediment Sampling	5/30/2013
SC-FIELD-004	1	Low-Level Mercury Sampling	5/30/2013



SC-FIELD-005	1	Waste Water Sampling	5/30/2013
		Administration	
SC-ADM-003	1	Work Order Reporting	5/30/2013
SC-ADM-004	1	Client Complaint Resolution	5/30/2013
SC-ADM-005	1	Work Order Formatting	5/30/2013

* SOP listings can change between QAM revisions. Contact the laboratory Project Manager or QA Manager for a current listing.



APPENDIX H – Data Qualifiers

- ND** - Not Detected at or above the Reporting Limit
- U** - Not detected at or above the Method Detection Limit
- J** - Value between the Method Detection Limit and Method Reporting Limit
- B** - Detected in the associated method blank
- S** - Accuracy outside defined recovery limits
- R** - Precision outside defined deviation limits
- P** - Dual column results > 40% difference
- E** - Estimated – value above quantitation range
- H** - Processed (analyzed or extracted) outside recommended hold time
- O** - Sample Concentration > 400% analyte spike level
- *** - Value exceeded Maximum Contaminant Level
- Z** - Laboratory defined as explained in narrative



APPENDIX I – Master List of Controlled Documents

Document Identification	Rev #	Document Title	Effect. Date
		Controlled Documents (Non-SOP)	
ALS-SC-QAM	2	Quality Assurance Manual	8/01/2016

Other normative documents:

- West Virginia 47CSR32 - *Regulations Governing Environmental Laboratories Certification and Standards of Performance.*
<http://apps.sos.wv.gov/adlaw/csr/readfile.aspx?DocId=22511&Format=PDF>
- TNI (The NELAC Institute) Quality Manual template, Revision 1, February 23, 2011.



APPENDIX J – Laboratory Accreditations

ATTACHMENT I

WEST VIRGINIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER AND WASTE MANAGEMENT

List of Certified Parameters
for

**ALS ENVIRONMENTAL - SOUTH
CHARLESTON, WV
SOUTH CHARLESTON, WEST VIRGINIA**

PARAMETERS CERTIFIED

NONPOTABLE WATER INORGANIC NONMETALS

<u>ANALYTE</u>	<u>METHOD</u>	<u>TECHNOLOGY</u>
Chlorine, Residual	SM4500-Cl G-11	Spectrophotometric
Color	SM2120 B-11	Spectrophotometric
Conductance, Specific	SM2510 B-11	Probe
Nitrate	SM4500-NO3 E-11	Calculation
Nitrate-Nitrite	SM4500-NO3 E-11	Spectrophotometric
Nitrite	SM4500-NO2 B-11	Spectrophotometric
Oxygen Demand, Biochemical (BOD)	SM5210 B-11	Probe
Oxygen Demand, Carbonaceous Biochemical (CBOD)	SM5210 B-11	Probe
Oxygen, Dissolved	SM4500-O G-11	Probe
pH (Hydrogen Ion)	SM4500-H B-11	Electrode
pH (Hydrogen Ion)	SW9040C	Electrode
Solids, Settleable	SM2540 F-11	Imhoff
Sulfite	SM4500-SO3 B-11	Titrimetric
Temperature	SM2550 B-00	Thermometric
Turbidity	EPA180.1 Rev 2.0-1993	Turbidimetric

NONPOTABLE WATER MICROBIOLOGY

<u>GROUP</u>	<u>METHOD</u>	<u>TECHNOLOGY</u>
Coliform, Fecal (MF)	SM9222 D-06	Membrane Filter
Coliform, Fecal (MPN)	SM9221 E-06	Multiple Tube
Coliform, Total (MF)	SM9222 B-06	Membrane Filter
Coliform, Total (MPN)	SM9221 B-06	Multiple Tube
E. Coli (MF)	HACH 10029	Membrane Filter



WHOLE EFFLUENT TOXICITY

<u>GROUP</u>	<u>METHOD</u>	<u>TECHNOLOGY</u>
Acute - Ceriodaphnia dubia	EPA821-R-02-012 2002.0	Acute
Acute - Fathead Minnow	EPA821-R-02-012 2000.0	Acute
Chronic - Ceriodaphnia dubia	EPA821-R-02-013 1002.0	Chronic
Chronic - Fathead Minnow	EPA821-R-02-013 1000.0	Chronic

SOLID AND CHEMICAL INORGANIC NONMETALS

<u>ANALYTE</u>	<u>METHOD</u>	<u>TECHNOLOGY</u>
pH (Hydrogen Ion)	SW9040C	Electrode
pH (Hydrogen Ion)	SW9045D	Electrode

SOLID AND CHEMICAL MICROBIOLOGY

<u>GROUP</u>	<u>METHOD</u>	<u>TECHNOLOGY</u>
Coliform, Fecal (MPN)	SM9221 E-06	Multiple Tube

This laboratory may test **ONLY** for those environmental parameters listed above for compliance reporting purposes. All testing must be by the test method cited in the current application for certification.

This Certification Expires May 31, 2019.

Certificate No 385

 Issued on March 26, 2018

Tommy W. Smith II
Quality Assurance Officer

This certified parameter list supersedes all previously issued parameter lists for this certificate number.

APPENDIX B
Health and Safety Plan

HEALTH AND SAFETY PLAN

Artistic Cleaners

821 20th Street
Huntington, Cabell County, West Virginia



Triad Project No. 04-21-0199

Prepared For:

City of Huntington
800 5th Avenue
Huntington, WV 25714

Prepared By:

Triad Engineering Inc.
10541 Teays Valley Road
Scott Depot, WV 25560

October 22, 2021

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1.0 PURPOSE AND SCOPE

This Site-Specific Health and Safety Plan (HASP), describes the health and safety procedures to be followed by Triad Engineering, Inc. (Triad) employees and subcontractors for environmental sampling and analysis activities to be performed at the Artistic Cleaners Site located in Huntington, Cabell County, West Virginia.

This HASP has been prepared by the Environmental Health & Safety (EH&S) Director for use by Triad, its designated representatives and subcontractors. This HASP is a dynamic document intended to be modified if additional information becomes available regarding planned field activities or potential hazards during the course of the project. It is the responsibility of the Project Manager (PM) to communicate any such information to the EH&S Director, who will determine the need to modify or addend this HASP.

The project will consist of field work described within the Sampling and Analysis Plan (SAP) which includes site assessment, surface and subsurface soil sample collection, and groundwater sample collection at the Artistic Cleaners located in Huntington, Cabell County, West Virginia.

The objective of the HASP is to provide workers with site-specific information and procedures that are to be followed in order to protect the health and safety of site personnel during field work activities. It is designed to provide guidance in identifying, evaluating, and controlling hazards in the work environment, as well as providing for emergency preparedness and response at the site during all field operations. All work shall be performed in compliance with applicable Federal, State, and local regulations, and in particular with the provisions of OSHA 29 CFR 1910 and 1926, Occupational Safety and Health Standards for General Industry and Construction.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Project Contacts:

Contact: Shannon Johnson (Field Operations Manager)
10541 Teays Valley Road
Scott Depot, West Virginia 25560
Phone: (304) 755-0721 (office)
Cell: (304) 951-4995 (mobile)

Contact: Heather Metz (Project Manager)
10541 Teays Valley Road
Scott Depot, West Virginia 25560
Phone: (304) 755-0721 (office)
Cell: (304) 544-1649 (mobile)

Contact: Cadaris Woods (Safety Director)
10541 Teays Valley Road
Scott Depot, West Virginia 25560
Phone: (304) 755-0721 (office)
Cell: (304) 417-6619 (mobile)

Contact: Joe Fleck (EnviroCore, Inc. – Drilling Sub-Contractor)
8250 Estates Parkway
Plain City, Ohio 43064
Phone: (614) 263-6554 (office)
Cell: (614) 733-0377 (mobile)

2.1 PROJECT ORGANIZATION

Project Manager: Heather Metz

The Triad PM is responsible for the overall coordination of site activities and changes in the scope of work. The PM shall communicate any new or additional information concerning planned field activities or potential hazards to the EH&S Director. The PM will communicate any modifications of the HASP to all field personnel, including subcontractors. In addition, the

PM is responsible for seeing that all personnel have received required training, medical surveillance, proper PPE and will continuously monitor site operations for compliance with this HASP.

Environmental Health and Safety Director: Cadaris Woods

The EH&S Director is a resource for development of the site-specific HASP and will be consulted on all health and safety issues that arise in the field and will be solely responsible for making final decisions associated with this HASP.

Field Operations Manager: Shannon Johnson

The Field Operations Manager (FOM) will assist the Project Manager with coordinating field-related activities and maintaining field operations in accordance with project requirements. The FOM will make initial health and safety decisions in relation to the guidelines set forth in this HASP and will consult with the EH&S Director with questions whenever necessary. The FOM will assist with the implementation of this HASP, which will include but not be limited to site briefings, record keeping, and evaluation of constantly changing site conditions. The FOM will also exercise stop-work authority if an unanticipated dangerous situation arises. Furthermore, the FOM will be responsible for maintaining a first aid kit at all times and coordinate all on-site safety and health issues with site operators. The FOM will assure that on-site personnel have the proper equipment and training to effectively perform their designated responsibilities and ensure that each employee understands the purpose and intricacies of this plan.

3.0 HAZARD ANALYSIS

3.1 PHYSICAL HAZARDS

There are various physical hazards that field personnel may encounter. The following are the hazards potentially associated with this project:

- Lifting Hazards
- Heavy Equipment Operations
- Slip, Trip and Fall Hazards
- Ambient Temperature Extremes

- Inclement Weather
- Environmental Hazards
- Housekeeping
- Elevated Work Surfaces
- Stress & Fatigue
- Noise Hazards
- Underground Utilities

All physical hazards shall be addressed in a Job Hazard Analysis (JHA) during the safety meeting prior to job commencement by the EH&S Director/Project Manager.

See Attachment 1.0 for JHA Form

Lifting Hazards

The potential exists for workers to become injured while lifting or maneuvering heavy objects during the performance of various tasks on site. If these objects are improperly lifted, it could result in debilitating back injuries. Site personnel should employ proper lifting techniques when working individually and use a buddy system or machinery when a situation involves an object that is too heavy for one person to manage.

Six-Step Technique for Lifting:

1. **Plan ahead before lifting** – Knowing what you're doing and where you're going will prevent you from making awkward movements while holding something heavy. Clear a path, and if lifting something with another person, make sure both of you agree on the plan.
2. **Lift close to your body** – You will be a stronger and more stable lifter if the object is held close to your body rather than at the end of your reach. Make sure you have a firm hold on the object you are lifting, and keep it balanced close to your body.
3. **Feet shoulder width apart** – A solid base of support is important while lifting. Holding your feet too close together will be unstable, too far apart will hinder movement. Keep the feet about shoulder width apart and take short steps.

4. **Bend your knees and keep your back straight** – Practice the lifting motion before you lift the object, and think about your motion before you lift. Focus on keeping your spine straight--raise and lower objects to the ground by bending your knees.
5. **Tighten your stomach muscles** – Tightening your abdominal muscles will hold your back in a good lifting position and will help prevent excessive force on the spine.
6. **Lift with your legs** – Your legs are many times stronger than your back muscles--let your strength work in your favor. Again, lower to the ground by bending your knees, not your back. Keeping your eyes focused upwards helps to keep your back straight.

Heavy Equipment

Ground personnel shall communicate with the operator before entering and after exiting that operator's work area. The swing radius of any piece of equipment must be established and at no time are ground personnel to enter that area when the equipment is in operation. Only qualified personnel shall operate equipment.

Truck Staging

Trucks shall be staged where they will be within a safe distance of all heavy equipment. Ground travel will not be permitted between any heavy machinery during loading. Spotters will be used to assist trucks in navigation of the job site.

Excavations

Excavations 5ft. in depth or greater will not be entered without having an adequate protective system designed to prevent cave-ins. Sloping or shoring procedures should be overseen by a competent person and these systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system. Inspections and atmospheric monitoring may be required where necessary and should only be performed by a competent person. Soil should always be considered class "C" unless otherwise stated.

Ambient Temperature Extremes (Heat/Cold Stress)

Extreme cold environments may occur during performance of this work. Work performed

when the ambient air temperature is below 40°F, may result in varying levels of cold stress that include frost bite, hypothermia or trench foot. Environmental factors such as temperature, wind speed and moisture can contribute greatly to cold stress risk, as well as overall physical condition of the employee. Physiological factors such as metabolic rate and moisture content of the skin also play a large part in determining susceptibility to cold related illness. Work load will be monitored carefully, and proper personal protective equipment donned correctly. These conditions are dangerous, and when extreme could be fatal.

Work performed when the ambient air temperatures exceed 80° F may result in varying levels of heat stress which include heat rash, heat cramps, heat exhaustion and heat stroke. Environmental factors that contribute to heat related illness are high temperatures, wind speed, humidity and direct sun exposure. Employees working under these conditions will wear light colored clothing, take frequent breaks and consume plenty of water. It is imperative that our employees understand the importance of preventing heat/cold related illness. All employees will be trained to recognize signs, symptoms of overexposure and factors that significantly contribute to that.

See Attachment 2.0 for associated heat/cold stress information.

Stress and Fatigue

Stress and fatigue may become a factor during the course of this project. Extended hours worked by field personnel can be mentally and physically demanding. Field personnel should attempt to maintain a well-balanced diet and get a sufficient amount of sleep during the course of this project. Consumption of alcohol outside of work or over the counter medications during work can contribute to a stressful work environment and employees that practice these behaviors could experience a lack of hazard awareness while on the job.

Noise Hazards (excess of 85 dBA)

Noise exposure exceeding the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) may be encountered during operation of mechanical equipment. Personnel who are repeatedly overexposed could experience a permanent reduction in their ability to hear normal conversation. Appropriate hearing protection shall be worn while all mechanical equipment is in operation. It shall also be the responsibility of the PM to ensure that the application, use and maintenance of occupational hearing protection are in accordance with policies established by TRIAD and OSHA 29 CFR 1926.101.

Underground Utilities

All underground utilities shall be identified prior to any intrusive work in the project area. A Miss Utility One-Call shall be completed and documented at least 3 days prior to initiation of subsurface work. Underground utilities shall not at any time be located by mechanically powered excavation equipment.

Boat Safety

All vessels must be equipped with a U.S. Coast Guard approved personal flotation device for each person on board. Each PFD must be in good condition, be the proper size intended for the wearer and be readily accessible. PFD's must not be kept in containers, locked up or have other gear stowed on top of them as this will increase donning time in case of emergency.

3.3 ENVIRONMENTAL HAZARDS

Rodents, reptiles, stray animals, insects, spiders and poison ivy/oak/sumac are all environmental hazards that may be encountered during daily site operations. A site investigation to identify these hazards prior to work related activities is essential. The information obtained in that study will be conveyed to site personnel.

See Attachment 3.0 for related poison ivy information

Uneven/Unstable Terrain

Planned activities described in the scope of work will bring field personnel into areas where the potential exists for slips, trips and falls. These work areas shall be identified, discussed and documented on the JHA prior to work being performed in those areas.

Inclement Weather

As all work will be conducted outdoors, inclement weather may be encountered. As conditions may vary, it will be at the discretion of the PM to temporarily suspend or terminate activities as conditions dictate. If lightning is observed, work will be stopped immediately and not continued again until 30 minutes after the last known sighting. Refer to the Emergency Action Plan for specific information involving what to do in cases of extreme weather conditions.

Housekeeping

Good housekeeping is essential to the success of any project. Good housekeeping practices shall be maintained throughout the duration of the project. Items such as tools, cords, trash, debris or any other equipment utilized during the course of the project shall be maintained in an orderly fashion so as to not pose slip, trip and fall hazards.

3.4 CHEMICAL HAZARDS

Based on the previous environmental investigations performed, contaminants of potential concern (COPCs) have been identified at the site. COPCs at the site include volatile organic compounds (VOC), polynuclear aromatic hydrocarbons (PAH), and RCRA 8 metals.

Precautions will be taken to minimize the potential for site workers to encounter any such hazards. Eating, drinking and tobacco use in or around work zones is strictly prohibited and all site personnel will thoroughly wash their hands and face before practicing any of the aforementioned items.

See Attachment 4.0 for information on the items listed above

4.0 TRAINING

By signing this HASP, all personnel certify that they have read and understand the document and will abide by all of its requirements and provisions. Furthermore, the employee states that they have completed the training required by Triad and OSHA, including all necessary annual updates and certifications.

5.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE shall be required for various field activities and will be selected to minimize the potential for chemical contamination through the following routes of exposure: inhalation, ingestion, injection, and absorption. Selection of PPE will be determined by the HSC in this HASP and may be modified during the course of the work by the PM only after consultation and approval by the HSC. In addition, PPE will also be selected to minimize exposure to physical hazards. All field personnel shall wear the following PPE:

- Inner Nitrile Gloves (while sampling)
- Work Gloves
- Steel Toe Boots with tops that extend over the ankle
- Eye Protection (ANSI z.87) at all times
- Hard Hats (bill forward) if working in areas with overhead hazards or if required by site specific rules
- Hearing protection while mechanical equipment is in operation

6.0 MEDICAL SURVEILLANCE

All personnel who may come in contact with hazardous materials during field operations shall be medically monitored under the Triad medical monitoring program, in accordance with OSHA 29 CFR 1910.120 (f). At no time during field operations may a Triad employee be present on-site without current medical monitoring status. Other subcontractors working on site will also comply with OSHA 1910.120 medical monitoring requirements.

7.0 AIR MONITORING

Periodic air monitoring utilizing a Photo Ionization Detector (PID) of certain sampling locations shall be performed to ensure no exposure over OSHA PELs are encountered with respect to volatile or semi-volatile organic compounds. Should PID reading of 5 parts per million (ppm) above background levels be encountered in the breathing zone at certain sampling locations, site activities shall be terminated and the location re-evaluated with a higher level of protection. PID detectors utilize an ultraviolet light source to detect organic compounds in air. The light source (lamp) must be properly selected based on the photo ionization energies of the organic compounds present. (10.2 electron volts [eV] or 11.7 eV probe) By necessity, one must have knowledge of the contaminants on a site to select the proper probe.

8.0 SITE CONTROL MEASURES

Only designated and authorized personnel or subcontractors shall be permitted to enter the work zone. This shall be regulated by the PM. All personnel are to be in voice or visual contact with each other at all times. Under no circumstance should an employee cross any red taped areas.

9.0 DECONTAMINATION

The PM will implement decontamination activities in accordance with the provisions of OSHA 29 CFR 1910.120(k) **Decontamination**. The PM will establish decontamination procedures in consultation with the HSC. Decontamination procedures shall be monitored by the PM to determine effectiveness.

The objective of these procedures is to minimize the risk of exposure to hazardous substances. The procedures for decontaminating personnel upon leaving the contaminated area are addressed for each of the designated levels of protection. The procedures given are for the maximum and minimum amount of decontamination used for each level of protection (Level A, B, and C).

Decontamination lines are site specific since they are dependent upon the types of contamination on site. When the decontamination line is no longer required, contaminated wash and rinse solutions and contaminated articles must be contained and disposed of as hazardous waste in compliance with state and federal regulations.

Components of decontamination shall include:

- The establishment of three defined zones, an Exclusion Zone (EZ), a Contamination Reduction Zone (CRZ), and a Support Zone (SZ)
- The number and layout of decontamination stations
- Decontamination equipment needed
- Appropriate decontamination methods
- Methods to minimize site personnel contact with contaminants during removal of PPE

Decontamination procedures shall be revised whenever the type of PPE or equipment changes, the site conditions change, or the site hazards are reassessed based on new information.

Decontamination zones will be located so as to minimize the potential for contamination. The location of these zones shall be determined based on site reconnaissance performed by the PM.

All field equipment and non-disposable PPE will be decontaminated before personnel exit the CRZ. Disposable PPE and decontamination water and/or debris will be placed into 55-gallon drums or other suitable containers, labeled as "Potential Hazardous Waste, Pending Analysis" and stored on-site pending laboratory analytical results.

Decontamination of a direct-push rig and rods shall be performed prior to any drilling activities. At a minimum decontamination shall consist of thoroughly washing the rods with a steam pressure washer prior to any direct push activities. All rods used for this project will be decontaminated after the completion of the final boring and prior to leaving the site. Decontamination water from this process shall be collected in 55-gallon drums.

10.0 EMERGENCY RESPONSE PLAN

In the event of a serious injury, fire, or other emergency, the PM/FOM shall notify emergency services by calling **911**. In the event that an injury is serious enough to require transport to the nearest hospital by ambulance, this need will be coordinated by the FOM. **All injuries of a serious or non-serious nature will immediately be reported to the PM and/or the EH&S Director.**

The nearest hospital is: **Cabell Huntington Hospital**
 1340 Hal Greer Boulevard
 Huntington, West Virginia 25701

Attachment 5.0 identifies the location, map and the route to Cabell Huntington Hospital

Phone: (304) 526-2000

The following is a list of phone numbers to be used in the event of an emergency:

Fire	911
Ambulance	911
FOM	Shannon Johnson (Mobile: 304-951-4995)
PM	Heather Metz (Mobile: 304-544-1649)

11.0 CONFINED SPACE ENTRY

Triad does not anticipate a confined space entry on this project. Should a situation arise where an entry needs to be made the EH&S Director will coordinate and enforce the program and its components set forth by Triad.

12.0 SPILL CONTAINMENT

The only potential spill will be from water used for decontamination procedures. Liquids generated during decontamination will be containerized and staged on site pending later off-site disposal. Decontamination will occur in a designated area where spill controls are in place.

13.0 ACKNOWLEDGMENT

I hereby acknowledge that I have read and understand this Health and Safety Plan and that I agree to comply with its provisions and specifications.

NAME

SIGNATURE

DATE

JOB HAZARD ANALYSIS CHECKLIST

GENERAL PROJECT INFORMATION	HAZARD ELIMINATION MEASURES									
PROJECT NUMBER: _____ CLIENT: _____ BEGIN DATE: _____ EMPLOYEE NAME(S): _____ JOB TASK(S): _____ _____	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> <input type="checkbox"/> Traffic Control/Flagger <input type="checkbox"/> Caution Tape/Signage <input type="checkbox"/> Work Permit <input type="checkbox"/> Air Monitor <input type="checkbox"/> Training/Certification <input type="checkbox"/> Confined Space Permit <input type="checkbox"/> Railings/Barriers <input type="checkbox"/> Maintain 3-Point Contact <input type="checkbox"/> Task-specific Training </td> <td style="width: 50%; border: none; vertical-align: top;"> <input type="checkbox"/> Ladder/Trench Box <input type="checkbox"/> Lock Out/Tag Out Permit <input type="checkbox"/> Utilities Cleared <input type="checkbox"/> Insulate/De-energize Electrical <input type="checkbox"/> Safe Lifting Practices <input type="checkbox"/> Machine Guarding <input type="checkbox"/> Tools/Equip. in Good Condition <input type="checkbox"/> Clearing/Cleaning/Housekeeping <input type="checkbox"/> HAZWOPER Training </td> </tr> </table> Other: _____ _____	<input type="checkbox"/> Traffic Control/Flagger <input type="checkbox"/> Caution Tape/Signage <input type="checkbox"/> Work Permit <input type="checkbox"/> Air Monitor <input type="checkbox"/> Training/Certification <input type="checkbox"/> Confined Space Permit <input type="checkbox"/> Railings/Barriers <input type="checkbox"/> Maintain 3-Point Contact <input type="checkbox"/> Task-specific Training	<input type="checkbox"/> Ladder/Trench Box <input type="checkbox"/> Lock Out/Tag Out Permit <input type="checkbox"/> Utilities Cleared <input type="checkbox"/> Insulate/De-energize Electrical <input type="checkbox"/> Safe Lifting Practices <input type="checkbox"/> Machine Guarding <input type="checkbox"/> Tools/Equip. in Good Condition <input type="checkbox"/> Clearing/Cleaning/Housekeeping <input type="checkbox"/> HAZWOPER Training							
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PREPARED BY: _____ DATE: _____	<table style="width: 100%; border: none;"> <tr> <td colspan="3" style="text-align: center; border: none;">MULTI-DAY USE - REVIEW FOR CHANGED CONDITIONS - INITIAL & DATE</td> </tr> <tr> <td style="width: 33%; border: none; text-align: center;">_____</td> <td style="width: 33%; border: none; text-align: center;">_____</td> <td style="width: 33%; border: none; text-align: center;">_____</td> </tr> <tr> <td style="border: none; text-align: center;">_____</td> <td style="border: none; text-align: center;">_____</td> <td style="border: none; text-align: center;">New JHA after 5 days!</td> </tr> </table>	MULTI-DAY USE - REVIEW FOR CHANGED CONDITIONS - INITIAL & DATE			_____	_____	_____	_____	_____	New JHA after 5 days!
MULTI-DAY USE - REVIEW FOR CHANGED CONDITIONS - INITIAL & DATE										
_____	_____	_____								
_____	_____	New JHA after 5 days!								

JHA CHECKLIST INSTRUCTIONS

1. A minimum of one JHA must be prepared for each project that requires work outside the office.
2. If the project requires that work extends beyond one day, a single JHA can be used for up to one work week or five days, however, site conditions and job tasks must be reviewed and assessed each day.
3. If job tasks or site conditions change during the course of the project, you must revise the JHA or to prepare a new JHA (e.g., Change in weather, Change in job scope, Change in surroundings).
4. If changes are significant, or if work extends beyond five (5) days, a new JHA must always be completed.
5. Carefully read and consider each item individually under the **Potential Hazards Affecting Work** section. Ensure that you have considered all possible hazards.
6. Carefully read and consider each item individually under the **Hazard Elimination Measures** section. Ensure that you have determined and implemented all measures possible to eliminate or mitigate potential hazards.
7. Carefully read and consider each item individually under the **PPE Required** section. Ensure that you have obtained and are properly trained and qualified to utilize each required item of PPE.
8. If you have any questions regarding the assessment of your work, contact your supervisor immediately for advice.
9. **If you have any concerns that you cannot perform the work safely, do not begin work.** Immediately contact your supervisor to discuss alternatives.

ATTACHMENT 2.0

HEAT INDEX CHART

RELATIVE HUMIDITY (%)

°F	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	102	106	110	114	119	124	129	135			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	106	109	113	117	122	127	132
88	88	89	91	93	95	98	100	103	105	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

With Prolonged Exposure and/or Physical Activity

Extreme Danger: Heat Stroke Highly Likely

Danger: Heat Stroke, Heat Exhaustion, Muscle Cramps Likely

Caution: Heat Stroke, Heat Exhaustion, Muscle Cramps, and Fatigue Possible

Note: Heat Index values are devised for shady light wind conditions, exposure to full sunshine may increase these Heat Index values by 15°F.

Signs and Symptoms of Heat Stress:

Heat Rash may result from continuous exposure to heat or humid air.

Heat Cramps are caused by heavy sweating with inadequate electrolyte replacement.

Signs and symptoms include:

- Muscle spasms

- Pain in the hands, feet, and abdomen.

Heat Exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- Pale, cool, moist skin
- Heavy sweating
- Dizziness
- Nausea
- Fainting.

Heat Stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained.

Signs and symptoms are:

- Red, hot, usually dry skin
- Lack of or reduced perspiration
- Nausea
- Dizziness and confusion
- Strong, rapid pulse, or coma

Control Measures for Heat Stress:

- Provide adequate liquids to replace body fluids. Personnel must replace water and salt lost from sweating. Personnel must be encouraged to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement
- Replacement fluids can be commercial mixes such as Gatorade (dilute if possible). Maintain water temperature at 50° to 60°F. Have site personnel drink 16 ounces of fluid preferably water before beginning work
- Establish a work regimen that will provide adequate rest periods for cooling down. This may require additional shifts of workers
- Cooling devices such as cooling vests may be worn beneath protective garments

- Breaks are to be taken in a cool rest area
- Personnel shall remove impermeable protective garments during rest periods
- Personnel shall not be assigned other tasks during rest periods

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE

Estimated Wind Speed	Actual Temperature Readings (°F)						
	50	40	30	20	10	0	-10
Calm	50	40	30	20	10	0	-10
5	48	37	27	16	6	-5	-15
10	40	28	16	4	-9	-24	-33
15	36	22	9	-5	-18	-32	-45
20	32	18	4	-10	-25	-39	-53
25	30	16	0	-15	-29	-44	-59
30	28	13	-2	-18	-33	-48	-63
35	27	11	-4	-20	-35	-51	-67
40	26	10	-6	-21	-37	-53	-69
Wind speeds greater than 40 mph have little additional effect	LITTLE DANGER In <hr with dry skin Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute		

Developed by U.S. Army Research Institute of Environmental Medicine

Physiological Factors:

- **Level of Acclimatization**-Cold acclimatization, which is much less profound than heat acclimatization, produces a lowered internal body temperature and an increased blood flow through the exposed extremities.
- **Physical Condition**-As with heat stress the greater the physical fitness level of the person, the more the worker will adapt to, and tolerate, both the heat and the cold.
- **Age**-Older workers with circulatory problems require special precautionary protection against cold injury.
- **Gender**-There are some fundamental physiological differences between sexes in thermal tolerance; however, these differences tend to combine during work in such a way as to minimize the difference in overall response.
- **Weight**-In the cold, size is usually an advantage because typically more heat is generated in the body, and the reduced surface area-to-mass ratio keeps the person warmer. However, as with heat tolerance there is much individual variation in the influence of this factor

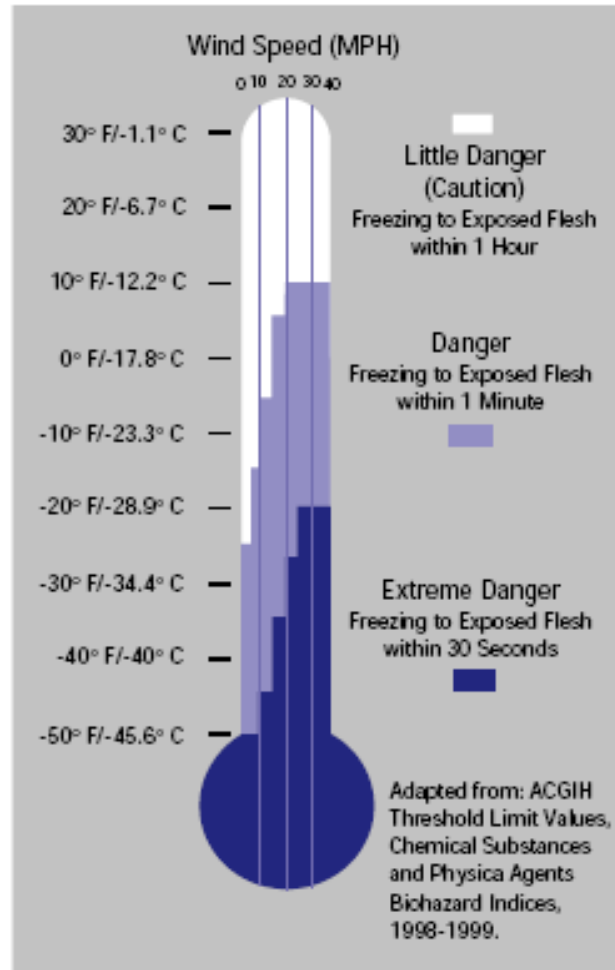
COLD INDEX CHART

THE COLD STRESS EQUATION

LOW TEMPERATURE + WIND SPEED + WETNESS
= INJURIES & ILLNESS

When the body is unable to warm itself, serious cold-related illnesses and injuries may occur, and permanent tissue damage and death may result.

Hypothermia can occur when *land temperatures* are **above** freezing or *water temperatures* are below 98.6°F/ 37°C. Cold-related illnesses can slowly overcome a person who has been chilled by low temperatures, brisk winds, or wet clothing.



U.S. Department of Labor
Occupational Safety and Health Administration

OSHA 3156
1998

Signs and Symptoms of Cold Stress:

- **Frostnip**-Less severe than frostbite, it causes the skin to turn white and typically occurs on the face and other exposed parts of the body. There is no tissue damage with frostnip. However, if the exposed area is not either covered or removed from exposure to the cold, frostnip can become frostbite.
- **Trench Foot**-A condition that manifests itself as tingling, itching, swelling, and pain. If these symptoms are not treated, this condition can lead to serious injury including blistering, death of tissue, and ulceration. Trench foot is caused by continuous exposure of the feet simultaneously to a cold but not freezing environment and moisture.
- **Frostbite**-Frostbite is similar to burns in that it has three degrees:
 - With first degree frostbite there is freezing but no blistering or peeling
 - With second degree frostbite there is freezing accompanied by blistering and peeling
 - With third degree frostbite there is freezing accompanied by death of skin and/or tissue.
- The first sign of frostbite is typically a sensation of cold and numbness. These symptoms may be accompanied by tingling, stinging, aching, or cramps. Frostbite of the outer layer of skin results in a whitish, waxy look. Deep frostbite results in tissue that is cold, pale, and solid.
- **Hypothermia**-A condition that results when the body's core temperature drops to dangerously low levels. If the condition is not reversed, the patient likely freezes to death. Signs and symptoms are:
 - Uncontrolled shivering
 - Sensation of cold
 - Slow or irregular heartbeat
 - Slow, slurred speech
 - Incoherence and confusion
 - Irregular breathing
 - Memory lapses
 - Fatigue or listlessness
 - Exhaustion.
 - A person's susceptibility to hypothermia is increased by sedative drugs and alcohol.
 - Sedatives interfere with the transmission of impulses from the nerve endings in the skin to the brain. This may cause a person to miss natural signs that they are in danger.
 - Alcohol dilates blood vessels near the skin surface. This in turn, increases the amount and rate of heat loss, which results in an even lower body temperature.

Control Measures for Cold Stress:

- Personnel should learn the hazards associated with cold stress and the means to

protect themselves and their fellow workers.

- Wear appropriate protective clothing
- Limit duration of exposure, be aware of actual temperature as well as wind chill factor, and seek heated shelter away from the wind for breaks
- Drink warm drinks for fluid replacement (nonalcoholic, caffeine free) this is just as important in cold environments as it is in hot environments
- Eat a properly balanced diet to ensure that the body is able to generate metabolic heat
- Keep the feet and all extremities dry.

Physiological Factors:

- **Level of Acclimatization**-Cold acclimatization, which is much less profound than heat acclimatization, produces a lowered internal body temperature and an increased blood flow through the exposed extremities.
- **Physical Condition**-As with heat stress the greater the physical fitness level of the person, the more the worker will adapt to, and tolerate, both the heat and the cold.
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ATTACHMENT 3.0

Poison Ivy Prevention

Because most people are sensitive to, and have a reaction when exposed to poison ivy and other poison ivy type plants, avoiding them are important. To avoid them, you have to learn what they look like.

To avoid these plants, in addition to the basic 'leaves of three, let it be', you should look for these characteristics of poison ivy, poison oak, and poison sumac:

Poison Ivy Identification

- frequently found around lakes and streams in the Midwestern and the Eastern parts of the United States and is also commonly found growing along trails and roadsides
- poison ivy grows as a woody, ropelike vine that can grow along fences or up trees, a trailing shrub on the ground, or a free-standing shrub
- it normally has three leaflets (groups of leaves all on the same small stem coming off the larger main stem), but may vary from groups of three to nine
- leaves are green in the summer and red in the fall
- yellow or green flowers and white berries

Poison Ivy Prevention

- **Avoid contact with plant by becoming familiar with the identification of poison ivy, poison oak, and poison sumac.**
- Wear long pants and long sleeve shirts when you have to go into areas of poison ivy type plants.
- Use protective skin wipes: Pre-Contact and Cleanser Towelettes.
- **DON'T BE TOUCHY** - You can spread urushiol-containing oils from one area of your body to others if you touch the contaminated area and get oils on your hands.
- **Give yourself, clothing and tools a good wash — quickly.** Use dish soap to remove all of the poison ivy, as dish soap is made to remove grease and oils, which includes poison ivy oil

CHEMICAL	PHYSICAL DESC.	EXPOSURE ROUTES	SYMPTOMS OF EXP.	FIRST AID MEASURES
Aluminum	Silvery-white, malleable, ductile, odorless metal	Inhalation, Ingestion, Absorption	Irritant	Wash affected area immed
Anthracene	Orange to dark-brown, crystalline solid.	Inhalation, Ingestion, Absorption	Irritant to skin and eyes (cough, wheeze and decreased pulmonary function)	Flush eyes, soap wash of skin
Alpha-BHC	White to yellow crystalline powder with a slight musty odor.	Inhalation, Ingestion, Absorption	Headache, nausea, muscle spasms. Irritation of the eyes, skin, nose and throat.	Flush of the eyes, wash skin with soap and water
Beryllium	Metal: Hard, brittle, gray-white solid.	Inhalation	Irritant to the eyes Chest pain, cough, clubbing of the fingers	Flush eyes, fresh air
Beta-BHC	White to yellow crystalline powder with a slight musty odor.	Inhalation, Ingestion, Absorption	Headache, nausea, muscle spasms. Irritation of the eyes, skin, nose and throat.	Flush of the eyes, wash skin with soap and water
Benzo Anthracene				
Arsenic	Silver-gray or tin-white, brittle, odorless solid	Inhalation, Absorption, Ingestion	Irritant to skin and eyes (lung and lymphatic cancer)	Flush eyes, wash of skin
Barium	White, odorless solid	Inhalation, Absorption, Ingestion	Irritant to skin, eyes, upper respiratory, musc. Spasms, slow pulse	Wash area, respiratory support
Lead	Heavy, ductile, soft, gray solid	Inhalation, Ingestion, Absorption	Kidney disease, hypertension, eye irritant	Flush eyes, wash skin, respiratory support, medical attention
Iron				
Calcium				
Cyanide				
Carbon Disulfide	Colorless to faint yellow liquid with a sweet ether-like odor.	Inhalation, Absorption, Ingestion	Dizzy, poor sleep, anxiety, weight loss	Flush eyes, wash skin with soap and water
Nickle	Lustrous, silvery, odorless solid			
Phenol				
Endosulfan Sulfate				
Endrin				
Acenaphthylene	Colorless solid	Inhalation, Ingestion, Absorption	Irritant to eyes and skin	Flush eyes, wash skin, respiratory support, medical attention

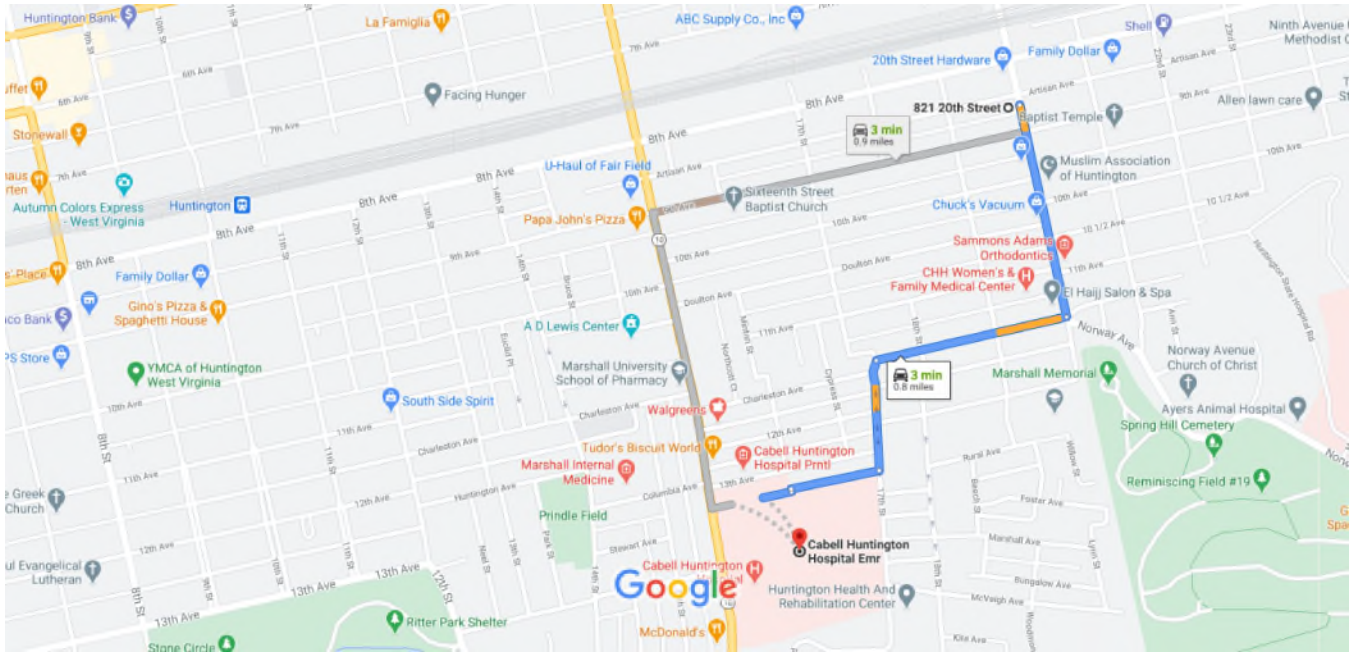
Cobalt	Odorless, silver-gray to black solid	Inhalation, Ingestion, Absorption	Cough, decrease pulmonary function, resp hypersensitivity	Flush eyes, wash skin, respiratory support, medical attention
Copper	Reddish, lustrous, malleable, odorless solid	Inhalation, Ingestion, Absorption	Metallic taste, eyes, nose, throat irritant	Flush eyes, wash skin, respiratory support, medical attention
Benzo(b)fluoranthene	Black or dark-brown amorphous residue	Inhalation, Ingestion, Absorption	Irritates throat, nose or lungs. May act as a sensitizer	Flush eyes, wash skin, respiratory support, medical attention
Benzo(k)fluoranthene	Black or dark-brown amorphous residue	Inhalation, Ingestion, Absorption	Irritates throat, nose or lungs. May act as a sensitizer	Flush eyes, wash skin, respiratory support, medical attention
Benzo(a)pyrene	Black or dark-brown amorphous residue	Inhalation, Ingestion, Absorption	Irritates throat, nose or lungs. May act as a sensitizer	Flush eyes, wash skin, respiratory support, medical attention
Chrysene	Black or dark-brown amorphous residue	Inhalation, Ingestion, Absorption	Irritates throat, nose or lungs. May act as a sensitizer	Flush eyes, wash skin, respiratory support, medical attention
Dieldrin	Colorless to light-tan crystals with a mild chemical odor (insecticide)	Inhalation, Ingestion, Absorption	Dizziness, nausea, vomiting, sweating, coma	Flush eyes, wash skin, respiratory support, medical attention
Mercury				
Gamma-BHC	White to yellow crystalline powder with a slight musty odor.	Inhalation, Ingestion, Absorption	Headache, nausea, muscle spasms. Irritation of the eyes, skin, nose and throat.	Flush of the eyes, wash skin with soap and water
Pyrene	Black or dark-brown amorphous residue	Inhalation, Ingestion, Absorption	Irritates throat, nose or lungs. May act as a sensitizer	Flush eyes, wash skin, respiratory support, medical attention
Ethylbenzene	Colorless liquid with an aromatic odor	Inhalation, Absorption, Ingestion	Irritant	Wash affected area immed; Give fresh air; Seek Med. Attn.; Flush eyes with water
Dioxin	Colorless to white crystalline solid	Inhalation, Ingestion, Absorption	Irritant, teratogenic effects	Flush eyes, wash skin, respiratory support, medical attention
Heptachlor	White to light tan crystals with a camphor-like odor	Inhalation, Ingestion, Absorption	Irritant	Flush eyes, wash skin, respiratory support, medical attention
Manganese	Lustrous brittle, silvery solid	Inhalation, Ingestion, Absorption	Mental confusion	Flush eyes, wash skin, respiratory support, medical attention
Phenanthrene	See coal tar pitch			

The above information was gathered from the National Institute for Occupational Safety and Health (NIOSH) pocket guide to hazardous chemicals.



821 20th St, Huntington, WV 25703 to Cabell
Huntington Hospital Emr

Drive 0.8 mile, 3 min



Map data ©2020 500 ft

821 20th St

Huntington, WV 25703

- ↑ 1. Head south on 20th St toward 9th Ave
0.3 mi
- ↘ 2. Turn right onto Charleston Ave
0.3 mi
- ↙ 3. Turn left onto 17th St
0.1 mi
- ↘ 4. Turn right toward Elm St
0.1 mi
- ↙ 5. Turn left onto Elm St
20 ft
- ↘ 6. Turn right
200 ft

Cabell Huntington Hospital Emr

1340 Hal Greer Boulevard, Huntington, WV 25701

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to

differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

APPENDIX C
Analytical Method Information



Data Quality Objectives - 2021

ALS Environmental
3352 128th Avenue
Holland, MI 49424
(616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,1,1,2-Tetrachloroethane	15.88	30	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,1,1-Trichloroethane	13.61	30	µg/Kg	70	135	70	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,1,2,2-Tetrachloroethane	13.24	30	µg/Kg	55	130	55	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,1,2-Trichloroethane	12.75	30	µg/Kg	60	125	60	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,1,2-Trichlorotrifluoroethane	19	30	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,1-Dichloroethane	10.94	30	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,1-Dichloroethene	9.72	30	µg/Kg	76	148	76	148	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,1-Dichloropropene	20.46	30	µg/Kg	70	135	70	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2,3-Trichlorobenzene	36	30	µg/Kg	60	135	60	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2,3-Trichloropropane	12.56	30	µg/Kg	65	130	65	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2,3-Trimethylbenzene	11.39	30	µg/Kg	65	135	65	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2,4-Trichlorobenzene	34	100	µg/Kg	65	130	65	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2,4-Trimethylbenzene	22	30	µg/Kg	65	135	65	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2-Dibromo-3-chloropropane	27.62	100	µg/Kg	40	135	40	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2-Dibromoethane	8.43	30	µg/Kg	80	195	80	195	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2-Dichlorobenzene	11.38	30	µg/Kg	75	120	75	120	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2-Dichloroethane	45	100	µg/Kg	70	135	70	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2-Dichloropropane	22.11	30	µg/Kg	70	120	70	120	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,3,5-Trichlorobenzene	16.06	30	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,3,5-Trimethylbenzene	35	100	µg/Kg	65	135	65	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,3-Dichlorobenzene	10.01	30	µg/Kg	70	125	70	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,3-Dichloropropane	8.41	30	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,4-Dichlorobenzene	7.23	30	µg/Kg	70	125	70	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,4-Dioxane	7509	10000	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	1-Methylnaphthalene	40	100	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	2,2,4-Trimethylpentane	16.67	30	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	2,2-Dichloropropane	32	100	µg/Kg	54	146	54	146	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	2-Butanone	24.68	200	µg/Kg	30	160	30	160	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	2-Chlorotoluene	10.99	30	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	2-Hexanone	14.88	30	µg/Kg	45	145	45	145	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	2-Methylnaphthalene	44	100	µg/Kg	0	0	0	0	
SW8260D	Volatile Organic Compounds	Soil-MeOH	4-Chlorotoluene	7.07	30	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	4-Isopropyltoluene	25.3	100	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	4-Methyl-2-pentanone	27.96	30	µg/Kg	74	176	74	176	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Acetone	89.03	100	µg/Kg	20	160	20	160	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Acetonitrile	25.35	100	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	Acrolein	361.7	1000	µg/Kg	0	0	0	0	0
SW8260D	Volatile Organic Compounds	Soil-MeOH	Acrylonitrile	35.26	100	µg/Kg	70	135	70	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Allyl chloride	20.92	100	µg/Kg	51	129	51	129	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Benzene	14.53	30	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Benzyl chloride	14.76	30	µg/Kg	0	0	0	0	0
SW8260D	Volatile Organic Compounds	Soil-MeOH	Bromobenzene	11.74	30	µg/Kg	65	120	65	120	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Bromochloromethane	15.26	30	µg/Kg	74	134	74	134	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Bromodichloromethane	16.8	30	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Bromofom	12.63	30	µg/Kg	55	135	55	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Bromomethane	57.38	100	µg/Kg	50	170	50	170	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Butyl acetate	19.18	100	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Carbon disulfide	15.53	30	µg/Kg	45	160	45	160	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Carbon tetrachloride	11.74	30	µg/Kg	65	135	65	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Chlorobenzene	9.96	30	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Chloroethane	29.52	100	µg/Kg	40	155	40	155	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Chloroform	10.99	30	µg/Kg	70	125	70	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Chloromethane	82	100	µg/Kg	50	144	50	144	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Chloropicrin	143.29	1000	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	Chloroprene	9.68	100	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	cis-1,2-Dichloroethene	19.29	30	µg/Kg	65	125	65	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	cis-1,3-Dichloropropene	22.6	30	µg/Kg	70	125	70	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Cyclohexane	26.94	100	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	Cyclohexanone	135.4	250	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	Dibromochloromethane	16.85	30	µg/Kg	65	135	65	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Dibromomethane	29	30	µg/Kg	75	130	75	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Dichlorodifluoromethane	36.31	100	µg/Kg	35	135	35	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Dichloromethane	79.61	250	µg/Kg	55	145	55	145	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Diethyl ether	14.99	30	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Diisopropyl ether	15.01	30	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Ethyl acetate	23.45	100	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Ethyl methacrylate	10.38	30	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Ethyl tert butyl ether	10.22	30	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Ethylbenzene	6.33	30	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Heptane	24.76	100	µg/Kg					



Data Quality Objectives - 2021

ALS Environmental
 3352 128th Avenue
 Holland, MI 49424
 (616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW8260D	Volatile Organic Compounds	Soil-MeOH	Hexachlorobutadiene	26.99	100	µg/Kg	55	140	55	140	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Hexachloroethane	17.82	100	µg/Kg	51	122	51	122	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Hexane	17.88	100	µg/Kg	0	0	0	0	0
SW8260D	Volatile Organic Compounds	Soil-MeOH	Iodomethane	460	500	µg/Kg	64	180	64	180	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Isobutyl alcohol	24.9	100	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	Isopropylbenzene	9.15	30	µg/Kg	75	130	75	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	m,p-Xylene	40	60	µg/Kg	80	125	80	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Methacrylonitrile	17.57	100	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Methyl acetate	35.92	250	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	Methyl iodide	460	500	µg/Kg	64	180	64	180	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Methyl methacrylate	21.64	100	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Methyl tert-butyl ether	8.65	30	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Methylcyclohexane	11.44	30	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	Methylene chloride	79.61	250	µg/Kg	55	145	55	145	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Naphthalene	72	100	µg/Kg	40	140	40	140	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	n-Butylbenzene	22	30	µg/Kg	65	140	65	140	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	n-Hexane	29.62	100	µg/Kg					
SW8260D	Volatile Organic Compounds	Soil-MeOH	n-Propylbenzene	23	30	µg/Kg	65	135	65	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	o-Xylene	11.6	30	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	p-Isopropyltoluene	25.3	100	µg/Kg	71	157	71	157	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Propionitrile	46.34	100	µg/Kg	0	0	0	0	0
SW8260D	Volatile Organic Compounds	Soil-MeOH	sec-Butylbenzene	11.82	30	µg/Kg	65	130	65	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Styrene	11.89	30	µg/Kg	80	138	80	138	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	tert-Amyl methyl ether	16.69	30	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	tert-Butyl alcohol	138.22	500	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	tert-Butylbenzene	9.71	30	µg/Kg	65	130	65	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Tertiaryamylmethylether	8.31	30	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Tetrachloroethene	18.07	30	µg/Kg	67	167	67	167	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Tetrahydrofuran	60	100	µg/Kg	70	135	70	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Toluene	8.19	30	µg/Kg	70	125	70	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	trans-1,2-Dichloroethene	11.03	30	µg/Kg	65	135	65	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	trans-1,3-Dichloropropene	16.75	30	µg/Kg	59	129	59	129	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	trans-1,4-Dichloro-2-butene	11.79	30	µg/Kg	62	112	62	112	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Trichloroethene	13.45	30	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Trichlorofluoromethane	15.34	30	µg/Kg	25	185	25	185	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Vinyl acetate	20.72	250	µg/Kg	0	0	0	0	0
SW8260D	Volatile Organic Compounds	Soil-MeOH	Vinyl chloride	19.94	30	µg/Kg	60	125	60	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2-Dichloroethene, Total	11.03	60	µg/Kg	65	135	65	135	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,3-Dichloropropene, Total	22.6	60	µg/Kg	59	129	59	129	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Xylenes, Total	40	90	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	1,2-Dichloroethane-d4	0	0	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	4-Bromofluorobenzene	0	0	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Dibromofluoromethane	0	0	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Soil-MeOH	Toluene-d8	0	0	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,1,1,2-Tetrachloroethane	0.76	5	µg/Kg	72	129	72	129	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,1,1-Trichloroethane	0.79	5	µg/Kg	73	138	73	138	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,1,2,2-Tetrachloroethane	0.64	5	µg/Kg	71	126	71	126	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,1,2-Trichloroethane	0.67	5	µg/Kg	77	123	77	123	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,1,2-Trichlorotrifluoroethane	1.1	5	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	1,1-Dichloroethane	0.62	5	µg/Kg	63	148	63	148	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,1-Dichloroethene	0.98	5	µg/Kg	67	156	67	156	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,1-Dichloropropene	0.87	5	µg/Kg	72	137	72	137	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2,3-Trichlorobenzene	1.8	5	µg/Kg	73	129	73	129	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2,3-Trichloropropane	0.83	5	µg/Kg	70	126	70	126	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2,4-Trichlorobenzene	1.1	5	µg/Kg	70	132	70	132	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2,4-Trimethylbenzene	1.8	5	µg/Kg	71	133	71	133	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2-Dibromo-3-chloropropane	0.99	5	µg/Kg	48	127	48	127	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2-Dibromoethane	0.36	5	µg/Kg	71	144	71	144	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2-Dichlorobenzene	0.7	5	µg/Kg	77	127	77	127	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2-Dichloroethane	0.56	5	µg/Kg	77	127	77	127	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2-Dichloropropane	0.44	5	µg/Kg	74	130	74	130	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,3,5-Trimethylbenzene	1.6	5	µg/Kg	71	139	71	139	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,3-Dichlorobenzene	0.61	5	µg/Kg	75	133	75	133	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,3-Dichloropropane	0.41	5	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,4-Dichlorobenzene	0.64	5	µg/Kg	74	130	74	130	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,4-Dioxane	98	100	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	1-Methylnaphthalene	1.9	5	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	2,2-Dichloropropane	0.59	5	µg/Kg	61	152	61	152	30
SW8260D	Volatile Organic Compounds - Low	Soil	2-Butanone	5.1	10	µg/Kg	55	132	55	132	30



Data Quality Objectives - 2021

ALS Environmental
3352 128th Avenue
Holland, MI 49424
(616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW8260D	Volatile Organic Compounds - Low	Soil	2-Chlorotoluene	0.77	5	µg/Kg	78	135	78	135	30
SW8260D	Volatile Organic Compounds - Low	Soil	2-Hexanone	1.8	5	µg/Kg	55	124	55	124	30
SW8260D	Volatile Organic Compounds - Low	Soil	2-Methylnaphthalene	2.3	5	µg/Kg	0	0	0	0	
SW8260D	Volatile Organic Compounds - Low	Soil	2-Nitropropane	3.1	10	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	4-Chlorotoluene	1.2	5	µg/Kg	75	125	75	125	30
SW8260D	Volatile Organic Compounds - Low	Soil	4-Isopropyltoluene	0.72	5	µg/Kg	70	139	70	139	30
SW8260D	Volatile Organic Compounds - Low	Soil	4-Methyl-2-pentanone	1.8	5	µg/Kg	67	159	67	159	30
SW8260D	Volatile Organic Compounds - Low	Soil	Acetone	4.6	10	µg/Kg	31	156	31	156	30
SW8260D	Volatile Organic Compounds - Low	Soil	Acetonitrile	2.2	10	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Acrolein	64	100	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Acrylonitrile	1.1	5	µg/Kg	54	141	54	141	30
SW8260D	Volatile Organic Compounds - Low	Soil	Allyl chloride	0.79	10	µg/Kg	72	130	72	130	30
SW8260D	Volatile Organic Compounds - Low	Soil	Benzene	0.52	5	µg/Kg	77	133	77	133	30
SW8260D	Volatile Organic Compounds - Low	Soil	Benzyl chloride	0.86	5	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Bromobenzene	0.56	10	µg/Kg	78	127	78	127	30
SW8260D	Volatile Organic Compounds - Low	Soil	Bromochloromethane	0.54	5	µg/Kg	72	139	72	139	30
SW8260D	Volatile Organic Compounds - Low	Soil	Bromodichloromethane	0.6	5	µg/Kg	69	133	69	133	30
SW8260D	Volatile Organic Compounds - Low	Soil	Bromoform	0.5	5	µg/Kg	55	126	55	126	30
SW8260D	Volatile Organic Compounds - Low	Soil	Bromomethane	2.5	10	µg/Kg	31	174	31	174	30
SW8260D	Volatile Organic Compounds - Low	Soil	Carbon disulfide	0.59	5	µg/Kg	45	160	45	160	30
SW8260D	Volatile Organic Compounds - Low	Soil	Carbon tetrachloride	1	5	µg/Kg	69	140	69	140	30
SW8260D	Volatile Organic Compounds - Low	Soil	Chlorobenzene	0.63	5	µg/Kg	76	130	76	130	30
SW8260D	Volatile Organic Compounds - Low	Soil	Chloroethane	1.9	5	µg/Kg	53	150	53	150	30
SW8260D	Volatile Organic Compounds - Low	Soil	Chloroform	0.82	5	µg/Kg	72	132	72	132	30
SW8260D	Volatile Organic Compounds - Low	Soil	Chloromethane	1	10	µg/Kg	43	150	43	150	30
SW8260D	Volatile Organic Compounds - Low	Soil	Chloropicrin	1.048	100	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Chloroprene	0.85	10	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	cis-1,2-Dichloroethene	0.54	5	µg/Kg	74	134	74	134	30
SW8260D	Volatile Organic Compounds - Low	Soil	cis-1,3-Dichloropropene	0.6	5	µg/Kg	62	134	62	134	30
SW8260D	Volatile Organic Compounds - Low	Soil	Cyclohexane	1.7	10	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Cyclohexanone	15	25	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Dibromochloromethane	0.51	5	µg/Kg	57	118	57	118	30
SW8260D	Volatile Organic Compounds - Low	Soil	Dibromomethane	0.68	5	µg/Kg	76	129	76	129	30
SW8260D	Volatile Organic Compounds - Low	Soil	Dichlorodifluoromethane	2.5	10	µg/Kg	43	126	43	126	30
SW8260D	Volatile Organic Compounds - Low	Soil	Dichloromethane	6.2	10	µg/Kg	55	157	55	157	30
SW8260D	Volatile Organic Compounds - Low	Soil	Diethyl ether	0.53	5	µg/Kg	70	125	70	125	30
SW8260D	Volatile Organic Compounds - Low	Soil	Diisopropyl ether	0.81	5	µg/Kg	67	125	67	125	30
SW8260D	Volatile Organic Compounds - Low	Soil	Ethyl acetate	1	10	µg/Kg	61	107	61	107	30
SW8260D	Volatile Organic Compounds - Low	Soil	Ethyl methacrylate	1	5	µg/Kg	59	121	59	121	30
SW8260D	Volatile Organic Compounds - Low	Soil	Ethylbenzene	0.87	5	µg/Kg	75	133	75	133	30
SW8260D	Volatile Organic Compounds - Low	Soil	Hexachlorobutadiene	1.2	5	µg/Kg	67	138	67	138	30
SW8260D	Volatile Organic Compounds - Low	Soil	Hexachloroethane	0.6	5	µg/Kg	49	123	49	123	30
SW8260D	Volatile Organic Compounds - Low	Soil	Hexane	2	5	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Iodomethane	3.3	5	µg/Kg	58	168	58	168	30
SW8260D	Volatile Organic Compounds - Low	Soil	Isobutyl alcohol	1.4	10	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Isopropylbenzene	0.85	5	µg/Kg	74	137	74	137	30
SW8260D	Volatile Organic Compounds - Low	Soil	m,p-Xylene	2.2	2.5	µg/Kg	75	134	75	134	30
SW8260D	Volatile Organic Compounds - Low	Soil	Methacrylonitrile	1.3	10	µg/Kg	54	119	54	119	30
SW8260D	Volatile Organic Compounds - Low	Soil	Methyl acetate	1.2	10	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Methyl iodide	3.3	5	µg/Kg	58	168	58	168	30
SW8260D	Volatile Organic Compounds - Low	Soil	Methyl methacrylate	1.6	10	µg/Kg	64	104	64	104	30
SW8260D	Volatile Organic Compounds - Low	Soil	Methyl tert-butyl ether	0.61	5	µg/Kg	62	136	62	136	30
SW8260D	Volatile Organic Compounds - Low	Soil	Methylcyclohexane	1.49	10	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Methylene chloride	6.2	10	µg/Kg	55	157	55	157	30
SW8260D	Volatile Organic Compounds - Low	Soil	Naphthalene	2.1	5	µg/Kg	67	125	67	125	30
SW8260D	Volatile Organic Compounds - Low	Soil	n-Butylbenzene	1.5	5	µg/Kg	69	141	69	141	30
SW8260D	Volatile Organic Compounds - Low	Soil	n-Hexane	2	5	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	n-Propylbenzene	1.7	5	µg/Kg	74	136	74	136	30
SW8260D	Volatile Organic Compounds - Low	Soil	o-Xylene	1.2	2.5	µg/Kg	76	130	76	130	30
SW8260D	Volatile Organic Compounds - Low	Soil	p-Isopropyltoluene	1.4	5	µg/Kg	70	139	70	139	30
SW8260D	Volatile Organic Compounds - Low	Soil	Propionitrile	3.19	10	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	sec-Butylbenzene	1.6	5	µg/Kg	73	139	73	139	30
SW8260D	Volatile Organic Compounds - Low	Soil	Styrene	0.75	5	µg/Kg	72	138	72	138	30
SW8260D	Volatile Organic Compounds - Low	Soil	tert-Butyl alcohol	15.97	25	µg/Kg	49	144	49	144	30
SW8260D	Volatile Organic Compounds - Low	Soil	tert-Butylbenzene	1.6	5	µg/Kg	70	139	70	139	30
SW8260D	Volatile Organic Compounds - Low	Soil	Tetrachloroethene	0.89	5	µg/Kg	70	171	70	171	30
SW8260D	Volatile Organic Compounds - Low	Soil	Tetrahydrofuran	3.86	20	µg/Kg	50	128	50	128	30
SW8260D	Volatile Organic Compounds - Low	Soil	Toluene	0.86	5	µg/Kg	76	130	76	130	30
SW8260D	Volatile Organic Compounds - Low	Soil	trans-1,2-Dichloroethene	0.5	5	µg/Kg	65	137	65	137	30
SW8260D	Volatile Organic Compounds - Low	Soil	trans-1,3-Dichloropropene	0.48	5	µg/Kg	58	126	58	126	30



Data Quality Objectives - 2021

ALS Environmental
3352 128th Avenue
Holland, MI 49424
(616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW8260D	Volatile Organic Compounds - Low	Soil	trans-1,4-Dichloro-2-butene	1.1	5	µg/Kg	56	128	56	128	30
SW8260D	Volatile Organic Compounds - Low	Soil	Trichloroethene	0.72	5	µg/Kg	75	135	75	135	30
SW8260D	Volatile Organic Compounds - Low	Soil	Trichlorofluoromethane	0.71	5	µg/Kg	62	136	62	136	30
SW8260D	Volatile Organic Compounds - Low	Soil	Vinyl acetate	3.4	20	µg/Kg					
SW8260D	Volatile Organic Compounds - Low	Soil	Vinyl chloride	0.7	5	µg/Kg	57	143	57	143	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2-Dichloroethene, Total	0.54	10	µg/Kg	76	125	76	125	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,3-Dichloropropene, Total	0.6	15	µg/Kg	70	130	70	130	30
SW8260D	Volatile Organic Compounds - Low	Soil	Xylenes, Total	2.2	5	µg/Kg	75	132	75	132	30
SW8260D	Volatile Organic Compounds - Low	Soil	1,2-Dichloroethane-d4		0	µg/Kg	83	132	83	132	30
SW8260D	Volatile Organic Compounds - Low	Soil	4-Bromofluorobenzene		0	µg/Kg	83	111	83	111	30
SW8260D	Volatile Organic Compounds - Low	Soil	Dibromofluoromethane		0	µg/Kg	77	125	77	125	30
SW8260D	Volatile Organic Compounds - Low	Soil	Toluene-d8		0	µg/Kg	86	108	86	108	30
SW8260D	Volatile Organic Compounds	Water	1,1,1,2-Tetrachloroethane	0.38	1	µg/L	73	114	73	114	30
SW8260D	Volatile Organic Compounds	Water	1,1,1-Trichloroethane	0.46	1	µg/L	75	130	75	130	30
SW8260D	Volatile Organic Compounds	Water	1,1,2,2-Tetrachloroethane	0.4	1	µg/L	75	130	75	130	30
SW8260D	Volatile Organic Compounds	Water	1,1,2-Trichloroethane	0.46	1	µg/L	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Water	1,1,2-Trichlorotrifluoroethane	0.52	1	µg/L					
SW8260D	Volatile Organic Compounds	Water	1,1-Dichloroethane	0.44	1	µg/L	68	142	68	142	30
SW8260D	Volatile Organic Compounds	Water	1,1-Dichloroethene	0.4	1	µg/L	70	145	70	145	30
SW8260D	Volatile Organic Compounds	Water	1,1-Dichloropropene	0.37	1	µg/L	75	135	75	135	30
SW8260D	Volatile Organic Compounds	Water	1,2,3-Trichlorobenzene	0.42	1	µg/L	70	140	70	140	30
SW8260D	Volatile Organic Compounds	Water	1,2,3-Trichloropropane	0.4	1	µg/L	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Water	1,2,3-Trimethylbenzene	0.32	1	µg/L	75	130	75	130	30
SW8260D	Volatile Organic Compounds	Water	1,2,4-Trichlorobenzene	0.45	1	µg/L	70	135	70	135	30
SW8260D	Volatile Organic Compounds	Water	1,2,4-Trimethylbenzene	0.45	1	µg/L	75	130	75	130	30
SW8260D	Volatile Organic Compounds	Water	1,2-Dibromo-3-chloropropane	0.43	1	µg/L	60	130	60	130	30
SW8260D	Volatile Organic Compounds	Water	1,2-Dibromoethane	0.41	1	µg/L	67	155	67	155	30
SW8260D	Volatile Organic Compounds	Water	1,2-Dichlorobenzene	0.32	1	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	1,2-Dichloroethane	0.44	1	µg/L	78	125	78	125	30
SW8260D	Volatile Organic Compounds	Water	1,2-Dichloropropane	0.48	1	µg/L	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Water	1,3,5-Trichlorobenzene	0.31	1	µg/L					
SW8260D	Volatile Organic Compounds	Water	1,3,5-Trimethylbenzene	0.65	1	µg/L	75	130	75	130	30
SW8260D	Volatile Organic Compounds	Water	1,3-Dichlorobenzene	0.33	1	µg/L	75	130	75	130	30
SW8260D	Volatile Organic Compounds	Water	1,3-Dichloropropane	0.4	1	µg/L	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Water	1,4-Dichlorobenzene	0.35	1	µg/L	75	130	75	130	30
SW8260D	Volatile Organic Compounds	Water	1,4-Dioxane	77.68	120	µg/L					
SW8260D	Volatile Organic Compounds	Water	1-Methylnaphthalene	0.56	5	µg/L					
SW8260D	Volatile Organic Compounds	Water	2,2,4-Trimethylpentane		1	µg/L					
SW8260D	Volatile Organic Compounds	Water	2,2-Dichloropropane	0.52	1	µg/L	43	150	43	150	30
SW8260D	Volatile Organic Compounds	Water	2-Butanone	0.52	5	µg/L	55	150	55	150	30
SW8260D	Volatile Organic Compounds	Water	2-Chloro-1,3-butadiene	0.46	1	µg/L					
SW8260D	Volatile Organic Compounds	Water	2-Chloroethyl vinyl ether	0.82	1	µg/L					
SW8260D	Volatile Organic Compounds	Water	2-Chlorotoluene	0.36	1	µg/L	76	117	76	117	30
SW8260D	Volatile Organic Compounds	Water	2-Hexanone	0.59	5	µg/L	60	135	60	135	30
SW8260D	Volatile Organic Compounds	Water	2-Methylnaphthalene	0.66	5	µg/L	55	140	55	140	30
SW8260D	Volatile Organic Compounds	Water	4-Chlorotoluene	0.31	1	µg/L	80	125	80	125	30
SW8260D	Volatile Organic Compounds	Water	4-Isopropyltoluene	0.1	1	µg/L	61	164	61	164	30
SW8260D	Volatile Organic Compounds	Water	4-Methyl-2-pentanone	0.52	1	µg/L	77	178	77	178	30
SW8260D	Volatile Organic Compounds	Water	Acetone	6.2	10	µg/L	60	160	60	160	30
SW8260D	Volatile Organic Compounds	Water	Acetonitrile	0.6	1	µg/L					
SW8260D	Volatile Organic Compounds	Water	Acrolein	0.38	1	µg/L					
SW8260D	Volatile Organic Compounds	Water	Acrylonitrile	0.5	1	µg/L	60	140	60	140	30
SW8260D	Volatile Organic Compounds	Water	Allyl chloride	0.62	1	µg/L	52	113	52	113	30
SW8260D	Volatile Organic Compounds	Water	Benzene	0.46	1	µg/L	85	125	85	125	30
SW8260D	Volatile Organic Compounds	Water	Benzyl chloride	0.34	1	µg/L					
SW8260D	Volatile Organic Compounds	Water	Bromobenzene	0.38	1	µg/L	80	125	80	125	30
SW8260D	Volatile Organic Compounds	Water	Bromochloromethane	0.45	1	µg/L	72	141	72	141	30
SW8260D	Volatile Organic Compounds	Water	Bromodichloromethane	0.49	1	µg/L	75	125	75	125	30
SW8260D	Volatile Organic Compounds	Water	Bromoform	0.56	1	µg/L	60	125	60	125	30
SW8260D	Volatile Organic Compounds	Water	Bromomethane	0.9	1	µg/L	30	185	30	185	30
SW8260D	Volatile Organic Compounds	Water	Butyl acetate	0.42	1	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	Carbon disulfide	0.49	1	µg/L	60	165	60	165	30
SW8260D	Volatile Organic Compounds	Water	Carbon tetrachloride	0.4	1	µg/L	65	140	65	140	30
SW8260D	Volatile Organic Compounds	Water	Chlorobenzene	0.4	1	µg/L	80	120	80	120	30
SW8260D	Volatile Organic Compounds	Water	Chloroethane	0.68	1	µg/L	31	172	31	172	30
SW8260D	Volatile Organic Compounds	Water	Chloroform	0.46	1	µg/L	80	130	80	130	30
SW8260D	Volatile Organic Compounds	Water	Chloromethane	0.83	1	µg/L	46	148	46	148	30
SW8260D	Volatile Organic Compounds	Water	Chloropicrin	9.76	100	µg/L					
SW8260D	Volatile Organic Compounds	Water	Chloroprene	0.46	1	µg/L					



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ALS Environmental
 3352 128th Avenue
 Holland, MI 49424
 (616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW8260D	Volatile Organic Compounds	Water	cis-1,2-Dichloroethene	0.42	1	µg/L	75	134	75	134	30
SW8260D	Volatile Organic Compounds	Water	cis-1,3-Dichloropropene	0.57	1	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	Cyclohexane	0.63	2	µg/L					
SW8260D	Volatile Organic Compounds	Water	Cyclohexanone	9.37	10	µg/L					
SW8260D	Volatile Organic Compounds	Water	Dibromomethane	0.65	1	µg/L	79	126	79	126	30
SW8260D	Volatile Organic Compounds	Water	Dibromochloromethane	0.4	1	µg/L	60	115	60	115	30
SW8260D	Volatile Organic Compounds	Water	Dichlorodifluoromethane	0.68	1	µg/L	20	120	20	120	30
SW8260D	Volatile Organic Compounds	Water	Dichloromethane	0.86	5	µg/L	72	125	72	125	30
SW8260D	Volatile Organic Compounds	Water	Diethyl ether	0.51	1	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	Diisopropyl ether	0.41	5	µg/L	58	133	58	133	30
SW8260D	Volatile Organic Compounds	Water	Ethyl acetate	0.44	5	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	Ethyl methacrylate	0.28	1	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	Ethyl tert butyl ether	0.4	1	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	Ethylbenzene	0.34	1	µg/L	76	123	76	123	30
SW8260D	Volatile Organic Compounds	Water	Hexachlorobutadiene	0.56	1	µg/L	70	155	70	155	30
SW8260D	Volatile Organic Compounds	Water	Hexachloroethane	0.45	1	µg/L	50	124	50	124	30
SW8260D	Volatile Organic Compounds	Water	Hexane	0.4	1	µg/L					
SW8260D	Volatile Organic Compounds	Water	Iodomethane	2.02	5	µg/L	60	160	60	160	30
SW8260D	Volatile Organic Compounds	Water	Isobutyl alcohol	0.88	1	µg/L					
SW8260D	Volatile Organic Compounds	Water	Isopropylbenzene	0.35	1	µg/L	80	127	80	127	30
SW8260D	Volatile Organic Compounds	Water	m,p-Xylene	0.81	2	µg/L	75	130	75	130	30
SW8260D	Volatile Organic Compounds	Water	Methacrylonitrile	0.59	1	µg/L	54	131	54	131	30
SW8260D	Volatile Organic Compounds	Water	Methyl acetate	0.59	2	µg/L					
SW8260D	Volatile Organic Compounds	Water	Methyl iodide	2.02	5	µg/L	60	160	60	160	30
SW8260D	Volatile Organic Compounds	Water	Methyl methacrylate	0.55	1	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	Methyl tert-butyl ether	0.45	1	µg/L	68	129	68	129	30
SW8260D	Volatile Organic Compounds	Water	Methylcyclohexane	0.35	1	µg/L					
SW8260D	Volatile Organic Compounds	Water	Methylene chloride	0.86	5	µg/L	72	125	72	125	30
SW8260D	Volatile Organic Compounds	Water	Naphthalene	0.77	5	µg/L	55	160	55	160	30
SW8260D	Volatile Organic Compounds	Water	n-Butyl alcohol	15.1	50	µg/L					
SW8260D	Volatile Organic Compounds	Water	n-Butylbenzene	0.34	1	µg/L	75	145	75	145	30
SW8260D	Volatile Organic Compounds	Water	n-Heptane	0.66	5	µg/L					
SW8260D	Volatile Organic Compounds	Water	n-Propylbenzene	0.48	1	µg/L	76	116	76	116	30
SW8260D	Volatile Organic Compounds	Water	o-Xylene	0.31	1	µg/L	76	127	76	127	30
SW8260D	Volatile Organic Compounds	Water	p-Isopropyltoluene	0.26	1	µg/L	61	164	61	164	30
SW8260D	Volatile Organic Compounds	Water	Propionitrile	0.8	10	µg/L					
SW8260D	Volatile Organic Compounds	Water	sec-Butylbenzene	0.3	1	µg/L	80	134	80	134	30
SW8260D	Volatile Organic Compounds	Water	Styrene	0.33	1	µg/L	83	137	83	137	30
SW8260D	Volatile Organic Compounds	Water	t-Butanol	9.3	20	µg/L					
SW8260D	Volatile Organic Compounds	Water	t-Butyl ethyl ether	0.4	1	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	tert-Butyl alcohol	9.3	20	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	tert-Butylbenzene	0.39	1	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	Tertiaryamylmethylether	0.4	1	µg/L	70	130	70	130	30
SW8260D	Volatile Organic Compounds	Water	Tetrachloroethene	0.39	1	µg/L	68	166	68	166	30
SW8260D	Volatile Organic Compounds	Water	Tetrahydrofuran	0.73	1	µg/L	54	139	54	139	30
SW8260D	Volatile Organic Compounds	Water	Toluene	0.45	1	µg/L	76	125	76	125	30
SW8260D	Volatile Organic Compounds	Water	trans-1,2-Dichloroethene	0.48	1	µg/L	80	140	80	140	30
SW8260D	Volatile Organic Compounds	Water	trans-1,3-Dichloropropene	0.38	1	µg/L	56	132	56	132	30
SW8260D	Volatile Organic Compounds	Water	trans-1,4-Dichloro-2-butene	0.58	2	µg/L	46	118	46	118	30
SW8260D	Volatile Organic Compounds	Water	Trichloroethene	0.43	1	µg/L	77	125	77	125	30
SW8260D	Volatile Organic Compounds	Water	Trichlorofluoromethane	0.52	1	µg/L	60	140	60	140	30
SW8260D	Volatile Organic Compounds	Water	Vinyl acetate	0.83	5	µg/L					
SW8260D	Volatile Organic Compounds	Water	Vinyl chloride	0.53	1	µg/L	50	136	50	136	30
SW8260D	Volatile Organic Compounds	Water	1,2-Dichloroethene, Total	0.48	2	µg/L	75	140	75	140	30
SW8260D	Volatile Organic Compounds	Water	1,3-Dichloropropene, Total	0.57	2	µg/L	56	132	56	132	30
SW8260D	Volatile Organic Compounds	Water	Xylenes, Total	0.81	3	µg/L	76	127	76	127	30
SW8260D	Volatile Organic Compounds	Water	1,2-Dichloroethane-d4	0	0	µg/L	75	120	75	120	30
SW8260D	Volatile Organic Compounds	Water	4-Bromofluorobenzene	0	0	µg/L	80	110	80	110	30
SW8260D	Volatile Organic Compounds	Water	Dibromofluoromethane	0	0	µg/L	85	115	85	115	30
SW8260D	Volatile Organic Compounds	Water	Toluene-d8	0	0	µg/L	85	110	85	110	30

*Laboratory limits subject to change as new MDL studies are performed and/or improvements in sensitivity are demonstrated.



Data Quality Objectives - 2021

ALS Environmental
3352 128th Avenue
Holland, MI 49424
(616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,1'-Biphenyl	23.24	33	µg/Kg	53	97	53	97	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,2,3,4-Tetrachlorobenzene	5.43	33	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,2,4,5-Tetrachlorobenzene	29.83	167	µg/Kg	51	96	51	96	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,2,4-Trichlorobenzene	17.8	33	µg/Kg	40	93	40	93	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,2-Dichlorobenzene	21.97	33	µg/Kg	42	94	42	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,2-Dinitrobenzene	16.42	33	µg/Kg	55	122	55	122	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,2-Diphenylhydrazine	15.83	33	µg/Kg	61	105	61	105	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,3,5-Trinitrobenzene	57	667	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,3-Dichlorobenzene	22.45	33	µg/Kg	41	94	41	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,3-Dinitrobenzene	22.72	67	µg/Kg	56	105	56	105	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,4-Dichlorobenzene	20.48	33	µg/Kg	42	94	42	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,4-Dinitrobenzene	23.14	167	µg/Kg	54	121	54	121	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,4-Dioxane	78.09	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1,4-Napthoquinone	119.5	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1-Methylnaphthalene	4.8	6.67	µg/Kg	56	94	56	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	1-Naphthylamine	118	667	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,2'-Oxybis(1-chloropropane)	22.79	33	µg/Kg	47	107	47	107	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,3,4,6-Tetrachlorophenol	24.41	67	µg/Kg	51	110	51	110	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,3,5,6-Tetrachlorophenol	27.91	67	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,4,5-Trichlorophenol	19.75	33	µg/Kg	52	111	52	111	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,4,6-Trichlorophenol	8.87	33	µg/Kg	46	105	46	105	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,4-Diaminotoluene	323	667	µg/Kg	30	105	30	105	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,4-Dichlorophenol	17.94	33	µg/Kg	47	96	47	96	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,4-Dimethylphenol	17.14	33	µg/Kg	49	97	49	97	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,4-Dinitrophenol	59.49	667	µg/Kg	10	106	10	106	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,4-Dinitrotoluene	21.65	33	µg/Kg	58	110	58	110	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,6-Dichlorophenol	50.28	67	µg/Kg	48	94	48	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,6-Dinitrotoluene	21.81	33	µg/Kg	59	108	59	108	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Acetylaminofluorene	15.8	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Chloronaphthalene	4.66	6.67	µg/Kg	56	104	56	104	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Chlorophenol	22.48	33	µg/Kg	50	104	50	104	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Methylnaphthalene	3.39	6.67	µg/Kg	54	96	54	96	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Methylphenol	20.44	33	µg/Kg	49	105	49	105	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Naphthylamine	89.76	667	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Nitroaniline	18.51	33	µg/Kg	54	107	54	107	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Nitrophenol	21.13	33	µg/Kg	51	94	51	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Picoline	42.82	330	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	3&4-Methylphenol	18.17	33	µg/Kg	48	105	48	105	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	3,3'-Dichlorobenzidine	15.56	167	µg/Kg	39	99	39	99	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	3,3'-Dimethylbenzidine	213	667	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	3-Methylcholanthrene	57.33	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	3-Nitroaniline	19.34	33	µg/Kg	17	92	17	92	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	4,6-Dinitro-2-methylphenol	27.84	33	µg/Kg	32	103	32	103	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	4-Aminobiphenyl	113.8	667	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	4-Bromophenyl phenyl ether	18.26	33	µg/Kg	60	106	60	106	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	4-Chloro-3-methylphenol	24.57	33	µg/Kg	51	101	51	101	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	4-Chloroaniline	16.94	67	µg/Kg	27	110	27	110	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	4-Chlorophenyl phenyl ether	21.67	33	µg/Kg	58	106	58	106	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	4-Nitroaniline	51.7	167	µg/Kg	21	100	21	100	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	4-Nitrophenol	16.13	167	µg/Kg	29	120	29	120	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	4-Nitroquinoline 1-oxide	277.6	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	5-Nitro-o-tolidine	73.47	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	7,12-Dimethylbenz(a)anthracene	129	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	a,a-Dimethylphenethylamine	269.1	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Acenaphthene	4.82	6.67	µg/Kg	55	101	55	101	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Acenaphthylene	4.32	6.67	µg/Kg	59	106	59	106	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Acetophenone	21.21	33	µg/Kg	51	100	51	100	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Aniline	14.14	33	µg/Kg	36	113	36	113	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Anthracene	4.7	6.67	µg/Kg	67	105	67	105	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Aramite	219.3	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Atrazine	19.53	33	µg/Kg	45	125	45	125	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Benzaldehyde	51.2	67	µg/Kg	10	120	10	120	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Benazidine	100.4	667	µg/Kg	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Benzo(a)anthracene	5.76	6.67	µg/Kg	68	105	68	105	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Benzo(a)pyrene	4.09	6.67	µg/Kg	68	110	68	110	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Benzo(b)fluoranthene	4.97	6.67	µg/Kg	65	110	65	110	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Benzo(g,h,i)perylene	5.11	6.67	µg/Kg	60	120	60	120	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Benzo(k)fluoranthene	5.05	6.67	µg/Kg	66	113	66	113	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Benzoic acid	80.5	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Benzyl alcohol	67.47	167	µg/Kg	45	106	45	106	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Bis(2-chloroethoxy)methane	21.11	33	µg/Kg	53	96	53	96	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Bis(2-chloroethyl)ether	23.63	33	µg/Kg	47	108	47	108	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Bis(2-chloroisopropyl)ether	22.79	33	µg/Kg	50	118	50	118	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Bis(2-ethylhexyl)phthalate	27.57	33	µg/Kg	59	117	59	117	30



Data Quality Objectives - 2021

ALS Environmental
3352 128th Avenue
Holland, MI 49424
(616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Butyl benzyl phthalate	41.73	67	µg/Kg	59	106	59	106	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Caprolactam	51.26	67	µg/Kg	42	105	42	105	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Carbazole	24.11	33	µg/Kg	67	108	67	108	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Chlorobenzilate	87.48	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Chrysene	5.39	6.67	µg/Kg	68	108	68	108	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Di-n-butyl phthalate	20.45	33	µg/Kg	59	105	59	105	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Di-n-octyl phthalate	28.83	33	µg/Kg	51	123	51	123	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Diallate	100.2	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Dibenzo(a,h)acridine	99.51	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Dibenzo(a,h)anthracene	3.6	6.67	µg/Kg	62	119	62	119	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Dibenzofuran	20.56	33	µg/Kg	60	104	60	104	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Diethyl phthalate	26.31	33	µg/Kg	62	111	62	111	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Dimethoate	104	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Dimethyl phthalate	25.33	33	µg/Kg	62	106	62	106	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Dinoseb	205.8	333	µg/Kg	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Diphenylamine	37.88	67	µg/Kg	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Disulfoton	93.1	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Ethyl methanesulfonate	120.8	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Famphur	168.8	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Fluoranthene	3.2	6.67	µg/Kg	67	106	67	106	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Fluorene	4.84	6.67	µg/Kg	59	107	59	107	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Hexachloro-1,3-butadiene	25.83	33	µg/Kg	51	94	51	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Hexachlorobenzene	20.55	33	µg/Kg	62	103	62	103	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Hexachlorobutadiene	25.83	33	µg/Kg	51	94	51	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Hexachlorocyclopentadiene	31.6	33	µg/Kg	25	120	25	120	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Hexachloroethane	13.8	33	µg/Kg	55	93	55	93	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Hexachlorophene	1670	1670	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Hexachloropropene	137.6	167	µg/Kg	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Indeno(1,2,3-cd)pyrene	4.64	6.67	µg/Kg	56	120	56	120	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Isodrin	102.2	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Isophorone	23.71	167	µg/Kg	52	99	52	99	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Isosafrole	112.6	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Kepone	405	667	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Methapyrilene	133.7	667	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Methyl methanesulfonate	136.1	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Methyl parathion	127.6	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Naphthalene	4.26	6.67	µg/Kg	46	98	46	98	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Nitrobenzene	25.18	167	µg/Kg	53	95	53	95	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	N-Nitrosodiethylamine	118.6	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	N-Nitrosodimethylamine	69.44	167	µg/Kg	49	100	49	100	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	N-Nitroso-di-n-butylamine	109.7	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	N-Nitrosodi-n-propylamine	32.47	33	µg/Kg	50	104	50	104	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	N-Nitrosodiphenylamine	19.03	33	µg/Kg	63	107	63	107	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	N-Nitrosomethylethylamine	134.7	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	N-Nitrosomorpholine	126.6	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	N-Nitrosopiperidine	61.57	167	µg/Kg	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Soil	N-Nitrosopyrrolidine	117.5	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	O,O,O-Triethylphosphorothioate	99.35	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	o-Toluidine	109.3	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	p-Dimethylaminoazobenzene	62.89	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Parathion	157	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Pentachlorobenzene	105.4	667	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Pentachloroethane	127.7	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Pentachloronitrobenzene	101.4	667	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Pentachlorophenol	26.48	33	µg/Kg	34	106	34	106	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Phenacetin	113	133	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Phenanthrene	3.1	6.67	µg/Kg	66	101	66	101	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Phenol	16.74	33	µg/Kg	44	109	44	109	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Phorate	96.73	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	p-Phenylenediamine	80	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Pronamide	129.2	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Pyrene	6.32	6.67	µg/Kg	60	119	60	119	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Pyridine	65.61	167	µg/Kg	36	93	36	93	30
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Quinoline	68.1	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Safrole	116.9	333	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Sulfotepp	112.1	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Thionazin	124.1	167	µg/Kg					
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Methylphenol, Total	9.01	67	µg/Kg	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2,4,6-Tribromophenol	0	0	µg/Kg	38	92	38	92	40
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Fluorobiphenyl	0	0	µg/Kg	44	107	44	107	40
SW846 8270E	Semi-Volatile Organic Compounds	Soil	2-Fluorophenol	0	0	µg/Kg	37	109	37	109	40
SW846 8270E	Semi-Volatile Organic Compounds	Soil	4-Terphenyl-d14	0	0	µg/Kg	52	123	52	123	40
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Nitrobenzene-d5	0	0	µg/Kg	41	94	41	94	40
SW846 8270E	Semi-Volatile Organic Compounds	Soil	Phenol-d6	0	0	µg/Kg	28	111	28	111	40



Data Quality Objectives - 2021

ALS Environmental
 3352 128th Avenue
 Holland, MI 49424
 (616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,1'-Biphenyl	0.42	1	µg/L	40	85	40	85	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,2,3,4-Tetrachlorobenzene	0.16	1	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,2,4,5-Tetrachlorobenzene	0.34	5	µg/L	34	82	34	82	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,2,4-Trichlorobenzene	0.41	1	µg/L	20	82	20	82	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,2-Dichlorobenzene	0.39	1	µg/L	15	85	15	85	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,2-Dinitrobenzene	0.38	1	µg/L	51	94	51	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,2-Diphenylhydrazine	0.14	1	µg/L	43	98	43	98	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,3,5-Trinitrobenzene	0.43	10	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,3-Dichlorobenzene	0.65	1	µg/L	12	84	12	84	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,3-Dinitrobenzene	0.22	1	µg/L	52	95	52	95	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,4-Dichlorobenzene	0.32	1	µg/L	12	85	12	85	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,4-Dinitrobenzene	0.18	1	µg/L	47	97	47	97	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,4-Dioxane	0.72	5	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	1,4-Napthoquinone	0.14	5	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	1-Methylnaphthalene	0.083	0.1	µg/L	33	87	33	87	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	1-Naphthylamine	1.63	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,2'-Oxybis(1-chloropropane)	0.23	1	µg/L	33	83	33	83	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,3,4,6-Tetrachlorophenol	0.45	1	µg/L	43	104	43	104	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,3,5,6-Tetrachlorophenol	0.27	1	µg/L	45	95	45	95	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,4,5-Trichlorophenol	0.17	1	µg/L	47	84	47	84	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,4,6-Trichlorophenol	0.25	1	µg/L	45	83	45	83	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,4-Dichlorophenol	0.35	1	µg/L	39	84	39	84	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,4-Dimethylphenol	0.36	1	µg/L	34	79	34	79	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,4-Dinitrophenol	2.61	5	µg/L	11	117	11	117	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,4-Dinitrotoluene	0.42	1	µg/L	54	93	54	93	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,6-Dichlorophenol	0.27	1	µg/L	40	83	40	83	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,6-Dinitrotoluene	0.11	1	µg/L	51	90	51	90	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Acetylaminofluorene	0.35	5	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Chloronaphthalene	0.075	0.1	µg/L	37	84	37	84	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Chlorophenol	0.23	1	µg/L	38	83	38	83	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Methylnaphthalene	0.065	0.1	µg/L	33	85	33	85	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Methylphenol	0.25	1	µg/L	29	76	29	76	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Naphthylamine	0.27	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Nitroaniline	0.21	1	µg/L	45	94	45	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Nitrophenol	0.34	1	µg/L	41	84	41	84	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Picoline	0.3	5	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	3&4-Methylphenol	0.21	1	µg/L	24	70	24	70	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	3,3'-Dichlorobenzidine	0.46	5	µg/L	39	96	39	96	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	3,3'-Dimethylbenzidine	7.32	25	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	3-Methylcholanthrene	0.56	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	3-Nitroaniline	0.64	1	µg/L	50	93	50	93	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	4,6-Dinitro-2-methylphenol	0.27	1	µg/L	23	116	23	116	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	4-Aminobiphenyl	0.19	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	4-Bromophenyl phenyl ether	0.33	1	µg/L	51	93	51	93	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	4-Chloro-3-methylphenol	0.26	1	µg/L	41	86	41	86	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	4-Chloroaniline	0.34	1	µg/L	44	92	44	92	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	4-Chlorophenyl phenyl ether	0.31	1	µg/L	49	89	49	89	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	4-Nitroaniline	0.57	1	µg/L	47	98	47	98	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	4-Nitrophenol	0.24	5	µg/L	10	43	10	43	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	4-Nitroquinoline 1-oxide	1.48	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	5-Nitro-o-toluidine	0.16	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	7,12-Dimethylbenz(a)anthracene	0.16	1	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	a,a-Dimethylphenethylamine	1.64	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Acenaphthene	0.081	0.1	µg/L	42	85	42	85	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Acenaphthylene	0.075	0.1	µg/L	42	88	42	88	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Acetophenone	0.37	1	µg/L	39	91	39	91	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Aniline	0.49	1	µg/L	33	88	33	88	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Anthracene	0.028	0.1	µg/L	55	93	55	93	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Aramite	0.73	1	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Atrazine	0.35	1	µg/L	52	100	52	100	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Benzaldehyde	0.52	1	µg/L	42	110	42	110	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Benzidine	1.99	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Benzo(a)anthracene	0.099	0.1	µg/L	56	91	56	91	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Benzo(a)pyrene	0.044	0.1	µg/L	55	96	55	96	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Benzo(b)fluoranthene	0.051	0.1	µg/L	55	99	55	99	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Benzo(g,h,i)perylene	0.089	0.1	µg/L	44	102	44	102	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Benzo(k)fluoranthene	0.048	0.1	µg/L	57	96	57	96	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Benzoic acid	6.24	20	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	Benzyl alcohol	0.17	1	µg/L	30	79	30	79	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Bis(2-chloroethoxy)methane	0.29	1	µg/L	39	88	39	88	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Bis(2-chloroethyl)ether	0.37	1	µg/L	36	91	36	91	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Bis(2-chloroisopropyl)ether	0.23	1	µg/L	33	83	33	83	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Bis(2-ethylhexyl)phthalate	0.4	1	µg/L	39	113	39	113	30



Data Quality Objectives - 2021

ALS Environmental
3352 128th Avenue
Holland, MI 49424
(616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW846 8270E	Semi-Volatile Organic Compounds	Water	Butyl benzyl phthalate	0.3	1	µg/L	49	97	49	97	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Caprolactam	0.96	5	µg/L	0	0	0	0	
SW846 8270E	Semi-Volatile Organic Compounds	Water	Carbazole	0.24	1	µg/L	59	92	59	92	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Chlorobenzilate	0.93	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Chrysene	0.048	0.1	µg/L	55	92	55	92	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Diallate	0.28	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Dibenzo(a,h)acridine	0.19	5	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	Dibenzo(a,h)anthracene	0.073	0.1	µg/L	47	100	47	100	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Dibenzofuran	0.23	1	µg/L	44	89	44	89	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Diethyl phthalate	0.17	1	µg/L	54	95	54	95	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Dimethyl phthalate	0.18	1	µg/L	51	92	51	92	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Di-n-butyl phthalate	0.21	1	µg/L	57	98	57	98	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Di-n-octyl phthalate	0.53	1	µg/L	36	117	36	117	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Dinoseb	0.9	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Diphenylamine	0.23	1	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Ethyl methanesulfonate	0.69	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Fluoranthene	0.038	0.1	µg/L	59	93	59	93	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Fluorene	0.051	0.1	µg/L	47	91	47	91	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Hexachloro-1,3-butadiene	0.63	1	µg/L	11	83	11	83	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Hexachlorobenzene	0.44	1	µg/L	53	89	53	89	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Hexachlorobutadiene	0.63	1	µg/L	11	83	11	83	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Hexachlorocyclopentadiene	1.09	5	µg/L	14	75	14	75	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Hexachloroethane	0.62	1	µg/L	10	85	10	85	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Hexachlorophene	80	80	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Hexachloropropene	2.83	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Indeno(1,2,3-cd)pyrene	0.067	0.1	µg/L	46	102	46	102	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Isodrin	0.41	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Isophorone	0.34	5	µg/L	42	90	42	90	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Isosafrole	0.29	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Kepone	0.34	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Methapyrilene	1.55	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Methyl methanesulfonate	0.32	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Naphthalene	0.067	0.1	µg/L	26	78	26	78	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Nitrobenzene	0.26	1	µg/L	38	86	38	86	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	N-Nitrosodiethylamine	0.37	1	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	N-Nitrosodimethylamine	0.48	1	µg/L	14	65	14	65	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	N-Nitroso-di-n-butylamine	0.45	1	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	N-Nitrosodi-n-propylamine	0.35	1	µg/L	39	95	39	95	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	N-Nitrosodiphenylamine	0.49	1	µg/L	47	94	47	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	N-Nitrosomethylethylamine	1.35	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	N-Nitrosomorpholine	0.32	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	N-Nitrosopiperidine	0.33	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	N-Nitrosopyrrolidine	0.33	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	o-Toluidine	0.74	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	p-Dimethylaminoazobenzene	0.85	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Pentachlorobenzene	0.26	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Pentachloroethane	0.27	1	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	Pentachloronitrobenzene	0.25	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Pentachlorophenol	0.97	5	µg/L	37	94	37	94	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Phenacetin	0.39	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Phenanthrene	0.081	0.1	µg/L	51	90	51	90	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Phenol	0.21	1	µg/L	10	40	10	40	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	p-Phenylenediamine	25	50	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Pronamide	0.3	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Pyrene	0.036	0.1	µg/L	48	98	48	98	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Pyridine	0.57	10	µg/L	10	50	10	50	30
SW846 8270E	Semi-Volatile Organic Compounds	Water	Quinoline	0.43	5	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	Safrole	0.58	5	µg/L	0	0	0	0	0
SW846 8270E	Semi-Volatile Organic Compounds	Water	Methylphenol, Total	0.38	2	µg/L					
SW846 8270E	Semi-Volatile Organic Compounds	Water	2,4,6-Tribromophenol	0	0	µg/L	27	83	27	83	40
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Fluorobiphenyl	0	0	µg/L	26	79	26	79	40
SW846 8270E	Semi-Volatile Organic Compounds	Water	2-Fluorophenol	0	0	µg/L	13	56	13	56	40
SW846 8270E	Semi-Volatile Organic Compounds	Water	4-Terphenyl-d14	0	0	µg/L	43	106	43	106	40
SW846 8270E	Semi-Volatile Organic Compounds	Water	Nitrobenzene-d5	0	0	µg/L	29	80	29	80	40
SW846 8270E	Semi-Volatile Organic Compounds	Water	Phenol-d6	0	0	µg/L	10	35	10	35	40

*Laboratory limits subject to change as new MDL studies are performed and/or improvements in sensitivity are demonstrated.



Data Quality Objectives - 2021

ALS Environmental
 3352 128th Avenue
 Holland, MI 49424
 (616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW8082	PCBs	Soil	Aroclor 1016	22.86	66.7	µg/Kg	50	130	40	140	50
SW8082	PCBs	Soil	Aroclor 1221	22.86	66.7	µg/Kg					
SW8082	PCBs	Soil	Aroclor 1232	22.86	66.7	µg/Kg					
SW8082	PCBs	Soil	Aroclor 1242	22.86	66.7	µg/Kg					
SW8082	PCBs	Soil	Aroclor 1248	22.86	66.7	µg/Kg					
SW8082	PCBs	Soil	Aroclor 1254	18.62	66.7	µg/Kg					
SW8082	PCBs	Soil	Aroclor 1260	18.62	66.7	µg/Kg	50	130	40	140	50
SW8082	PCBs	Soil	Aroclor 1262	18.62	66.7	µg/Kg					
SW8082	PCBs	Soil	Aroclor 1268	18.62	66.7	µg/Kg					
SW8082	PCBs	Soil	PCBs, Total	18.62	66.7	µg/Kg					
SW8082	PCBs	Soil	Decachlorobiphenyl	0	0	µg/Kg	40	140	40	140	50
SW8082	PCBs	Soil	Tetrachloro-m-xylene	0	0	µg/Kg	45	124	45	124	50
SW8082	PCBs	Water	Aroclor 1016	0.09	0.2	µg/L	50	150	50	150	50
SW8082	PCBs	Water	Aroclor 1221	0.09	0.2	µg/L					
SW8082	PCBs	Water	Aroclor 1232	0.09	0.2	µg/L					
SW8082	PCBs	Water	Aroclor 1242	0.09	0.2	µg/L					
SW8082	PCBs	Water	Aroclor 1248	0.09	0.2	µg/L					
SW8082	PCBs	Water	Aroclor 1254	0.091	0.2	µg/L					
SW8082	PCBs	Water	Aroclor 1260	0.091	0.2	µg/L	50	150	50	150	50
SW8082	PCBs	Water	Aroclor 1262	0.091	0.2	µg/L					
SW8082	PCBs	Water	Aroclor 1268	0.091	0.2	µg/L					
SW8082	PCBs	Water	PCBs, Total	0.09	0.2	µg/L					
SW8082	PCBs	Water	Decachlorobiphenyl	0	0	µg/L	30	150	30	150	50
SW8082	PCBs	Water	Tetrachloro-m-xylene	0	0	µg/L	50	150	50	150	50

*Laboratory limits subject to change as new MDL studies are performed and/or improvements in sensitivity are demonstrated.



Data Quality Objectives - 2021

ALS Environmental
3352 128th Avenue
Holland, MI 49424
(616) 399-6070

Test Method	Test Name	Matrix	Analyte	MDL*	PQL*	Units	LCS Low (%)	LCS High (%)	MS/MSD Low (%)	MS/MSD High (%)	RPD (%)
SW6020B	Metals by ICP-MS	Soil	Aluminum	1.600	2	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Antimony	0.067	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Arsenic	0.030	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Barium	0.230	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Beryllium	0.017	0.1	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Boron	0.940	1	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Cadmium	0.015	0.1	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Calcium	12.000	25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Chromium	0.110	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Cobalt	0.041	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Copper	0.250	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Hardness (Calculation)	59.000	103	mg/Kg					20
SW6020B	Metals by ICP-MS	Soil	Iron	8.000	10	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Lead	0.120	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Lithium	0.095	0.5	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Magnesium	7.000	10	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Manganese	0.210	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Molybdenum	0.049	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Nickel	0.130	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Potassium	4.200	10	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Selenium	0.230	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Silicon	11.000	50	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Silver	0.033	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Sodium	13.410	15	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Strontium	0.110	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Thallium	0.039	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Thorium	0.025	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Tin	0.059	0.1	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Titanium	0.140	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Uranium	0.035	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Vanadium	0.064	0.25	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Soil	Zinc	0.490	0.5	mg/Kg	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Aluminum	0.008	0.010	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Antimony	0.002	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Arsenic	0.00019	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Barium	0.002	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Beryllium	0.00013	0.002	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Boron	0.0157	0.020	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Cadmium	0.00015	0.002	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Calcium	0.250	0.500	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Chromium	0.00116	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Cobalt	0.00013	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Copper	0.002	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Hardness (Calculation)	0.205	2.000	mg/L					20
SW6020B	Metals by ICP-MS	Water	Iron	0.050	0.080	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Lead	0.00072	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Lithium	0.0032	0.010	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Magnesium	0.050	0.200	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Manganese	0.0025	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Molybdenum	0.00033	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Nickel	0.0009	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Potassium	0.0962	0.200	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Selenium	0.00048	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Silicon	0.170	1.000	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Silver	0.00084	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Sodium	0.1850	0.200	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Strontium	0.0036	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Thallium	0.00015	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Thorium	0.00028	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Tin	0.00094	0.002	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Titanium	0.0011	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Uranium	0.00018	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Vanadium	0.0007	0.005	mg/L	80	120	75	125	20
SW6020B	Metals by ICP-MS	Water	Zinc	0.0047	0.010	mg/L	80	120	75	125	20

*Laboratory limits subject to change as new MDL studies are performed and/or improvements in sensitivity are demonstrated.

APPENDIX D
Standard Operating Procedures

Field Activities
Standard Operating Procedures
for the
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Voluntary Remediation Program
UECA-LUST Program
CERCLA (Superfund) and Federal Facilities Program



Prepared by:
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March 2021

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**Field Activities Standard Operating Procedures
for the
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation**

Signature/Approval Page

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General Decontamination Procedures for Non-Disposable Field Sampling Equipment

SOP OER-0100

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	7/1/2010	Reformatted, added SOP ID #, and renumbered. Supersedes Revision 0.0 Additional detail provided for decontamination procedures.	Editorial Technical
Dave Long	2.0	9/21/2016	Revised decontamination procedures. Reformatted.	Editorial, Technical
Ross Brittain	3.0	11/10/2020	Revised decontamination procedures as necessary, edited typographical and grammatical errors.	Editorial, Technical

**GENERAL DECONTAMINATION PROCEDURES FOR NON-
DISPOSABLE FIELD SAMPLING EQUIPMENT**
SOP OER-0100

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List of Acronyms and Abbreviations

HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	Investigation Derived Wasted
OER	Office of Environmental Remediation
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
QAPrP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
WVDEP	West Virginia Department of Environmental Protection

Disclaimer: Any mention in this SOP of any products or services does not constitute or imply the endorsement, recommendation or favoring by WVDEP or any of its employees or contractors acting on its behalf.

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide a description of the methods used for non-disposable field equipment decontamination. Field equipment decontamination serves many purposes, including, but not necessarily limited to:

- Preventing, minimizing, or limiting cross-contamination of samples
- Preventing cross-contamination of sampling locations
- Ensuring collection of representative samples
- Ensuring proper operation of field equipment
- Ensuring accuracy of field measurements
- Reducing potential exposure hazards for field personnel
- Preventing contamination of uncontaminated areas

This SOP also provides general guidelines for developing decontamination procedures for sampling equipment to be used for Office of Environmental Remediation (OER) projects within the West Virginia Department of Environmental Protection (WVDEP). This SOP does not address personnel decontamination.

These are standard (i.e. typically applicable) operating procedures which may be varied or changed as needed, dependent upon site conditions, equipment limitation, and/or limitations imposed by the procedure. The actual procedures employed at a site should be fully documented.

2.0 SUMMARY OF METHOD

All non-disposable sampling equipment (including, but not limited to: augers, GeoProbe™ drive rods, trowels, spatulas, hand augers, shovels, stainless steel mixing bowls, split spoon sampler, GeoProbe™ sampling spoon, etc.) will be thoroughly cleaned. Decontamination of all sampling equipment will be accomplished prior to and between sampling locations. The decontamination procedure is briefly summarized below.

Sampling equipment to be used at the site will be divided into one of two categories:

1. Equipment that does not contact the sample
2. Equipment that does contact the sample

Procedures for Non-Sample Contacting Equipment

- a) Physically remove gross contamination.
- b) Clean with portable power washer, steam cleaning machine or dedicated pressurized sprayer *or* hand wash with brush using detergent solution.
- c) Rinse with control water, such as tap water that has not been recycled.

Procedures for Sample Contacting Equipment

- a) Physically remove gross contamination.
- b) Wash with non-phosphate detergent and brush made of inert material.
[Note: For equipment that cannot be disassembled for cleaning (e.g., tubing), circulate decontamination liquid through the equipment.]
- c) Rinse with tap water.
- d) Rinse with inorganic desorbing agent (applicable only when analyzing for inorganics).
- e) Rinse with tap water.
- f) Rinse with organic desorbing agent rinse (applicable only when analyzing for organics).
- g) Rinse with deionized water.
- h) Let equipment air dry.
- i) Wrap equipment in inert material (e.g., aluminum foil or plastic wrap) for transport, to prevent contact with potentially contaminated materials.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Sample collection and analysis of decontamination waste may be required before beginning proper disposal of decontamination liquids and solids generated at a site. The amount of sample to be collected and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements should be determined prior to initiation of site activities. As part of the development of the project specific Site Assessment Work Plan (SAWP) or Sampling and Analysis Plan (SAP; hereafter, both SAWP and SAP are collectively referred to as SAWP), decontamination waste sampling procedures should be determined and then incorporated into the SAWP. Parameters to be sampled will be dependent upon the matrix being sampled and the requirements of the disposal facility.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The use of an untreated potable water supply is not an acceptable substitute for tap water. The use of deionized water commonly available from commercial vendors should generally be acceptable for decontamination of sampling equipment. If there is a concern that the water is not analyte free, then it can be verified by laboratory analysis. If acids or solvents are utilized in decontamination, they raise health and safety as well as waste disposal concerns. Care must be used when working with acids and organic solvents.

5.0 EQUIPMENT APPARATUS

Decontamination equipment, materials, and supplies are generally selected based on availability. Other considerations include the ease of decontaminating or disposing of the equipment. The following are some of the materials and equipment that are potentially needed for decontamination activities:

- Non-phosphate detergent
- Organic and inorganic decontamination reagents, if required by site-specific SAWP
- Tap water
- Deionized water
- Brushes (various assortment of sizes)
- Drop cloth/plastic sheeting made of inert materials appropriate for the contaminants of concern
- Paper towels
- Wash and rinse containers (buckets)
- Portable power washer, steam cleaning machine or pressurized sprayers
- Solvent sprayers
- Aluminum foil/plastic wrap
- Trowel
- Trash bags
- Trash containers
- DOT approved 55-gallon drums
- Safety glasses
- Gloves
- Eyewash
- First aid kit

6.0 REAGENTS

Depending upon the project, a solvent rinse using organic or inorganic desorbing agent may be required. This shall be specified in the site-specific SAWP. In cases where the use of solvents is planned, the analytical laboratory performing the analysis shall be consulted prior to sampling to ensure that decontamination procedures do not affect the subsequent analysis. It is recommended that all solvent rinses be made from an appropriate grade of chemical, such as pesticide or purge-and-trap grade quality.

7.0 PROCEDURES

These procedures are intended as general procedures to be followed for decontamination of field sampling equipment. The site-specific SAWP should be referred to for any given project in

order to establish what portions of these procedures are applicable to the project. It is always recommended that procedures be established in the site-specific SAWP to minimize the potential for contamination. Such procedures may include the following:

- Work practices that minimize contact with potential contaminants
- Covering monitoring and sampling equipment with plastic or other protective material
- Avoiding laying equipment down in areas of obvious contamination
- Use of disposable sampling equipment

7.1 Decontamination Methods

Various decontamination methods will physically remove contaminants, inactivate contaminants by disinfection or sterilization, or do both. In many cases, gross contamination can be removed by physical means. The physical decontamination techniques appropriate for equipment decontamination can be grouped into two categories: abrasive methods and non-abrasive methods.

7.1.1 Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The following abrasive methods are available:

- Mechanical cleaning methods are brushes of metal or nylon. The amount and type of contaminants removed will vary with the hardness of bristles, length of brushing time, and degree of brush contact.
- Air blasting is used for cleaning large equipment, such as bulldozers, drilling rigs or auger bits. The equipment used in air blast cleaning employs compressed air to force abrasive material through a nozzle at high velocities. The distance between the nozzle and the surface cleaned, as well as the pressure of air, the time of application, and the angle at which the abrasive strikes the surface, determines cleaning efficiency. This method generates a large amount of waste and is unlikely to be utilized on OER projects.
- Wet blast cleaning, also used to clean large equipment, involves use of a suspended fine abrasive delivered by compressed air to the contaminated area. The amount of materials removed can be carefully controlled by using very fine abrasives. This method generates a large amount of waste and is unlikely to be utilized on OER projects.

7.1.2 Non-Abrasive Cleaning Methods

Non-abrasive cleaning methods work by forcing the contaminant off of a surface with pressure. The following non-abrasive methods are available:

High-Pressure Water: This method consists of a high-pressure pump, an operator controlled directional nozzle, and a high-pressure hose.

Low-Pressure Water: This system produces a pressurized water jet with operating pressures less than 240 atm which relates to a flow rate less than 20 liters per minute. Because of the low pressure, this method is applicable for hand-held sampling equipment.

7.1.3 Disinfection/Rinse/Hand Removal Methods

Disinfection/Sterilization: Disinfectants are a practical means of inactivating infectious agents; sterilization methods involve heating the equipment which is impractical for large equipment. It is unlikely that these methods would be utilized on OER projects.

Rinsing: In cases of gross soil/sediment contamination on hand-held sampling equipment, a tap water rinse/wash may first be performed to remove clumps of dirt in order to make the detergent wash more effective.

Hand Removal: In cases of gross soil/sediment contamination on hand-held sampling equipment, dirt may be removed by hand (gloved) or using a trowel or similar device to remove clumps of dirt in order to make the detergent wash more effective.

7.2 Field Sampling Equipment Cleaning Procedures

If trace analysis for organics or metals is to be performed, then a solvent rinse for trace organics and an acid rinse for trace metals would be appropriate. If no trace analysis is planned, the solvent and acid rinses may be eliminated from the decontamination sequence specified below.

- a) In cases of gross contamination, follow the most appropriate physical removal procedures specified in section 7.1.
- b) Using a brush, wash equipment with soap (non-phosphate) and water.

- c) Rinse the equipment with tap water. If contaminants are clearly present, wash the equipment again and rinse again with tap water.
- d) Rinse with deionized water. A triple rinse with two rinses of tap water followed by a final rinse with deionized water is recommended. (If solvent or acid rinses are not necessary, then proceed to step i.)
- e) If applicable, rinse with an inorganic desorbing agent if the samples will be analyzed for inorganics.
- f) Rinse with deionized water.
- g) Use an organic desorbing agent rinse, as appropriate, if the sample will be analyzed for organics.
- h) Final rinse with deionized water.
- i) Decontaminated equipment shall be dried or allowed to air dry on plastic sheeting in an area free of potential contaminants.
- j) Wrap equipment in inert material (e.g., aluminum foil or plastic wrap) for transport. Store decontaminated equipment in an area free of potential contaminants when it is not in use.

8.0 CALCULATIONS

There are no calculations associated with decontamination procedures. This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Decontamination of field sampling equipment is necessary when dedicated or non-disposable sampling equipment is utilized at a site. An equipment rinsate blank should be collected as part of the quality control associated with the field decontamination on non-disposable, dedicated sampling equipment. This sample will provide information on the effectiveness of the decontamination process in the field. Equipment rinsate blanks are samples obtained by running deionized water over the decontaminated sampling equipment after cleaning to test for residual contamination. The equipment rinsate water is collected in sample containers and handled exactly as any other samples from the site. One equipment rinsate blank should be collected per each day of field work or at least one for every 20 samples, whichever frequency is greater. An equipment rinsate blank is used to assess cross-contamination brought about by improper decontamination procedures.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered to when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training with 8 Hour refreshers as appropriate. Some level of personal protective equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the site health and safety plan (HASP). Personnel should adhere to the safety requirements outlined in the site-specific plans.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derived waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Sampling Equipment Decontamination, SOP# 2006, US EPA, Environmental Response Team, August 11, 1994

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005, Update – April, 2011

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PID/FID Field Screening

SOP OER-0101

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	0.0	8/2/2010	New SOP	Technical
Dave Long	1.0	9/21/2016	Revised PID Screening Procedures. Reformatted.	Editorial, Technical
Ross Brittain	2.0	11/10/2020	Revised Summary of Method and edited the document for grammatical errors.	Editorial, Technical

PID/FID FIELD SCREENING
SOP OER-0101

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List of Acronyms and Abbreviations

eV	electronvolt
FID	Flame Ionization Detector
GC	Gas Chromatograph
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
ID	Identification
IDW	Investigation Derived Wasted
OER	Office of Environmental Remediation
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
QAPrP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
UV	Ultraviolet light
VOC	Volatile Organic Compounds
WVDEP	West Virginia Department of Environmental Protection
XRF	X-Ray Fluorescence

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1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe the procedure for using a photoionization detector (PID) or flame ionization detector (FID) used for Office of Environmental Remediation (OER) projects within the West Virginia Department of Environmental Protection (WVDEP). The PID is a portable vapor/gas detector employing the principle of photoionization to detect a variety of chemical compounds. It is of particular use in identifying organic compounds, but can identify certain inorganic compounds such as chlorine, bromine, silicon, and sulfur. This procedure is a non-specific method applicable to field screening for organic compounds in surface and subsurface soils. The FID is also a portable vapor/gas detector that operates by burning samples in a hydrogen flame to ionize the gases.

2.0 SUMMARY OF METHOD

The PID is a useful field screening tool. A PID is capable of detecting and measuring real-time concentrations of many organic vapors and some inorganic vapors. The PID is unable to respond to certain low molecular weight hydrocarbons, such as methane and ethane. The PID works by employing the principle of photoionization. It will respond to most vapors that have an ionization potential less than or equal to that supplied by the ionization source. The ionization source is an ultraviolet (UV) lamp.

Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and form a positive ion. This will occur when the ionization potential of the molecule in electron volts (eV) is less than the energy of the photon. The released electron and newly created positive ion are propelled toward electrodes, which produces a current that is proportional to the concentration of volatile organic compounds (VOCs) in the air sample. Several ionization sources are available for the PID, each having a different eV lamp and a different ionization potential. The selection of the appropriate ionization source is essential in obtaining useful data. Though it can be calibrated to a particular compound, the instrument cannot distinguish between detectable compounds in a mixture of gases. Therefore, the PID can only indicate an integrated response to the mixture; the primary use of the PID is as a semi-quantitative instrument for screening purposes.

By comparison, FID technology has the advantage of responding to all hydrocarbon gases including methane and has a wide measuring range. FIDs work by combusting samples to ionize the gases and generate an electrical current. The magnitude of the current is proportional to the concentration of organic vapors (e.g., hydrocarbons). In general, FIDs respond better to carbon chain length than functional groups. The disadvantage of FIDs is that they do not identify the type of hydrocarbons, should not be used in areas where there is a chance of explosion, and they respond poorly to highly halogenated hydrocarbon gases, ammonia, hydrogen sulfide, formaldehyde, amines, methanol and aromatic compounds. FIDs are less effected by humidity than are PIDs, but they can have problems in high humidity conditions by preventing the flame from igniting. Like PIDs, an FID is only used as a semi-quantitative instrument for screening purposes. Specific details for sampling at any location should be found in the Sampling and

Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

PIDs and FIDs are nonspecific total vapor detectors; therefore, they cannot be used to identify unknown substances. The PID does not respond to certain low molecular weight hydrocarbons, such as methane and ethane. The PID does not detect a compound if the probe has a lower energy than the compound's ionization potential. Certain toxic gases and vapors, such as carbon tetrachloride and hydrogen cyanide, have high ionization potentials and cannot be detected with a PID. Strong winds and high humidity will affect measurement readings. A PID may become unusable under foggy or humid conditions. The lamp window must be periodically cleaned to ensure ionization of the compounds by the probe. Pulling liquids into the probe will result in poor readings and can damage the instrument. FIDs should not be used in areas where there is a chance of explosion since they have a flame that could ignite the explosive materials. While FIDs are less effected by humidity than PIDs, high humidity conditions may prevent the flame from igniting. FIDs respond poorly to highly halogenated hydrocarbon gases, ammonia, hydrogen sulfide, formaldehyde, amines, methanol and aromatic compounds.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for soil screening activities using the PID. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- PID/FID
- Calibration equipment and gases (isobutylene)
- Quart of gallon zip-locking baggies (Note that some brands of baggies can produce elevated PID readings after sitting in the sun for a brief period. The baggies should be pre-screened with a PID to determine if they may be the source of vapors when screening soils.)
- Field logbook, field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Pails, tubs, or buckets
- Plastic sheeting
- Packing materials
- Sampling gloves

- Methanol
- Light source cleaning compound
- Mild, non-phosphate soap

6.0 REAGENTS

The following reagents may be needed when using a PID/FID for field screening purposes:

- Isobutylene standards for calibration
- Methanol for cleaning ionization chamber (GC grade)
- Mild soap solution for cleaning unit surfaces
- Specific gas standards when calibrating to a specific compound (as applicable)
- Light source cleaning compound (PID), or jet cleaning compound or replacements (FID)

7.0 PROCEDURES

The following procedures are applicable for field screening of organic compounds utilizing a PID/FID:

7.1 Standard Screening

- a) Conduct a fresh air calibration and multi-sensor span calibration on the instrument daily in accordance with manufacturer specifications before any headspace readings are performed. Re-calibrate the instrument throughout the day as needed.
- b) Place the portion of soil sample to be screened inside a clean zip-locking baggie and then seal the baggie. Fill the baggie at least 1/3 full (no more than 1/2 full) if sufficient sample is available and be sure to use the same size baggie and same relative proportion of soil for each sample in order to be consistent with the amount of headspace for appropriate comparisons.
- c) After the baggie has been sealed, knead the soil sample to thoroughly mix the soil within the baggie and maximize potential volatilization.
- d) Allow the baggie to set for no more than ten minutes prior to taking a reading.
Note: If the ambient temperature is below 60° F, headspace analysis shall be conducted in a heated environment (i.e., inside a building or vehicle).
- e) Carefully open a corner of the zip-locking baggie and insert the probe tip of the PID/FID, being careful not to fully open the baggie to minimize loss of vapors. Once the probe tip has been inserted use a clip or clean fingers to pinch and seal the baggie against the probe to prevent loss of vapors. *Note: Care shall be taken to ensure that neither water droplets nor soil particulates enter the probe tip.*
- f) The highest meter response shall be recorded as the volatile organic vapor concentration. This usually occurs within a few seconds. Some samples may

continue to climb by small increments over time and never stabilize, potentially due to releases from the baggie instead of the soil sample. For this reason, there should be a pre-determined set time limit used for each screening sample at a site, such as recording the highest PID/FID reading within 30 seconds or 60 seconds, but for no less than ten seconds.

- g) After withdrawing the probe, allow sufficient time for the PID/FID readings to return to zero before screening the next sample.
- h) All headspace analysis shall be completed at an equivalent time period between 8-10 minutes for specific samples.
- i) Record the PID/FID readings in the field logbook along with other sampling information such as:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Staining
 - Odor
 - Any other pertinent information (e.g., date, time and name of sampler)

7.2 Direct-Push Core Liner

Another option for screening soils collected via direct-push methods (e.g., Geoprobe™) is to use the method in *ASTM D4547-15 X3.1.2 Direct Subsurface Soil Sampling Technique Using a Cutting Tool* to collect the soil cores leaving them within the acetate liner and drilling holes through the liner to expose a portion of the soils (Sorini et al. 2009), but with a slight modification to the screening protocol.

- a. The core liner is brought to the surface and placed in a metal rack for sub-sampling. Care should be taken to ensure that the air around and over the core liner is still, such as the use of shielding or being inside a structure or vehicle.
- b. A cutting tool powered by a portable drill is used to cut circular screening holes in the liner at 12-inch intervals. The diameter of the circle is the dimension required for easy insertion of the hand-operated coring device to be inserted into the hole for sample collection (e.g., En Core®) and/or the PID/FID probe tip. Any portion of the liner that is not completely filled with soil should not be screened or sampled. Additionally, a small amount of cuttings may be generated, but will typically accumulate away from the soil core.
- c. As each hole is cut, the exposed soil should be dug out with a stainless steel tool to remove any potential cuttings and smeared soils to create a hole about 1-inch deep.

- d. The tip of the PID/FID should be inserted into the hole immediately after it is dug, being careful not to touch the probe tip to any exposed soils. A vapor reading should be taken with the PID/FID and the highest value within ~15 seconds should be recorded.
- e. The 12-inch section with the highest PID/FID reading will then be sampled for laboratory analysis by drilling another hole next to the screening hole and collecting samples using Method 5035 and placing them on ice at $< 6^{\circ}\text{C}$ without freezing. Be sure to expose a fresh area of the soil core before collecting the sample to make sure that smeared soils were not collected.
- f. Once the VOC soil samples have been collected, the liner may be cut horizontally and removed to proceed with XRF screening, if applicable, soil core logging and sample collection in accordance with the SAWP. OER recognizes that this method may be more likely to select the inappropriate 12-inch sample interval or generate false negatives during the field screening procedures, but it should reduce the amount of IDW generated and the chances of false negatives should be minimal.

Note: Soil samples collected for field soil screening may not be used for laboratory analysis. Separate soil samples must be collected according to the soil sampling protocols outlined in the site-specific SAWP.

8.0 CALCULATIONS

No calculations are applicable to this SOP. The PID/FID is a direct reading instrument.

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

There are no specific quality assurance activities which apply to these procedures. However, the following general QA/QC procedures do apply:

- All data must be documented on field data sheets and/or in field logbooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.
- Equipment calibration activities must be documented and must occur prior to beginning sampling operations. Performance checks on the PID/FID should be performed throughout the course of a day, and recalibration should be performed as needed.

Refer to the site-specific SAWP and/or *QAPrP* for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered to when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASP). Personnel should adhere to the safety requirements outlined in the site-specific plans.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

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XRF Field Screening

SOP OER-0102

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	0.0	8/3/2010	New SOP	Technical
Ross Brittain	1.0	11/10/2020	Edited grammatical mistakes and clarified sampling procedures.	Editorial, Technical

XRF FIELD SCREENING
SOP OER-0102

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List of Acronyms and Abbreviations

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XRF	X-Ray Fluorescence

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1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) is applicable to field screening of a variety of metals in surface and subsurface soils used for Office of Environmental Remediation (OER) projects within the West Virginia Department of Environmental Protection (WVDEP). This is a field screening method used for profiling an area, locating sources of contamination, determining the horizontal and vertical extent of contamination, and/or collecting preliminary data that may be used to design a sampling plan.

X-Ray Fluorescence Spectroscopy (XRF) is a nondestructive qualitative and quantitative analytical technique used to determine the elemental composition of samples. Primary X-rays are emitted from a sealed radioisotope source and are utilized to irradiate samples. In the samples, radiation knocks out an electron from the innermost shell of an atom. The atom is excited and releases its surplus energy almost instantly by filling the vacancy created with an electron from one of the higher energy shells. This rearrangement of electrons is associated with emission of X-rays characteristic of the given atom and represents an emission of fluorescent X-rays. Energies of the characteristic, fluorescent X-rays are converted within the detector into electric pulses, the amplitudes of which are linearly proportional to the energy. An electronic analyzer measures the pulse amplitudes which are the basis of a qualitative X-ray analysis. The number of equivalent counts at a given energy is representative of element concentration in a sample basis for quantitative analysis.

2.0 SUMMARY OF METHOD

Testing of samples may be done in-situ, in plastic bags with minimal preparation, or in plastic bags or the XRF cup with more extensive sample preparation. If the primary objective of the sampling event is to determine whether an element is present, then in-situ or bagged samples with little preparation would be the quickest and simplest way to proceed. If measuring accuracy of the concentration of metal(s) present is the primary objective, then additional preparation of the sample is recommended. Precision and accuracy between samples is best achieved with prepared homogenous samples. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Generally, the instrument precision is the least significant source of error in XRF analysis. User or application related error is the most significant source of error. Following are some of the components of user or application related errors.

4.1 Sample Placement

This is a potential source of error since the X-ray signal decreases as the distance from the radioactive source increases. This type of error can be minimized by maintaining the same sample distance from the source. This SOP allows for the use of a thin plastic wrap (like Saran Wrap) that can be placed between the soil and the analyzer window to keep the window clean. This has little, if any, effect on the distance from the sample to the radioactive source; therefore, it does not cause a potential source of error due to sample placement issues. However, for a few elements (namely Chromium, Vanadium, and Barium) testing through thin plastic may result in lower readings (~ 20%) for these elements.

4.2 Representative Nature of Samples

Heterogeneous samples can be a major source of error. This error can be minimized by either homogenizing a large volume of sample prior to analyzing an aliquot, or by analyzing several samples (in-situ) at each sampling point and then averaging the results.

4.3 Chemical Matrix Effects

Chemical matrix effects result from differences in concentrations of interfering elements. These effects appear as either spectral interferences (peak overlaps) or as X-ray absorption/enhancement phenomena. Both effects are common in soils contaminated with heavy metals. For example, Fe (iron) tends to absorb Cu (copper), reducing the intensity of Cu measured by the detector. Measuring arsenic concentrations also has known interference issues in the presence of high concentrations of lead due to spectral peak overlap, but many of the newer XRF models have built correction factors for As in the presence of Pb.

4.4 Physical Matrix Effects

Physical matrix effects are the result of variations in the physical character of the sample. They may include such parameters as particle size, uniformity, homogeneity and surface condition.

4.5 Moisture Content

The overall error from moisture may be a minor source of error when the moisture range is small (5-20%) or may be a major source of error when measuring on the surface of soils that are saturated with water. Analyses conducted to accurately determine metal concentrations in soil should be done with soils that have been homogenized and dried.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for soil screening activities using the XRF. Refer to the site SAWP to determine specific needs for any given project.

- XRF
- Batteries and chargers
- Standardization clip
- Sieves
- Plastic bags
- Mortar and pestle
- Sample test stand, if desired
- Logbook
- Field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Pails, tubs, or buckets
- Plastic sheeting
- Packing materials
- Sampling gloves

6.0 REAGENTS

Standardization of the XRF is performed utilizing the metal standardization clip; therefore, reagents are not generally used for site screening using the XRF. Reagents associated with decontamination of sampling equipment may be applicable if samples are not analyzed “in-situ”. Refer to SOP OER-0100 for general decontamination procedures for non-disposable sampling equipment.

7.0 PROCEDURES

7.1 General Procedures

- a) Install a fully charged battery in the instrument, or fully charge the instrument as applicable.
- b) Follow manufacturer’s instructions to turn on the XRF unit.
- c) Choose the soil test mode and perform a standardization/calibration test, as applicable.
- d) As necessary, prepare the instrument for analyzing samples by following the manufacturer’s instructions.

7.2 In-Situ Analysis

These procedures are applicable for analysis of surface soils and can be used for vertical profiling of acetate sleeves retrieved by direct push technology.

- a) Complete the procedures outlined in the General Procedures Section.
- b) Clear the area selected for analysis of any surface debris or vegetation. Level the area so the XRF sample window will contact the area evenly. If desired, a thin plastic wrap (like Saran Wrap) can be placed between the soil and the analyzer window to keep the window clean. *(Note: Except for a few elements (namely Chromium, Vanadium, and Barium) testing through the thin plastic has little effect on the test results. Results for chromium, vanadium, and barium may be 20 to 30% lower.)*
- c) Hold the XRF against the sample. Make sure the sample is as flush against the analyzing window as is possible. Conduct the test according to the manufacturer's instructions.
- d) Collect as many samples as needed for the project.

7.3 Bagged Soil Sample Testing

- a) A soil sample is collected in a thin plastic bag (i.e. a "baggie"). It is recommended that at least 100 grams of soil are placed in the baggie. A thickness of at least 0.5 inches of soil in the bag is recommended when conducting the test.
- b) When placing soil in the baggie, remove vegetation, debris, and rocks from the soil to the extent practical. Mix the soil in the baggie to homogenize it. If greater accuracy is desired, dry soil may be passed through a 10 μ m sieve to better homogenize it. A mortar and pestle may be used to break the soil into smaller particles to ease its passage through the sieve and to provide better accuracy. If wet soil is encountered, using a sieve is not an option in the field unless a method to dry the soil can be found. Note that analyses with wet soils are biased low and results should be used with caution.
- c) Hold the XRF to the sample. Make sure the sample is as flush against the analyzing window as is possible. Conduct the test according to the manufacturer's instructions.

8.0 CALCULATIONS

No calculations are applicable to this SOP. The XRF is a direct reading instrument.

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The analysis of soils by XRF should be considered as a screening tool. Data derived from the instrument should be used with discretion. The following general QA/QC procedures apply:

- All data must be documented on field data sheets, in field logbooks, and/or downloaded to a computer.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.
- Equipment calibration activities must be documented and must occur prior to beginning sampling operations. Performance checks on the XRF should be performed throughout the course of a day, and re-standardization of the instrument should be performed as needed.
- Confirmation samples should be collected at a rate established in the SAWP and sent to a laboratory for analysis. Typically, confirmation samples will be 10% of the total samples to meet OER requirements but may be a lower percentage on sites with numerous samples to save money. In order to properly perform a comparative analysis of the field screening method with the lab data, it is important to send the soil to the lab that was actually field screened due to the potential problems noted in Section 4.0 of this SOP.

Refer to the site-specific SAWP and/or *QAPrP* for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

Confirmation samples are recommended at a minimum rate of 10%. Ideally, the sample that was analyzed by XRF should be the same sample that is sent for laboratory analysis. When confirming an in-situ analysis, collect a sample from a six-inch by six-inch area for both an XRF measurement and confirmation analysis.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered to when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASp). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with soil sampling and the use of the XRF for environmental analysis:

- Exposure to unknown contaminants.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slips, trips, and fall hazards.
- The XRF has an x-ray radiation source and potentially additional sources of radiation. The XRF should not be pointed at anyone or any body part, whether energized or de-energized. A radiation dosimeter or radiation meter may be necessary to provide adequate safety for personnel using the XRF.
- Ensure that the proper batteries are placed in the instrument. There is a danger of explosion if improper substitution of batteries is made.
- Biohazards, such as snakes, biting insects and poison ivy.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Innov-X Alpha Series XRF User Manual, Innov-X Systems Inc., August 2005

“Field-Portable X-Ray Fluorescence”, U.S. EPA/ERT Quality Assurance Technical Information Bulletin, Vol. 1, No. 4, May 1991.

XRAY Fluorescence Operating Procedures, SOP# 1707, US EPA, Environmental Response Team, December 22, 1994

Groundwater Well Sampling Procedures

SOP OER-0110

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

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Ross Brittain	3.0	11/10/2020	Edited grammatical issues, clarified details and changed it to XRF instruments in general.	Editorial, Technical

GROUNDWATER WELL SAMPLING PROCEDURES

SOP OER-0110

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List of Acronyms and Abbreviations

DQO	Data Quality Objectives
FID	Flame Ionization Detector
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
ID	Identification
IDW	Investigation Derived Wasted
NTU	Nephelometric Turbidity Unit
OER	Office of Environmental Remediation
ORP	Oxidation Reduction Potential
OSHA	Occupational Safety and Health Administration
PDBS	Passive Diffusion Bag Sampler
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
QAPrP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
TOC	Top of Casing
USEPA	United States Environmental Protection Agency
WVDEP	West Virginia Department of Environmental Protection
VOC	Volatile Organic Compounds

Disclaimer: Any mention in this SOP of any products or services does not constitute or imply the endorsement, recommendation or favoring by WVDEP or any of its employees or contractors acting on its behalf.

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general reference information on sampling of groundwater wells for projects in the Office of Environmental Remediation (OER) within the West Virginia Department of Environmental Protection (WVDEP). Groundwater samples provide data on groundwater quality and give an indication of the nature and extent of any groundwater contamination. Groundwater sampling procedures are generally split into two tasks, purging and sampling. Purging is the process of removing water from the monitoring well prior to sampling and replacing it with adjacent groundwater from within the formation. This ensures that a more representative sample of the actual aquifer condition is collected. Every effort must be made to ensure that the sample is representative of the particular zone of water being sampled. These procedures are designed to be used in conjunction with analyses for the most common types of ground water contaminants (i.e., volatiles, semi-volatiles, and metals). These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site investigation report.

2.0 SUMMARY OF METHOD

In order to obtain a representative groundwater sample for chemical analysis, it is important to either purge water from the monitoring well or take steps to ensure that only water meeting the data quality objectives (DQO's) and work plan objectives is removed from the well during sampling. Purging is generally performed by removing a pre-determined number of well volumes (well-volume purging), or by removing groundwater until water quality parameters have stabilized. Purging is conducted to remove stagnant water in the well casing and/or immediately adjacent to the well screen before collecting the sample. This may be achieved in a variety of ways. Commonly used methods include but are not limited to the use of bailers and pumps. When utilizing pumps, low flow (or low stress) purging/sampling is recommended. Low flow purging/sampling is also highly recommended when sampling for volatile organic compounds (VOC's) and metals. Due to agitation, the tendency to mix formation water with stagnant water above the well screen, and the tendency to stir up fines in the bottom of the well, purging and sampling with a bailer should only be conducted as a last resort. Data is collected under the OER programs to delineate the extent of contamination from sites and to formulate remedial actions utilizing risk-based standards; therefore, a high level of data accuracy and validation is required for these programs. As such, groundwater data collected for volatile organic compounds (VOC's) and metals analysis utilizing bailers for purging and sampling may not be accepted in these programs. Note that passive sampling, minimal purge and no-purge methods do not attempt to purge the stagnant water in the well prior to sampling.

The primary method of sampling groundwater is to use low-flow sampling. However, low-flow sampling may not be possible or appropriate in low-yielding wells, in which case the well volume should be purged before sampling. When purging, monitoring wells should be purged, at a minimum, the equivalent of three times the well volume of standing water or they should continue to be purged until specific conductance, temperature, and pH stabilize. For well-volume purging, the volume of water present in each well shall be computed based on the length of water column and well casing diameter. Once purging is completed, sampling may proceed.

Care should be taken when choosing the sampling device as some will affect the integrity of the sample, depending on the analytical parameters of interest. If information about the contaminant levels in a well is known, then sampling should be performed in a progression from the least to most contaminated well. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The type of sample container, the preservative, holding time, and filtering requirements are all dependent upon the type of analysis to be performed upon the sample. This information should be clearly set forth in the Sampling and Analysis Plan (SAWP) for the site. The sampler should consult the SAWP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. A pair of clean, new, non-powdered disposable gloves shall be worn each time a different location is sampled to prevent cross-contamination. Samples should be collected directly from the sampling device (i.e. bailer or pump) into appropriate laboratory cleaned containers, without making contact with the sampling device. Samples shall be appropriately preserved, labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample, in accordance with the SAWP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold. Refer to Table 2 of the OER *QAPrP* for information on sample containers, preservation, and holding times for common contaminants.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 General

The goal is to obtain a representative sample of the groundwater. Proper field sampling techniques need to be utilized in order to ensure that a representative sample is collected and the sampler does not compromise the sample through their actions. Analysis can be compromised by field personnel in three primary ways; taking an unrepresentative sample, by incorrectly handling the sample or by improperly labeling the sample. There are a variety of ways to introduce contaminants into a sample; that is why it is very important to follow sampling protocols.

4.2 Purging

Purging is generally conducted with the use of a pump or a bailer. Two commonly recognized purging methods include the low-stress approach (utilized during low-flow sampling) and the well-volume approach.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for groundwater well sampling activities:

- Water level indicator
- Photoionization detector (PID) and/or Flame Ionization Detector (FID)

- Logbook
- Calculator
- Field data sheets and sample labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Pails, tubs, or buckets
- Plastic sheeting
- Packing materials and Ziploc plastic bags
- Decontamination solutions (i.e., tap water, non-phosphate soap, deionized water)
- Brushes
- Clean, decontaminated or new unused bailers
- Nylon line, enough to dedicate to each well
- In-line filters, 0.45 microns (μm), typically for sampling dissolved metals
- Water quality meter (e.g., YSI)
- 55-gallon drums for storage of purged groundwater
- Paper towels
- Personal protective equipment (PPE)
- Pump

6.0 REAGENTS

Reagents may be utilized for preservation of samples and for decontamination of sampling equipment. Refer to the SOP for the decontamination procedures and required reagents. Refer to the site-specific Sampling and Analysis Plan for the preservatives required for the specified analysis to be performed.

7.0 PROCEDURES

7.1 General Procedures

The following general procedures are applicable to all well sampling events.

- a) Place plastic sheeting on the ground in the vicinity of the well to ensure that sampling equipment does not contact the ground surface.
- b) Remove the well cap and check for volatile organics in the headspace using a PID/FID, if applicable. If concentrations are detected in the headspace above the action levels established in the Site Health and Safety Plan, appropriate personal protective equipment will be required.
- c) Water-level measurement will be made using an electronic water level meter capable of measuring water levels to the nearest 0.01 foot.
- d) Typically, all depth measurements should be made from the top (the highest point) of the inner well casing (top-of-casing, TOC), also known as the well riser. The reference point location should be described in the field logbook and should be used in all subsequent sampling efforts. Check for well damage at each well that

could indicate a shift in the reference point. Lower the water-level measurement tape and gauge the depth to water and total depth of the well. Care should be taken to assure that the water-level measurement device hangs freely in the monitoring well and is not adhering to the wall of the well casing. Take replicate measurements (at least 3) in each well to ensure accuracy. Record water level data in the field logbook. The water level meter should be left in the well during low-flow purging and sampling.

- e) As necessary (depending on the purging/sampling approach), determine the well volume using one of the formulas in Section 8.0 of this SOP. If more than 24 hours have passed since water levels were measured, re-gauge and record the static water level prior to purging.

7.2 Peristaltic Pump (Low Flow Sampling)

(Note that USEPA does not recommend using peristaltic pumps for VOC samples.)

- a. Utilizing a water-level meter, find the depth to water. If water is above the screen interval, the tubing should be set at the middle of the screen; however, if the water level is below the top of the screen, the tubing should be set in the middle of the water column.
- b. Lower tubing to the appropriate depth. If tubing coils, brass or stainless-steel weights can be added to the bottom of the tubing, capped by a small piece of silicon tubing. At the surface, tubing should connect to silicon tubing, which is placed within the peristaltic apparatus. Additional tubing is connected to the outflow side of the apparatus, which is then joined to the intake of the flow-thru cell. The flow-thru cell's output should connect directly into a waste-water receptacle.
- c. Record the location of the tubing intake (feet below TOC) so that future sampling will occur at the same depth interval.
- d. Start the pump at the lowest possible flow setting. Increase the pump rate gradually until a continuous flow is achieved from the discharge tubing. The discharge rate of the pump can be determined by using a graduated cylinder and a stopwatch. Record the flow rate in milliliters per minute. Pumping rates should be kept at minimal flow to ensure minimal drawdown in the monitoring well. The flow rate should be maintained between 100 mL/min and 500 mL/min (0.03-0.13 gal/min), or between 100 mL/min and 300 mL/min (0.03-0.08 gal/min) for VOC sampling, throughout the purging and sampling activities. Flow rates achieved during the purging period should also be maintained throughout the sampling period.
- e. When a stable purge rate has been established (i.e., pumping rate is equal to or less than well recharge rate), begin recording water quality readings at a frequency of every three to five minutes. Note that drawdown should not exceed 4 inches.

- f. Continue to purge the well until water quality parameters have stabilized within the following stabilization criteria over three consecutive readings. Record the purging and sampling data in the field logbook.

g. Parameter	Criteria
Water level drawdown	<0.3 feet
pH	+/- 0.1 standard units
Conductivity	+/- 3% of readings
Temperature	+/- 3% of readings
Dissolved Oxygen	+/- 0.3 mg/L or 3% of readings, whichever is greater
Turbidity	+/- 10% of readings for values greater than 1 nephelometric turbidity unit (NTU)
Eh/ORP	+/- 10 millivolts

- h. Once the water quality parameters have stabilized, collect the ground water sample by detaching the tubing from the flow-through cell. Under no circumstances should the ground water sample be collected from the flow-through cell discharge stream. Collect the samples in the following order:
- i. Volatile organic compounds (Ensure that volatiles are immediately capped and have no headspace by inverting the vial, tapping gently and waiting at least 10 seconds. If an air bubble appears, unscrew the cap and pop the bubble or refill with more sample and re-seal the vial. Do not collect a sample with air trapped in the vial.)
 - ii. Semi-volatile organic compounds
 - iii. Nitroaromatics
 - iv. Herbicides/pesticides
 - v. Metals
 - vi. All other parameters
- i. Samples for total metals analysis, if applicable, should be collected prior to sampling for dissolved metals. However, OER generally only collects dissolved metals for groundwater assessment, and does both total metals and dissolved metals for surface water only. To collect samples for dissolved metals analysis, a 0.45µm filter should be added to the discharge line. Samples for dissolved metals analysis should be collected after 500 mL of water has passed through the in-line filter. Remove the filter following collection of samples for dissolved metals.
- j. Preserve and filter according to the requirements set forth in the site-specific SAWP. Label the sample containers using indelible pen, attach a chain-of-custody seal to each container lid, place the containers in plastic bags, and place them on ice in a cooler. Record sample collection date and time. Handle and store samples in accordance with the approved *QAPrP* and/or SAWP.
- k. Remove the water level meter (if not already removed) and then the pump from the monitoring well. Decontaminate the pump and dispose of the tubing if it is

non-dedicated to the well. Protect equipment from contamination by storing on plastic sheeting.

- l. Close and lock the well.
- m. Record the following information in the field logbook:
 - Sample ID
 - Location
 - Purging and sampling data
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information (e.g., date, time and sampler)

7.3 Submersible Pump (Low Flow Sampling)

- a) Connect the pump tubing to the flow-through cell and connect the multi-parameter probe to the cell. Connect the discharge from the flow-through cell to a purge water drum for later IDW disposal. Keep the flow-through cell out of direct sunlight.
- b) Lower the pump slowly in the well to minimize the disturbance of the water column.
 - Do not let the pump, tubing, electrical cords, and support cable touch the ground as you are lowering the pump into place.
 - Secure the pump at the desired depth using the support cable. The entire pump and tubing assembly should be supported by a stainless steel or Teflon coated cable. It is not advisable to use the tubing to support the pump.
 - Place the pump intake as close to the middle of the screened interval for wells with water levels above the top of the screen. For wells with water levels below the top of the screen, the pump should be set near the top of the water column and slowly lowered, being careful not to expose the screen to air, until the pump is placed in the middle (or just below the middle) of the water column.
 - The pump or water level probe should not be allowed to hit the bottom of the well before or during sampling because it will disturb sediment. It should be noted that at least three feet of water is needed to implement low flow sampling.
- c) Record the location of the pump intake (feet below TOC) so that future sampling will occur at the same depth interval.
- d) Start the pump at the lowest possible flow setting. Increase the pump rate gradually until a continuous flow is achieved from the discharge tubing. The discharge rate of the pump can be determined by using a graduated cylinder and

a stopwatch. Record the flow rate in gallons per minute. Pumping rates should be kept at minimal flow to ensure minimal drawdown in the monitoring well. The flow rate should be maintained between 100 mL/min and 500 mL/min (0.03-0.13 gal/min), or between 100 mL/min and 300 mL/min (0.03-0.08 gal/min) for VOC sampling, throughout the purging and sampling activities. Flow rates achieved during the purging period should also be maintained throughout the sampling period.

- e) When a stable purge rate has been established (i.e., pumping rate is equal to or less than well recharge rate), begin recording water quality readings at a frequency of every three to five minutes. Note that drawdown should not exceed 4 inches.
- f) Continue to purge the well until the water quality parameters have stabilized within the following stabilization criteria over three consecutive readings. Record the purging and sampling data in the field logbook.

Parameter	Criteria
Water level drawdown	<0.3 feet
pH	+/- 0.1 standard units
Conductivity	+/- 3% of readings
Temperature	+/- 3% of readings
Dissolved Oxygen	+/- 0.3 mg/L or 3% of readings, whichever is greater
Turbidity	+/- 10% of readings for values greater than 1 nephelometric turbidity unit (NTU)
Eh/ORP	+/- 10 millivolts

- g) Once the water quality parameters have stabilized, collect the ground water sample by detaching the tubing from the flow-through cell. Under no circumstances should the ground water sample be collected from the flow-through cell discharge stream. Collect the samples in the following order:
 - i. Volatile organic compounds (Ensure that volatiles are immediately capped and have no headspace by inverting the vial, tapping gently and waiting at least 10 seconds. If an air bubble appears, unscrew the cap and pop the bubble or refill with more sample and re-seal the vial. Do not collect a sample with air trapped in the vial.)
 - ii. Semi-volatile organic compounds
 - iii. Nitroaromatics
 - iv. Herbicides/pesticides
 - v. Metals
 - vi. All other parameters
- h) Samples for total metals analysis should be collected prior to sampling for dissolved metals. To collect samples for dissolved metals analysis, a 0.45µm filter should be added to the discharge line. Samples for dissolved metals

analysis should be collected after 500 mL of water has passed through the in-line filter. Remove the filter following collection of samples for dissolved metals.

- i) Preserve and filter according to the requirements set forth in the site-specific SAWP. Label the sample containers using indelible pen, attach a chain-of-custody seal to each container lid, place the containers in plastic bags, and place them on ice in a cooler. Record sample collection date and time. Handle and store samples in accordance with the approved *QAPrP* and/or SAWP.
- j) Remove the water level meter (if not already removed) and then the pump from the monitoring well. Decontaminate the pump and dispose of the tubing if it is non-dedicated to the well. Protect equipment from contamination by storing on plastic sheeting.
- k) Close and lock the well.
- l) Record the following information in the field logbook:
 - Sample ID
 - Location
 - Purging and sampling data
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information (e.g., date, time and sampler)

7.4 Bailer Method

[As noted above, bailers are not recommended for most purging/sampling situations, other than in low-permeability formations (see below). If bailers are to be used, justification must be provided in the SAWP.]

- a) Purge the well by manually bailing until a minimum of three well volumes have been removed and water quality parameters have stabilized within the following stabilization criteria over three consecutive readings. Record the purging and sampling data in the field logbook.

Parameter	Criteria
pH	+/- 0.1 standard units
Conductivity	+/- 3% of readings
Temperature	+/- 3% of readings
Dissolved Oxygen	+/- 0.3 mg/L or 3% of readings, whichever is greater
Turbidity	+/- 10% of readings for values greater than 1 nephelometric turbidity unit (NTU)
Eh/ORP	+/- 10 millivolts

- b) Lower bailer slowly and gently into well, do not drop or splash bailer into the water column. Stop lowering at desired point adjacent to well screen. Withdraw a sample from the well, transfer the sample from the bailer directly into sample

containers. Preserve and filter according to the requirements set forth in the site-specific SAWP.

- c) Collect the samples in the following order:
 - i. Volatile organic compounds (Ensure that volatiles are immediately capped and have no headspace by inverting the vial, tapping gently and waiting at least 10 seconds. If an air bubble appears, unscrew the cap and pop the bubble or refill with more sample and re-seal the vial. Do not collect a sample with air trapped in the vial.)
 - ii. Semi-volatile organic compounds
 - iii. Nitroaromatics
 - iv. Herbicides/pesticides
 - v. Metals
 - vi. All other parameters
- d) To collect samples for dissolved metals analysis, a 0.45 μ m filter should be attached to a syringe (or other device to force water through the filter). Samples for dissolved metals analysis should be collected after 500 mL of water has passed through the filter. Discard the filter following collection of samples for dissolved metals.
- e) Label appropriate sampling containers with sampling details and custody information.
- f) Replace the well cap and lock the cover.
- g) Record the following information in the field logbook:
 - Sample ID
 - Location
 - Purging and sampling data
 - Color
 - Odor
 - Field screening instrument readings (i.e., water quality, PID)
 - Any other pertinent information (e.g., date, time and sampler)

7.5 Sampling Wells in Low-Permeability Formations

Wells located in low-permeability formations (i.e., slow-recovery wells, wells that can be purged to dryness, etc.) require alternate sampling procedures than the methods listed above. One approach, for a well screened below the water table, is to remove the stagnant water in the casing to just above the top of the screened interval, to prevent the exposure of the gravel pack or formation to atmospheric conditions. The pumping rate should be as low as possible to minimize disturbance as much as possible in the well. A sample should then be secured from the water within the screened interval. Another approach is to use a dedicated pump located within the screened interval and purge only

the pump and tubing volume before collecting the sample (“passive sampling”). Another type of passive sampling uses a passive diffusion bag sampler (PDBS) which is deployed in the screened interval of the monitoring well for a period recommended by the manufacturer. Analytes of interest passively diffuse into deionized water contained within the sampler as the well equilibrates. It should be noted that only certain VOCs will diffuse into the PDBS. The PDBS is retrieved from the well and the sample is poured into appropriate sample containers. Other no-purge samplers include equilibrated grab samplers such as the HYDRASleeve™ and the Snap Sampler®. These samplers are deployed in the screened interval of the monitoring well and the well is allowed to equilibrate. Use of these passive sampling and no-purge sampling techniques will require development of a method-specific SOP to be included in the SAWP.

8.0 CALCULATIONS

Volume estimates per foot for common inside diameter tubing is presented in the following table:

Tubing Inside Diameter (inches)	Tubing Volume (gallon per foot)
1/4	0.0003
3/8	0.0057
1/2	0.010

If it is necessary to calculate the volume of the well, utilize the following equation:

$$V = kh\pi r^2$$

Where:

- V = Volume (gallons)
- π = 3.14
- r = radius of the well (feet)
- h = water column height (feet)
- k = conversion factor (7.48 gal/ft³)

Or if the variables are known:

$$V = k\{r_{ic}^2h + [(r_b^2h - r_{oc}^2h) * ne]\}$$

Where:

- V = Volume (gallons)
- r_{ic} = radius inside diameter of casing (feet)
- r_b = radius of borehole (feet)
- r_{oc} = radius outside diameter of casing (feet)
- h = water column height (feet)
- k = conversion factor (7.48 gal/ft³)
- ne = effective porosity of filter pack material (~ 35%)

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAWP.
- The collection of an equipment rinsate blank is recommended to evaluate potential for cross-contamination from the purging and/or sampling equipment.
- The collection of duplicate samples will likely be a requirement set forth in the SAWP and/or *QAPrP*.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAWP and/or *QAPrP* for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with well sampling:

- Exposure to unknown contaminants.
- Lifting injuries associated with moving equipment, coolers with samples, and retrieving pumps and bailers.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slips, trips, and fall hazards.
- Potential electrical shocks associated with use of submersible pumps.
- Biohazards, such as snakes, biting insects, and poison ivy.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

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Soil Sampling

SOP OER-0120

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	7/1/2010	Reformatted, added SOP ID #, and renumbered. Supersedes Revision 0.0. Combined previous soil sampling SOP for surface and subsurface sampling, added sampling information	Editorial Technical
Dave Long	2.0	9/21/2016	Revised procedures. Reformatted.	Editorial, Technical
Ross Brittain	3.0	11/10/2020	Edited grammatical issues and updated procedures.	Editorial, Technical

SOIL SAMPLING
SOP OER-0120

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List of Acronyms and Abbreviations

bgs	below ground surface
FID	Flame Ionization Detector
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HLC	Henry's Law Constant
IDW	Investigation Derived Wasted
OER	Office of Environmental Remediation
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
QAPrP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compounds
WVDEP	West Virginia Department of Environmental Protection
VOC	Volatile Organic Compounds
XRF	X-Ray Fluorescence

Disclaimer: Any mention in this SOP of any products or services does not constitute or imply the endorsement, recommendation or favoring by WVDEP or any of its employees or contractors acting on its behalf.

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of surface and subsurface soil samples using equipment such as a continuous flight auger, a split spoon, backhoe, hand auger, shovel, trowel, and/or scoop for projects in the Office of Environmental Remediation (OER) within the West Virginia Department of Environmental Protection (WVDEP). Refer to SOP OER-0121 for soil sample collection procedures using direct push (i.e. GeoprobeTM). Analysis of soil samples may determine whether concentrations of specific pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health or the environment. These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site investigation report. Refer to SOP OER-0122 for procedures for soil sampling of volatiles utilizing Method 5035. Refer to SOP OER-0101 and OER-0102 for procedures for field screening of soil with a photoionization detector (PID)/flame ionization detector (FID) and an X-Ray fluorescence (XRF) detector, respectively.

2.0 SUMMARY OF METHOD

Soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type. Surface and near-surface soils may be easily sampled using a spade, trowel, and scoop. Sampling at greater depths may be performed using a hand auger, continuous flight auger, a split-spoon, or a backhoe. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is generally not performed or recommended, except for Method 5035. However, samples should be cooled and protected from sunlight to minimize any potential reaction. The type of sample container, the preservative (if any), and holding times are all dependent upon the type of analysis to be performed upon the sample. Refer to Table 2 of this *QAPrP* for information on sample containers, preservation and holding times for common contaminants. This information should be clearly set forth in the Sampling and Analysis Plan or Site Assessment Work Plan (SAWP) for the site. The sampler should consult the SAWP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. A pair of clean, new, non-powdered disposable gloves shall be worn each time a different location is sampled to prevent cross-contamination. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Samples shall be appropriately preserved (if applicable), labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample, and custody seals attached to the cooler in accordance with the SAWP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold. Consider placing each sample container in a zip-lock bag to prevent ice/water in the cooler from

dislodging the label and custody seal. (Sample vials and jars for each sample from Method 5035 sampling may be placed in the same zip-lock bag.)

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary potential problems associated with soil sampling: cross-contamination of samples and improper sample collection. Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. Strictly following decontamination procedures of the non-dedicated sampling equipment, as outlined in SOP OER-0100 *General Decontamination Procedures for Non-Disposable Field Sampling Equipment* can prevent or reduce the chance of cross-contamination problems. Improper sample collection can involve disturbance of the matrix resulting in compaction of the sample, significant volatile loss for VOC sample collection or inadequate homogenization of the samples where required, resulting in variable, non-representative results. When sampling with a hand auger, non-cohesive sands may collapse in the borehole prior to reaching the sampling depth; also, in tight clays, the greater the depth attempted, the more difficult it is to recover a sample due to increased friction and torquing of the hand auger extensions.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for soil sampling activities. Refer to the SAWP to determine specific needs for any given project.

- Photoionization detector (PID) and/or flame ionization detector (FID)
- Logbook
- Field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Pails, tubs, or buckets
- Plastic sheeting
- Packing materials and Ziploc plastic bags
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water)
- Brushes
- Stakes and flagging
- Sampling gloves
- Shovel
- Spatula, scoops, and/or trowels
- Continuous flight (screw) auger
- Bucket auger
- Post hole auger
- Split spoons
- Drilling rig equipment (points, drive head, drop hammer, puller jack and grip, extension rods, T-handle, thin wall tube sampler, etc.)

- Backhoe
- Drums for storage of investigation derived waste
- Personal protective equipment (PPE)

6.0 REAGENTS

Chemical preservation of solids is not generally recommended except for sampling for VOC analysis; therefore, reagents will likely be utilized only for decontamination of sampling equipment. Refer to the SOP for the decontamination procedures and required reagents. Refer to the SOP for Method 5035 for VOC soil sample collection. Refer to the site-specific Sampling and Analysis Plan for the preservatives, if any, required for other specified analyses to be performed.

7.0 PROCEDURES

7.1 General Procedures

- a) Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.
- b) Obtain necessary sampling and monitoring equipment. Ensure that it has been decontaminated since its last use and ensure that the equipment is in good working condition.
- c) Use stakes and/or flagging to identify and mark all sampling locations.
- d) Ensure that WV811 and all local utilities have been called to perform a utility marking of the site.

7.2 Surface Soil Samples

The West Virginia Department of Environmental Protection Office of Environmental Remediation defines surface soil as the soil located from a depth of 0.0 to 2.0 ft. below ground surface (bgs). Collection of surface soil samples can be accomplished with tools such as spades, shovels, trowels, and scoops.

- a) Clear any surface debris (e.g., concrete/asphalt, vegetation, roots, gravel/rocks, and twigs) from the sampling location.
- b) Use a scoop, hand-auger, trowel, or shovel to collect a portion of surface soil. Plastic devices cannot be used to collect samples for SVOC analysis. Perform field screening as appropriate (see SOP OER-0101 *PID/FID Field Screening*). (Note: Soil samples collected for field soil screening may not be used for laboratory analysis.) Whenever a vertical or near-vertical surface is sampled, such as when shovels or similar devices are used for surface or subsurface sampling, the surface should be dressed (scraped) to remove smeared soil and to expose a fresh surface for sampling. If Method 5035 is required for volatiles, submerge the coring device directly into a fresh face of the remaining soil

contained in the sampling device and collect the sample, placing the soil in the appropriate sample jar for volatile organic analysis. Note, however, that if the soil is non-cohesive and crumbles when removed from the ground surface, consideration should be given to obtaining the soil plug for Method 5035 analysis directly from a newly exposed ground surface. Samples collected for SVOC analysis that includes lighter compounds such as naphthalene and acenaphthene must be collected by completely filling the sample jar and leaving no headspace rather than homogenizing first, due to the volatility of the lighter SVOCs. The volatility of target SVOC analytes will determine if the SVOC soil samples should be homogenized. In general, soils with potential contaminants whose vapor pressure > 0.1 mg Hg or Henry's Law Constant (HLC) > 0.0001 atm*m³/mol should not be homogenized, but it may be good practice to not homogenize any soils being analyzed for SVOCs. For all other analysis, the soil may be homogenized in a stainless-steel bowl prior to placing the soil in the appropriate sample containers. (Note: Remove rocks, pebbles, and organic material from the soil sample prior to placing the soil in the sample containers).

- c) Close the sample containers and affix labels (if not already present) and immediately place on ice.
- d) Measure the depth of the samples using a ruler and record it in the field logbook.
- e) Once the sampling is completed, dispose of disposable sampling equipment and 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
- f) Record the following information in the field logbook:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information (e.g., date, time and sampler)

7.3 Sampling Subsurface Soil with Hand Augers and Thin Wall Tube Samplers

This system consists of an auger (typically, 4-inch stainless steel auger buckets with cutting heads are used) and/or a thin-wall tube sampler, a series of extensions, and a "T" handle. The auger is used to bore a hole to a desired sampling depth and is then withdrawn. Perform field screening as appropriate and as referenced in Section 7.2.2 above. Samples for Method 5035 analysis will be collected first, immediately and directly from the auger. Samples collected for SVOC analysis may also need to be

collected prior to homogenization (see Step k below) and should not be collected with plastic equipment. Samples for other analysis may then be collected once the material is removed from the auger and homogenized. If a core sample is to be collected, the auger tip is then replaced with a thin wall tube sampler. The system is then lowered down the borehole and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler.

The following procedure is used for collecting soil samples with the auger:

- a) Clear the area to be sampled of any surface debris (e.g., twigs, rocks, etc.).
- b) Attach the auger bit to a drill rod extension and attach the "T" handle to the drill rod.
- c) Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole or into a 55-gallon drum. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. Consider using a second, clean auger bucket for sampling once the sampling depth is attained.
- d) After reaching the desired depth, slowly and carefully remove the auger from the hole.
- e) If soil has sloughed from the sides of the auger hole, discard the top 1" of soil in the auger. When sampling directly from the auger, collect the sample after the auger is removed from the hole (note special considerations for Method 5035 sampling above and proceed to Step k).
- f) Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
- g) Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.
- h) Remove the tube sampler and unscrew the drill rods.
- i) Remove the cutting tip and the core from the device.
- j) Discard the top 1" of the core as this may represent material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container.
- k) Perform field screening as appropriate. If Method 5035 is required for volatiles, collect this sample first, submerging the coring device directly into the soil contained in the sampling device and placing the soil in the appropriate sample jar for volatile organic analysis. Samples collected for SVOC analysis that includes lighter compounds such as naphthalene and acenaphthene must be collected by completely filling the sample jar and leaving no headspace rather than homogenizing first, due to the volatility of the lighter SVOCs. The volatility of target SVOC analytes will determine if the SVOC soil samples should be

homogenized. In general, soils with potential contaminants whose vapor pressure > 0.1 mg Hg or Henry's Law Constant (HLC) > 0.0001 atm*m³/mol should not be homogenized, but it may be good practice to not homogenize any soils being analyzed for SVOCs. For all other analyses, the soil may be homogenized in a stainless steel bowl prior to placing the soil in the appropriate sample containers.

- l) Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
- m) Record the following information in the field logbook:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information (e.g., date, time and sampler)
- n) Abandon the boring in accordance with applicable state regulations.
- o) Abandon the boring as necessary in accordance with applicable state regulations.

7.4 Sampling Surface and Subsurface Soils Using Test Pit/Trench Excavation

The following procedures are used for collecting soil samples from test pits or trenches:

- a) Backhoes may be used in the collection of surface and shallow subsurface soil samples. The trenches created by excavation with a backhoe offer the capability of collecting samples from very specific intervals and allow visual correlation with vertically and horizontally adjacent material. Using the backhoe, excavate a trench approximately three feet wide to the desired sampling depth. Place excavated soils on plastic sheets. (Note: Trenches greater than five feet deep must be sloped or protected by a shoring system, and personnel not operating the backhoe must follow safety protocols as required by OSHA regulations.)
- b) A shovel may be used to remove a one to two-inch layer of soil from the vertical face of the pit where sampling is to be done. Remember to dress (scrape) the vertical face if sampling is conducted directly from the trench/pit sidewall, to remove smeared soil from the backhoe bucket and expose fresh soil for screening and sampling. Field screening may be completed in accordance with SOP OER-0101, as there is plenty of soil available for screening and sampling with test pits and trenches.

- c) Samples may also be taken directly from the approximate center of the soil mass in the backhoe bucket using a shovel, trowel, scoop, or coring device after field screening. Field screening may be completed in accordance with SOP OER-0101. For Method 5035 sampling, submerge the coring device directly into the soil in the backhoe bucket adjacent to the field screening location and collect the sample, placing the soil in the appropriate sample jar for volatile organic analysis. Samples collected for SVOC analysis that includes lighter compounds such as naphthalene and acenaphthene must be collected by completely filling the sample jar and leaving no headspace rather than homogenizing first, due to the volatility of the lighter SVOCs. The volatility of target SVOC analytes will determine if the SVOC soil samples should be homogenized. In general, soils with potential contaminants whose vapor pressure > 0.1 mg Hg or Henry's Law Constant (HLC) > 0.0001 atm*m³/mol should not be homogenized, but it may be good practice to not homogenize any soils being analyzed for SVOCs. For all other analyses, the soil may be homogenized in a stainless steel bowl prior to placing the soil in the appropriate sample containers.
- d) Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
- e) Record the following information in the field logbook:
 - Sample ID
 - Location and depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information (e.g., date, time and sampler)
- f) Abandon the pit in accordance with applicable state regulations.

8.0 CALCULATIONS

No calculations are applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The following general quality assurance and quality control (QA/QC) procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAWP.

- The collection of an equipment rinsate blank is recommended to evaluate potential for cross-contamination.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAWP and/or *QAPrP* for further information on collection of duplicate samples.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAWP and/or *QAPrP* for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASP). Personnel should adhere to the safety requirements outlined in the site-specific plans. Before beginning any field work, be sure that all sampling locations are clear of overhead and buried utilities. The following is a summary of just some of the hazards associated with these soil sampling procedures:

- Exposure to unknown contaminants.
- Lifting and carrying injuries.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slips, trips, and fall hazards.
- Injury from moving equipment.
- Striking underground utilities in borings or test pits.
- Loud noises.
- Biohazards, such as snakes, biting insects and poison ivy.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

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Soil Sampling Using Direct-Push Drilling

SOP OER-0121

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	0.0	7/1/2010	New SOP	Technical
Ross Brittain	1.0	11/10/2020	Edit grammatical issues and clarify processes.	Editorial, Technical

SOIL SAMPLING USING DIRECT-PUSH DRILLING
SOP OER-0121

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List of Acronyms and Abbreviations

bgs	below ground surface
FID	Flame Ionization Detector
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HLC	Henry's Law Constant
ID	Identification
IDW	Investigation Derived Wasted
OER	Office of Environmental Remediation
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
QAPrP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compounds
WVDEP	West Virginia Department of Environmental Protection
VOC	Volatile Organic Compounds
XRF	X-Ray Fluorescence

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1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general reference information on soil sampling using direct push (i.e. Geoprobe™) technology for projects in the Office of Environmental Remediation (OER) within the West Virginia Department of Environmental Protection (WVDEP). Surface and subsurface soil sampling supplies information on subsurface lithology as well as providing data for use in evaluating the vertical and horizontal extent of contaminant impact.

These procedures are designed to be used in conjunction with analyses for the most common types of soil contaminants (i.e., volatile, semi-volatiles, and metals). These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site report. Refer to SOP OER-0122 for procedures for soil sampling of volatiles utilizing Method 5035. Refer to SOP OER-0101 for procedures for field screening of soil with a photoionization detector (PID) or flame ionization detector (FID) and OER-0102 for procedures for field screening soil with an X-Ray fluorescence (XRF) detector.

2.0 SUMMARY OF METHOD

Direct-push soil sampling devices are used to collect soil samples at specific depths below ground surface (bgs). Direct-push machines are hydraulically powered and are generally mounted on a customized four-wheel drive or tracked vehicle. The base of the sampling device is positioned on the ground over the sampling location and the vehicle is hydraulically raised on the base. As the weight of the vehicle is transferred to the probe, the probe is pushed into the ground. A built-in hammer mechanism allows the probe to be driven through dense materials. Maximum depth penetration under favorable circumstances may be greater than 100 feet.

Soil samples are collected using specially designed sample tubes. The sample tube is pushed and/or vibrated to a specified depth. In the simplest sampler, the piston-activated system, the interior plug of the sample tube is removed by inserting small diameter threaded rods. The sample tube is then driven an additional foot to collect the samples. The probe sections and sample tube are then withdrawn, and the sample is extruded from the tube. Latch-activated systems are similar to those that use piston-activation mechanisms, but they can collect samples more rapidly. Sampling rates can also be increased by using dual-tube samplers. The dual-tube sampling system is recommended for continuous sampling as the outer casing prevents sloughing and cross-contamination from other depths. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is not generally recommended, except for Method 5035. However, samples should be cooled and protected from sunlight to minimize any potential reaction. The type of sample container, the preservative (if any), and holding times are all dependent upon the type of analysis to be performed on the sample. This information should be

clearly set forth in the Sampling and Analysis Plan or Site Assessment Work Plan (SAWP) for the site. The sampler should consult the SAWP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Samples shall be appropriately preserved (if applicable), labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAWP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

A preliminary site survey should be performed in order to identify areas to be avoided with the Geoprobe™ and to determine if the Geoprobe™ will be able to access the desired sampling locations. All underground utilities should be located and marked. These areas where underground and aboveground utilities are located should be avoided during sampling.

Decontamination of sampling tubes, probe rods, adaptors, non-expendable points and other equipment that contact the soil is necessary to prevent cross-contamination of samples. During sampling, the bottom portion and outside of the sampling tubes can be contaminated with soil from other depth intervals. Care must be taken to prevent soil which does not represent the sampled interval from being carefully wiped from the outside surface of the sampling tube and the bottom 3 inches of the sample should be discarded before extruding the sample.

Obtaining sufficient volume of soil for analysis of multiple parameters from one sample location may present a problem. Most direct-push soil sampling systems recover a limited volume of soil and it is not possible to reenter the same hole and collect additional soil. When multiple analyses are to be performed on soil samples by this method, the relative importance of the analyses should be established. Identifying the order of importance will ensure that the limited sample volume will be used for the most crucial analyses. In some instances, it may be appropriate to push another boring very near the initial boring in order to have sufficient soil for all analysis. However, this should be clearly documented in the field notes and in the subsequent report for the site.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for soil sampling activities. Refer to the site SAWP to determine specific needs for any given project.

- Photoionization detector (PID) and/or flame ionization detector (FID)
- Logbook
- Field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Pails, tubs, or buckets

- Plastic sheeting
- Packing materials and Ziploc plastic bags
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water)
- Brushes
- Stakes and flagging
- Sampling gloves
- Personal protective equipment (PPE)
- Drums for storage of investigation derived waste
- Direct-push system and associated equipment (i.e., rods, extractor, drive and pull caps, expandable point holders, drive points, piston rods and stops, sample tubes, vinyl end caps)

6.0 REAGENTS

Chemical preservation of solids is not generally recommended, except for samples for VOC analysis; therefore, reagents will likely be utilized primarily for decontamination of sampling equipment. Refer to the SOP for the decontamination procedures and required reagents. Refer to the site-specific Sampling and Analysis Plan for the preservatives, if any, required for the specified analysis to be performed.

7.0 PROCEDURES

7.1 Hollow Stem

These procedures relate to the sampling activities associated with collecting a soil sample from a Geoprobe™ and are not intended to address in detail the actual operation of the Geoprobe™. The operator should follow the SOP requirements established by the manufacturer for the Geoprobe™ model being utilized at the site. Other direct-push systems with generally similar operating procedures are also available for soil sampling. Ensure that WV811 and all local utilities have been called to perform a utility marking of the site prior to beginning work.

- a) A decontaminated Geoprobe™ sampling spoon with an acetate or clear PVC liner is prepared at the surface and driven into the ground.
- b) The sample spoon is closed on the end with a drive point and advanced to the top of the desired sample interval.
- c) A pin is removed from the top of the sampler and the drive point is lifted out, thereby opening the bottom of the sampler, allowing soil to enter the sample spoon when the spoon is advanced.
- d) The hydraulic hammer advances the Geoprobe™ sampling spoon to fill the acetate liner inside the sampler.
- e) The sample spoon is then retrieved from the hole and the liner extruded from the sampling spoon.

- f) Immediately upon retrieval, field screening using one of the accepted methods below and Method 5035 sampling should be the first tasks performed to reduce the loss of volatiles from the sample as much as possible (Hewitt and Lukash 1996, Sorini et al. 2009). Note that field screening directly from an exposed soil core is unacceptable due to the dilution of vapors in ambient air and potential loss of volatiles from the samples. There are three options for field screening:
- i. The first option is to cut the core into 12-inch sections and immediately collect VOC samples using Method 5035 (be sure to expose a fresh area of the soil core to prevent collection of smeared soils), place the samples in laboratory-supplied vials, as necessary, and store them on ice at $< 6^{\circ}\text{C}$ without freezing. After collecting samples from each 12-inch section, screen the remaining soils using PID/FID Field Screening SOP OER-0101. Once the field screening has identified the 12-inch section from which samples should be collected to send to the laboratory for analyses, the samples collected using Method 5035 from those 12-inch sections should be packed for shipping to the lab. All other 12-inch section samples collected using Method-5035 should be disposed of as IDW. After determining the appropriate VOC samples, the rest of the soil core logging and sample collection may proceed in accordance with the SAWP. This method of collecting all potential VOC samples before field screening ensures that the samples are the most representative of VOC soil concentrations at the site by minimizing the loss of vapors, but OER recognizes that this method will also generate a larger amount of IDW for disposal, depending on the use of preservatives (En Core® vs. Terra Core™ samplers).
 - ii. The second option is to collocate borings where an initial boring is used only for field screening and logging of subsurface conditions. Once the sample depths for lab analysis have been determined based on PID/FID readings, staining and soil characteristics of the screening boring using SOP OER-0101, a second boring is completed to the desired sample depths at a location immediately adjacent to the first boring and samples are collected from this second, undisturbed core using Method 5035. Be sure to expose a fresh area of both soil cores to prevent collection of smeared soils. Once the VOC soil samples have been collected, XRF screening, if applicable, soil core logging and sample collection may proceed in accordance with the SAWP. OER recognizes that this method will require more use of the drill equipment and generate more cuttings as IDW.
 - iii. The third option is to use the method in *ASTM D4547-15 X3.1.2 Direct Subsurface Soil Sampling Technique Using a Cutting Tool* to collect the soil cores leaving them within the acetate liner and drilling holes through the liner to expose a portion of the soils (Sorini et al. 2009), but with a slight modification to the screening protocol. The core liner is brought to the surface and placed in a metal rack for sub-sampling. Care should be taken to ensure that the air around and over the core liner is still, such as the use of

shielding or being inside a structure or vehicle. A cutting tool powered by a portable drill is used to cut circular screening holes in the liner at 12-inch intervals. The diameter of the circle is the dimension required for easy insertion of the hand-operated coring device to be inserted into the hole for sample collection (e.g., En Core®) and/or the PID/FID probe tip. Any portion of the liner that is not completely filled with soil should not be screened or sampled. Additionally, a small amount of cuttings may be generated, but will typically accumulate away from the soil core. As each hole is cut, the exposed soil should be dug out with a stainless steel tool to remove any potential cuttings and smeared soils to create a hole about 1-inch deep. The tip of the PID/FID should be inserted into the hole immediately after it is dug, being careful not to touch the probe tip to any exposed soils. A vapor reading should be taken with the PID/FID and the highest value within ~15 seconds should be recorded. The 12-inch section with the highest PID/FID reading will then be sampled for laboratory analysis by drilling another hole next to the screening hole and collecting samples using Method 5035 and placing them on ice at < 6°C without freezing. Be sure to expose a fresh area of the soil core before collecting the sample to make sure that smeared soils were not collected. Once the VOC soil samples have been collected, the liner may be cut horizontally and removed to proceed with XRF screening, if applicable, soil core logging and sample collection in accordance with the SAWP. OER recognizes that this method may be more likely to select the inappropriate 12-inch sample interval or generate false negatives during the field screening procedures, but it should reduce the amount of IDW generated and the chances of false negatives should be minimal.

(Note that for risk assessment purposes, the field screening results should be used to determine the location of a sample from each boring for the surface soils (top 0-2 ft. bgs), unless surface soil samples were collected using another method, and subsurface soils in the zone of potential excavation activities (2-10 ft. bgs). Additional samples deeper than 10 ft. bgs may be necessary to locate potential sources of contamination leaching to groundwater.)

- g) If volatiles are being sampled, use the Encore or Terra Core samplers (Method 5035) to collect a soil sample directly from the soil core as outlined in section 7.f above. Refer to the SOP for Method 5035, as needed. Samples that will be analyzed for VOC's should be directly placed into the appropriate sample container without homogenizing or mixing and immediately placed on ice. As appropriate, refer to the SOP for sampling method SW-846 5035. Samples collected for SVOC analysis that includes lighter compounds such as naphthalene and acenaphthene must be collected by completely filling the sample jar and leaving no headspace rather than homogenizing first, due to the volatility of the lighter SVOCs. The volatility of target SVOC analytes will determine if the SVOC soil samples should be homogenized. In general, soils with potential

contaminants whose vapor pressure > 0.1 mg Hg or Henry's Law Constant (HLC) > 0.0001 atm*m³/mol should not be homogenized, but it may be good practice to not homogenize any soils being analyzed for SVOCs. All other non-volatile analytes may be placed in a stainless steel bowl and thoroughly homogenized. Fill the appropriate sample containers with the remaining homogenized sample.

- h) Record the following information in the field logbook:
- Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information (e.g., date, time and sampler)
- i) Abandon the boring, as needed, in accordance with applicable state regulations.

7.2 Sampling Subsurface Soil with a Split Spoon (Barrel) Sampler

Split spoon sampling is generally used to collect soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. For standard split spoon sampling, a drill rig is used to advance a borehole to the target depth. The drill string is then removed, and a standard split spoon is attached to a string of drill rod. The spoon is then lowered to the bottom of the borehole, and a safety hammer is used to drive the split spoon into the soil. After the spoon is filled it is retrieved to the surface, where it is removed from the drill string and opened for sample collection. Continuous split spoon samplers are also common. These are generally larger in diameter and longer in length than standard split spoons. The continuous split spoon is advanced into the soil column inside a hollow stem auger. After the auger string has been advanced into the soil column a distance equal to the length of the continuous sampler being used it is returned to the surface. The sampler is removed from inside the auger and opened for sampling. When split spoon sampling is performed for geotechnical purposes, all work should be performed in accordance with ASTM D1586/D1586M-18, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils".

The following procedures are used for collecting soil samples with a split spoon:

- a) Assemble the sampler by aligning both sides of the barrel and then screwing the drive shoe on the bottom and the head piece on top.

- b) Depending on the type of split spoon being used, the sampler is driven into the soil by the drilling rig, allowing the sample to be collected in the spoon.
- c) As the spoon is being retrieved from the drill string, record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.
- d) Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. Field screening (directly from the spoon) and Method 5035 sampling should be the first tasks performed after opening the spoon to reduce as much as possible the loss of volatiles from the sample. For screening, poke a small hole to the middle of the soil core and take readings with the PID/FID. Samples collected for SVOC analysis that includes lighter compounds such as naphthalene and acenaphthene must be collected by completely filling the sample jar and leaving no headspace rather than homogenizing first, due to the volatility of the lighter SVOCs. The volatility of target SVOC analytes will determine if the SVOC soil samples should be homogenized. In general, soils with potential contaminants whose vapor pressure > 0.1 mg Hg or Henry's Law Constant (HLC) > 0.0001 atm*m³/mol should not be homogenized, but it may be good practice to not homogenize any soils being analyzed for SVOCs. For all other analysis, the soil may be homogenized in a stainless steel bowl prior to placing the soil in the appropriate sample containers. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. The standard split spoon sampler is typically available in 2 and 3.5 inch diameters. A continuous split spoon sampler may be necessary to obtain the required sample volume depending upon the analysis required.
- e) The amount of soil recovery, blow counts (N-value for Standard Penetration Test), soil type/description, field screening results, sample interval, and depth of any groundwater encountered (first encounter and after boring completion) should all be recorded on the boring log.
- f) Once the sampling is completed, dispose of disposable sampling equipment and plastic 5035 plastic syringes. Decontaminate any non-disposable sampling equipment prior to the collection of the next sample.
- g) Record the following information in the field logbook:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable

- Blow counts
 - Any other pertinent information (e.g., date, time and sampler)
- h) Abandon the boring as necessary in accordance with applicable state regulations.

8.0 CALCULATIONS

No calculations are applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The following general quality assurance/quality control (QA/QC) procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAWP.
- The collection of an equipment rinsate blank is recommended to evaluate potential for cross-contamination.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAWP and/or *QAPrP* for further information on collection of duplicate samples.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAWP and/or *QAPrP* for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with soil sampling using direct push technology:

- Exposure to unknown contaminants.

- Lifting and carrying injuries.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slips, trips, and fall hazards.
- Injury from moving equipment.
- Underground utilities.
- Loud noises.
- Biohazards, such as snakes, insect bites and poison ivy.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Geoprobe™ Operation, SOP# 2050, US EPA, Environmental Response Team, March 27, 1996

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005

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Soil Sampling Method 5035

SOP OER-0122

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ruth Porter	1.0	7/1/2010	Reformatted, added SOP ID #, and renumbered. Supersedes Revision 0.0. Additional detail provided.	Editorial Technical
Ross Brittain	2.0	11/10/2020	Reformatted and updated the content	Editorial, Technical

SOIL SAMPLING METHOD 5035
SOP OER-0122

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List of Acronyms and Abbreviations

DQO	Data Quality Objective
FID	Flame Ionization Detector
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HLC	Henry's Law Constant
ID	Identification
IDW	Investigation Derived Wasted
OER	Office of Environmental Remediation
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
QAPrP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compounds
WVDEP	West Virginia Department of Environmental Protection
VOA	Volatile Organics Analysis
VOC	Volatile Organic Compounds

Disclaimer: Any mention in this SOP of any products or services does not constitute or imply the endorsement, recommendation or favoring by WVDEP or any of its employees or contractors acting on its behalf.

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general reference information on sample collection procedures utilizing Method 5035. The use of Method 5035 for the collection of volatiles samples is required for Office of Environmental Remediation (OER) programs within the West Virginia Department of Environmental Protection (WVDEP). The procedures in this SOP may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. The procedures utilized at a site should be documented and included in the site investigation report.

2.0 SUMMARY OF METHOD

Method 5035 was adopted because of studies showing that sampling according to the previous methods resulted in significant losses of selected volatile organic compounds (VOCs). Method 5035 incorporates chemical preservatives and sample storage techniques to limit volatilization and biodegradation of VOCs. There are two collection options for Method 5035: an airtight coring device such as the Encore® sampler, or preserved vials (Terra Core™). The collection method determination should be based on holding time, laboratory-processing considerations, soil type (calcareous soils have special considerations when using the preserved vial option), and shipping considerations. Samples for VOC analysis are not homogenized. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Samples collected with the Encore® Sampler do not require preservation other than being cooled to $\leq 6^{\circ}\text{C}$, but without freezing the sample. These samples should be extracted by the laboratory within 48 hours of the samples being collected. Samples collected by the Terra Core™ Method undergo chemical preservation. Three 40 mL vials are utilized in the Terra Core™ sampling method. Two of the vials have sodium bisulfate and the third has methanol as the preservative. After soil collection and preservation, the Terra Core™ samples should also be cooled to $\leq 6^{\circ}\text{C}$, but without freezing the sample. Terra Core™ samples should be extracted by the laboratory within 14 days of the samples being collected.

The type of sample container, the preservative (if any), and holding times should be clearly set forth in the Sampling and Analysis Plan or Site Assessment Work Plan (SAWP) for the site. The sampler should consult the SAWP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. Samples should be collected directly from the sampling device into appropriate laboratory cleaned containers. Samples shall be appropriately preserved (if applicable), labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample in accordance with the SAWP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Holding times for samples collected with the Encore® sampling equipment is 48-hours. This creates the need for overnight shipment and/or hand delivery to the laboratory. It also requires immediate attention to the samples by the analytical laboratory.

When using the Terra Core™ Sampling method, calcareous soil samples may react upon contact with sodium bisulfate solution in the pre-preserved sample vial, causing VOC loss through effervescence and potential failure of the VOA vial septum through pressure buildup. Additionally, when soil samples are highly calcareous in nature, the sodium bisulfate preservative solution may not be strong enough to reduce the pH of the aqueous solution to below 2.0, potentially rendering the preservative useless.

5.0 EQUIPMENT APPARATUS

The following are some of the materials and equipment that are potentially needed for soil sampling activities. Refer to the site Sampling and Analysis Plan to determine specific needs for any given project.

- Encore® Sampler
- Terra Core™ sampler
- Sample containers (Encore® air-tight container or Terra Core™ which will consist of 40- mL vials with appropriate preservative and stirring bar), plus additional minimum 2 oz. glass jar to collect sample for dry weight determination
- Photoionization detector (PID) or flame ionization detector (FID)
- Logbook
- Field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Preservatives, as applicable
- Packing materials
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water)
- Brushes
- Sampling gloves
- Plastic bags
- Containers for investigation derived waste
- Personal protective equipment (PPE)

6.0 REAGENTS

The Terra Core™ vials should come pre-prepared from the laboratory with the proper chemical preservatives (sodium bisulfate and methanol). Reagents for the decontamination of non-disposable sampling equipment used to collect the soil samples will be required. Refer to the SOP for the decontamination procedures and required reagents.

7.0 PROCEDURES

7.1 Encore® Sample Collection Method

- a) Clear any surface debris (e.g., vegetation, rocks, twigs) from the sampling location.
- b) Before taking the sample, hold the coring body and push plunger rod down until the small o-ring rests against tabs. This will ensure that the plunger moves freely.
- c) Depress locking lever on Encore® T-Handle. Place coring body, plunger end first, into open end of T-Handle, aligning the (2) slots on the coring body with the (2) locking pins in the T-Handle. Twist coring body clockwise to lock pins in slots. Check to ensure sampler is locked in place. Sampler is ready for use.
- d) Turn T-Handle with T-up and coring body down. This positions the plunger bottom flush with the bottom of the coring body (ensure that the plunger bottom is in position). Using T-Handle, push sampler into soil until the coring body is completely full. When full, the small o-ring will be centered in T-Handle viewing hole. Remove sampler from soil. Wipe excess soil from the coring body exterior.
- e) Cap the coring body while it is still on the T-handle. Push the cap over flat area of ridge. Push and twist the cap to lock the arm in place. Cap must be seated to seal the sampler.
- f) Remove the capped sampler by depressing locking lever on T-Handle while twisting and pulling sampler from T-Handle. Lock the plunger by rotating the extended plunger rod fully counterclockwise until the wings rest firmly against the tabs.
- g) Place the capped sampler back into the Encore® sample zipper bag and label. Seal the bag and put on ice. Samples collected with the Encore® method should be analyzed within 48 hours or preserved by the laboratory within 48 hours. Collect sample for dry-weight determination in 2-oz. glass jar. This container should be air-tight (septum lid) but should not contain any preservative. Place this sample in the cooler with the Encore® samples.
- h) Record the following information in the field logbook:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information (e.g., date, time and sampler)

7.2 TerraCore™ Sampling Method

- a) A determination of whether the sample will be considered high (>200 µg/Kg) or low (0.5-200 µg/Kg) concentration should be performed. This may be based on DQOs, expected concentrations, or regulatory limits. If the expected concentrations cannot be estimated prior to sampling, and/or DQOs or other considerations indicate the need for both concentration levels, both low and high concentration aliquots should be collected. Refer to the Table below for appropriate sample containers for high/low sample concentrations.

Sample Container and Preservative Requirements for Samples Collected by the TerraCore™ Method			
Concentration of Volatiles	<200 ug/kg	>200 ug/kg	Unknown Concentrations
Solid Type			
Non-Reactive	3-40 mL vials with 5 mL of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹	3-40 mL vials with 5 mL of methanol weighed to the nearest 0.01gram ¹	3-40 mL vials with 5 mL of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹ AND 3-40 mL vials with 5 mL of methanol weight checked to the nearest 0.01gram ¹
Reactive	3-40 mL vials with 5 mL of organic free reagent water weighed to the nearest 0.01gram ¹	3-40 mL vials with 5 mL of methanol weighed to the nearest 0.01gram ¹	3-40 mL vials with 5 mL of organic free reagent water weighed to the nearest 0.01gram ¹ AND 3-40 mL vials with 5 mL of methanol weighed to the nearest 0.01gram ¹
Unknown	3-40 mL vials with 5 mL of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹ AND 3-40 mL vials with 5 mL of organic free reagent water weighed to the nearest 0.01gram ¹	3-40 mL vials with 5 mL of methanol weighed to the nearest 0.01gram ¹	3-40 mL vials with 5 mL of organic free reagent water, 1 gram of NaHSO ₄ and a magnetic stirring bar weighed to the nearest 0.01gram ¹ AND 3-40 mL vials with 5 mL of organic free reagent water weighed to the nearest 0.01gram ¹ AND 3-40 mL vials with 5 mL of methanol weighed to the nearest 0.01gram ¹
¹ The vials will be pre-weighed by the laboratory to the nearest 0.01gram. If the required weight check is performed in the field, a variance of up to 0.2 grams is allowed. If the required weight check is performed in the laboratory, a variance of up to 0.01 gram is allowed. Weight checks should be performed within 24 hours of use.			

- b) Prior to adding solid to any vial, the individual vial should be checked to ensure that the weight of the vial and preservative have been written on the vial by the laboratory.
- c) Clear any surface debris (e.g., vegetation, rocks, twigs) from the sampling location.
- d) Have ready a 40-mL glass volatile organic analysis (VOA) vial containing the appropriate preservative. With the plunger seated in the handle, push the Terra Core™ into freshly exposed soil until the sample chamber is filled. A filled chamber will deliver approximately 5 grams of soil.
- e) Wipe all soil or debris from the outside of the Terra Core™ sampler. The soil plug should be flush with the mouth of the sampler. Remove any excess soil that extends beyond the mouth of the sampler.
- f) Rotate the plunger that was seated in the handle top 90° until it is aligned with the slots in the body. Place the mouth of the sampler into the 40-mL VOA vial containing the appropriate preservative and extrude the sample by pushing the plunger down, holding the VOA at a 45 degree angle so that when the soil plug falls into the preservative, none splashes out of the container. Quickly place the lid back on the 40-mL VOA vial. Repeat steps d-f for additional sample vials as necessary.

Note: When capping the 40-mL VOA vial, be sure to remove any soil or debris from the threads of the vial.

- g) Place the containers in a plastic bag and seal. Store sample on ice at approximately 6°C but without freezing. Collect sample for dry-weight determination in 2-oz. glass jar. This container should be air-tight (septum lid) but should not contain any preservative. Place this sample in the cooler with the Terra Core™ sample vials. Deliver the cooler to the laboratory.
- h) Record the following information in the field logbook:
 - Sample ID
 - Location
 - Depth of sample
 - Soil type description
 - Equipment used
 - Apparent moisture content (i.e., dry, moist, wet)
 - Color
 - Odor
 - Field screening instrument readings, if applicable
 - Any other pertinent information (e.g., date, time and sampler)

8.0 CALCULATIONS

No calculations are applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The following general quality assurance/quality control (QA/QC) procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAWP.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAWP and/or *QAPrP* for further information on collection of duplicate samples.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAWP and/or *QAPrP* for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the potential hazards associated with this SOP.

- Exposure to unknown contaminants.
- Exposure to chemical reagents and preservatives.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slips, trips, and fall hazards.
- Biohazards, such as snakes, biting insects and poison ivy.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, US EPA, Office of Environmental Information, April 2007

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, August 2005

Test Methods for Evaluation of Solid and Hazardous Wastes, SW 846 Method 5035, US Environmental Protection Agency, Washington, DC 1998.

US EPA Region 4, 2014, *Operating Procedure – Soil Sampling*; SESD PROC-300-R1, U.S. Environmental Protection Agency Region 4, Athens, GA, 24 pp

Soil Gas Sampling

SOP OER-0130

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
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SOIL GAS SAMPLING
SOP OER-0130

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List of Acronyms and Abbreviations

AC	Alternating Current
°C/°F	Degrees Celsius/Degrees Fahrenheit
FID	Flame Ionization Detector
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDPE	High Density Polyethylene
HEPA	High Efficiency Particulate Air
HPLC	High Performance Liquid Chromatography
IDW	Investigation Derived Wasted
L	Liter
NPT	National Pipe Thread
OD	Outer Diameter
OER	Office of Environmental Remediation
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
VOC	Volatile Organic Compound
USEPA	United States Environmental Protection Agency
WVDEP	West Virginia Department of Environmental Protection

Disclaimer: Any mention in this SOP of any products or services does not constitute or imply the endorsement, recommendation or favoring by WVDEP or any of its employees or contractors acting on its behalf.

1.0 SCOPE AND APPLICATION

Vapor intrusion of volatile organic compounds (VOCs), some semi-volatile organic compounds (SVOCs) and some vapor-phase metals (e.g., mercury) is often a leading risk pathway for contaminated sites, especially those with petroleum and/or halogenated compounds. Methods for identifying and tracing the movement of underground vapor-phase contaminants is critical to protecting human health. The purpose of this standard operating procedure (SOP) is to outline the methods used to install soil gas wells and sub-slab probes, as well as collecting soil gas using Tedlar bags and/or Summa canisters. Alternate methods of collecting samples, such as sorbent tubes, may be proposed for the site and the West Virginia Department of Environmental Protection (WVDEP) will review the merits of such alternatives for potential approval. These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. Refer to the site-specific Sampling and Analysis Plan or Site Assessment Work Plan (SAWP) for details on the procedures to be used at the site. The procedures utilized at a site should be documented and included in the site investigation report.

2.0 SUMMARY OF METHOD

2.1 Soil Gas Wells

A hole is driven into the ground using manual (e.g., slam bar) or power driven mechanical (e.g., Geoprobe) methods. A probe made from inert materials (e.g., stainless steel, copper, brass, PVC, or HDPE) is connected to ¼-inch outer diameter (OD) tubing inserted into the hole. Once the probe is inserted, silica sand should be poured into the hole so that the probe is covered by no less than six inches of silica sand. The remaining annular space in the hole shall be filled with expandable clay (such as bentonite chips) and wetted so that a seal is created between the sand-packed probe and the ambient air. The interstitial gases may be pulled through the probe using an air sampling pump where the sample may be stored in a Tedlar bag. Summa canisters do not require an air sampling pump, but rather are sampled by soil gas equilibration with the evacuated Summa canister. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

2.2 Sub-Slab Probes

Sub-slab probes can be installed by assembling a probe following the procedures outlined in this SOP, or installing a vapor probe kit (e.g., VaporPin®) using the manufacturer's SOP can be used to ease the installation procedures. Using a 3/8" diameter drill bit and an electric hammer drill or rotary hammer, an inner or pilot hole is drilled into the concrete slab to a depth ~2 inches below the slab. An outer hole is drilled to a depth of ~1 3/8 inches using a 1-inch diameter drill bit and the pilot

hole as the center. The 1-inch drill bit is then replaced by the $\frac{3}{8}$ -inch drill bit and the pilot hole is drilled through the slab and several inches into the subsurface soils. After drilling is complete, a probe made from inert materials (e.g., stainless steel, copper, or brass) probe is assembled, inserted into the pre-drilled hole, flush-mounted with the surrounding slab so it will not interfere with traffic and cemented into place. Tubing is then attached to the probe assembly and to a sample container/system. Specific details for sampling at any location should be found in the SAWP.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Tedlar Bags

Soil gas samples can be collected in 1.0 liter (L) Tedlar bags, which should be stored in the dark (e.g., opaque containers) and protected from damage during transit to the laboratory. Sample bags should be kept at ambient temperatures and out of direct sunlight and analyzed within 48 hours of sample collection.

3.2 Summa Canisters

Summa canister have up to a 6.0 L capacity and are certified clean by gas chromatography/mass spectrometry (GC/MS) before collecting samples in the field. Canisters are stored and shipped in travel cases and should be analyzed within 30 days of sample collection. The canister should be fitted with a regulator valve properly calibrated by the laboratory to allow a maximum flow rate of 200 milliliters per minute (mL/min).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 General

Physical and chemical characteristics of the soils and soil moisture can affect the concentrations of VOCs in soil gas. Highly charged soil particles, such as clays, can cause VOCs to be tightly adsorbed to the soils, and highly soluble compounds can dissolve in soil water or associate with organic matter in the soil and reduce the concentrations in the interstitial pore spaces. Fine textured soil may also impede the movement of soil vapors or reduce the sample volume available. High or perched water tables and impermeable subsurface layers may also interfere with the movement and sampling of soil gas. Soil Conservation Service soil surveys and other existing knowledge of site geology should be consulted prior to planning a soil gas survey. Importantly, it has been found that lighter SVOCs, particularly Naphthalene, may have significant sample losses in cool conditions (Hayes et al. 2005) and differences in soil temperatures in the upper profile can lead to variations in soil gas concentrations by a factor of two for all VOCs (Luo et al. 2009, USEPA 2010, Hers et al. 2014, Johnson and Deeb 2014).

Accordingly, WVDEP recommends that soil gas be sampled when the ambient

temperature is at least 21°C (70°F), especially when sampling for Naphthalene. WVDEP may require additional samples be collected at a time when ambient temperature is at least 21°C to verify the data if soil vapor is collected during periods of relatively low soil and ambient air temperatures, especially when initial sample concentrations are greater than one-half of benchmark values.

4.2 Soil Probe Clogging

Clogging of the soil gas probes is a common problem, best identified by using an in-line gauge or by listening for the sound that the pump is laboring. Clogging can usually be remedied by using a wire cable to clear the probe.

4.3 Underground Utilities

An underground utility search must be completed prior to selecting the sample locations by calling Miss Utility West Virginia at 811, or using the West Virginia 811 App. Additionally, the local utility companies can be contacted and requested to mark the locations of their underground lines. Each sample location should also be screened with a metal detector or magnetometer to verify that no metallic pipes, drums or other objects are present. Installation of sub-slab sample probes should also take place after first locating water, sanitary sewer, gas, electric or other potential buried hazards under the foundation/floor. The biggest and most constant threat to personnel safety is the existence of rebar in the concrete slab, since a significant amount of structures utilize rebar grids for floor construction.

5.0 EQUIPMENT APPARATUS

5.1 Soil Gas Wells

5.1.1 Slam Bar/Stainless Steel Hand Auger Method

- Slam bar or Stainless Steel Hand Auger
- Soil gas probes (stainless steel screen, ¼-inch OD, 5-foot length)
- Flexible wire or cable
- “Quick Connect” fittings, if applicable
- Bentonite clay
- Vacuum box
- Pumps, capable of drawing approximately 3.0 L/min
- ¼-inch OD tubing (type of tubing contingent upon site and sample requirements), ~3-ft length
- Tedlar bags, 1.0-L, if applicable
- Summa canisters (plus shipping cases), if applicable
- Sample documentation (soil gas sample labels, field data sheets, logbook, etc.)
- PID/FID for field air monitoring, if applicable

- Cooler(s)
- Metal detector or magnetometer, if applicable
- Portable GC instrument, if applicable
- Large plastic bags
- Silica sand
- Tubing cutter

5.1.2 *Direct-Push (Geoprobe) Method*

- Tubing: Polyethylene or Teflon
- Gas sampling cap
- Probe rods
- Tubing adaptor(s)
- Expendable point holder, threaded
- Expendable drive point(s)
- O-rings for expendable point holder
- O-rings for adaptor
- O-rings for probe rods
- O-rings for gas sampling cap
- Vacuum pumps
- PID/FID for field air monitoring
- Tape
- Tedlar bags, 1.0-L, if applicable
- Summa canisters (plus shipping cases), if applicable
- Sample documentation (soil gas sample labels, field data sheets, logbook, etc.)
- Metal detector or magnetometer, if applicable
- Cooler(s)
- Large dark plastic bags
- Portable GC instrument, if applicable
- Silica sand
- Tubing cutter

5.2 Sub-Slab Probes

- PID/FID for field air monitoring, if applicable
- Modeling clay
- Hammer Drill or Rotary Hammer
- Alternating current extension cord
- Alternating current generator, if AC power is not available on site
- Hammer or Rotary Hammer drill bits, $\frac{3}{8}$ " and 1" diameter
- Portable vacuum cleaner with HEPA filter
- 1 - $\frac{3}{4}$ -inch open end wrench or 1-medium adjustable wrench
- 2 - $\frac{9}{16}$ -inch open end wrenches or 2-small adjustable wrenches

- Hex head wrench, 1/4-inch
- Tubing cutter
- Disposable non-plastic cups, ~5 ounce
- Disposable non-plastic mixing device (e.g., craft stick, tongue depressor, etc.)
- Swagelok SS-400-7-4 Female Connector, 1/4-inch National Pipe Thread (NPT) to 1/4-inch Swagelok connector, or equivalent
- Swagelok SS-400-1-4 Male Connector, 1/4-inch NPT to 1/4-inch Swagelok connector, or equivalent
- 1/4-inch NPT flush mount hex socket plug, Teflon-coated
- 1/4-inch OD stainless steel tubing, pre-cleaned, instrument grade
- 1/4-inch OD Teflon tubing
- Teflon thread tape
- 1/8-inch OD stainless steel rod, 12-inch to 24-inch length
- Swagelok Tee, optional (SS-400-3-4TMT or SS-400-3-4TTM), or equivalent

6.0 REAGENTS

Refer to the site-specific SAWP for the preservatives required for the specified analysis to be performed. The following reagents are generally used for soil gas sampling in a soil gas well:

- Calibration and spike gases
- Deionized water
- Methanol, High Performance Liquid Chromatography (HPLC) grade
- Ultra-zero grade compressed air
- Bentonite

The following reagents are generally used for soil gas sampling from sub-slab probes:

- Tap water, for mixing anchoring cement
- Anchoring cement
- Modeling clay/Bentonite

7.0 PROCEDURES

7.1 Soil Gas Well Installation

7.1.1 *Slam Bar/Stainless Steel Hand Auger Method*

1. Before digging/drilling the hole, a soil gas probe made from inert materials (e.g., stainless steel, copper, brass, PVC, or HDPE) is constructed. Example probe construction includes 1/4-inch outer diameter (OD) stainless steel (USEPA Environmental Response Team 2001), and 1-inch PVC 0.010-slot well screen, with a screen length at least 1-ft long. A PVC busing fitted with a 1/4-inch nylon hose bard is installed on the top of the probe to allow for

connecting sample tubing, and a PVC cap is fitted on the bottom. All connections must be threaded or friction fit and no solvent or glue can be used to prevent false detections of VOCs.

2. A hole slightly deeper than the required depth is made using a piston slam bar or stainless steel hand auger. Generally, the well should be approximately 5-ft deep to assess the soil gas in the typical basement zone. Soil gas wells can be deeper than 5-ft, especially if the near-source zone is much deeper, but should not be less than 5-ft deep unless the presence of shallow groundwater prevents sampling soil gas at a depth of 5-ft or deeper. If shallow groundwater is present, consider the possibility of assessing soil gas via sub-slab samples, but if sub-slab samples would not allow adequate spatial cover to assess future buildings then make the soil gas well as deep as possible. If depths deeper than 5-ft are required, use a piston slam bar with extensions.
3. Drive the slam bar rod or dig the hole using an auger to the desired depth. After the hole is made, the slam bar/hand auger is carefully withdrawn to prevent the collapse of the walls.
4. The soil gas probe is carefully inserted into the hole. The probe is inserted to full depth of the hole, then pulled up three to six inches. The probe is cleared by moving the cable up and down several times.
5. The annular space between the probe and the borehole should be filled with a silica sand pack from the bottom of the borehole to at least 6 inches above the top of the probe. A bentonite grout seal should be placed in the annular space between the sample tubing connected to the probe and the borehole above the sand pack to the surface, or the probe may have a steel manway installed.

7.1.2 Direct-Push Method

1. Direct-push sampling technology refers to soil gas samplers that are inserted into the ground without the use of slam bars, demolition hammers, or drilling rigs, such as a Geoprobe.
2. Sampling probes, consisting of 3-foot sections of flush-threaded, 1¼-inch hardened steel alloy steel rod tipped by an expendable steel point, are available from Direct-Push suppliers and are driven into the ground to the target depth (default depth is 5-ft, but may be deeper if specified in the SAWP). The probe tools are withdrawn to release the expendable tip and allow soil gas to flow into the tool's tubing.
3. To ensure a representative soil gas sample, a discrete volume of gas is purged to rid the tubing of atmospheric air and allow the subsurface soil gas to enter the probe tubing. The volume of gas removed is determined by the volume of tubing used in the probe necessary to remove two times the volume of the ambient air in the tubing.
4. After allowing the system to return to atmospheric pressure, an aliquot of soil gas is withdrawn from the probe. Duplicate samples are collected as necessary and required in the site-specific SAWP.

5. If semi-permanent soil gas installations are required, the probe remains in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.2 Sub-Slab Probe

7.2.1 *Assembly and Installation*

Note that this assembly and installation is based on creating a sub-slab probe from scratch. Project Managers can use this method or alternately use a pre-manufactured vapor probe kit, such as Vapor Pin®, and follow their installation SOP to ease the process.

1. Drill a $\frac{3}{8}$ -inch diameter inner or pilot hole to a depth of 2 inches below the slab.
2. Using the $\frac{3}{8}$ -inch pilot hole as your center, drill a 1-inch diameter outer hole to a depth of $1\frac{3}{8}$ inches. Using a pre-assembled probe for testing the depth may facilitate the process. Vacuum out any cuttings from the hole.
3. Re-drill the $\frac{3}{8}$ -inch inner or pilot hole through the slab and a few inches into the sub-slab material to clear out the hole. Vacuum out any cuttings from the hole.
4. Determine the length of stainless steel tubing required to reach from the bottom of the outer hole, through the slab and into the open cavity below the slab. To avoid obstruction/clogging of the probe tube, ensure that it does not contact the sub-slab material. Using a tube cutter, cut the tubing to the desired length.
5. Attach the measured length (typically 8-12 inches) of $\frac{1}{4}$ -inch OD stainless steel tubing to a female connector (e.g., Swagelok SS-400-7-4, or equivalent) with the nut. Tighten the nut.
6. Insert the $\frac{1}{4}$ -inch hex socket plug into the female connector. Tighten the plug. **Do not over tighten.** If excessive force is required to remove the plug during the sample set up phase, the probe may break loose from the anchoring cement. The sampling probe may be pre-assembled.
7. Place a small amount of clean modeling clay around the stainless steel tubing adjacent to the nut, which connects the stainless steel tubing to the female connector. Use a sufficient amount of modeling clay so that the completed probe will create a seal between the outer and inner holes, when placed in the outer hole. The clay seal will prevent any anchoring cement from flowing into the inner hole during the final step of probe installation.
8. Place the completed probe into the outer hole. The probe tubing should not contact the sub-slab material and the top of the female connector should be flush with the surface of the slab and centered in the outer hole. If the top of the completed probe is not flush with the surface of the slab, due to the outer hole depth being greater than $1\frac{3}{8}$ inches, additional modeling clay may be placed around the stainless steel tubing adjacent to the nut that connects the stainless tubing to the female connector. Use a sufficient amount of clay to

raise the probe until it is flush with the surface of the slab while ensuring that a portion of the clay will still contact and seal the inner hole.

9. Mix a small amount of the anchoring cement and use it to fill the space between the probe and the outside of the outer hole. Allow the cement to cure according to manufacturer's instructions before sampling.

7.2.2 Sampling Set-Up

1. Wrap one layer of Teflon thread tape onto the NPT end of the male connector (e.g., Swagelok SS-400-1-4, or equivalent).
2. Remove the ¼-inch hex socket plug from the female connector (e.g., Swagelok SS-400-7-4, or equivalent).
3. To ensure that the interior of the sampling probe has not been blocked by the collapse of the inner hole below the end of the stainless steel tubing, a stainless steel rod, ⅛-inch diameter, may be passed through the female connector and the stainless steel tubing. The rod should pass freely to a depth greater than the length of the stainless steel tubing, indicating an open space or loosely packed soil below the end of the stainless steel tubing. Either condition should allow a soil gas sample to be collected. If the probe appears blocked, the stainless steel rod may be used as a ramrod to attempt to open the probe. If the probe cannot be opened, it should be reinstalled or a new probe installed in an alternate location.
4. Screw and tighten the male connector into the female connector. **Do not over tighten.** Overtightening may cause the probe to break loose from the anchoring cement during this step or when the male connector is removed upon completion of the sampling event.
5. If a collocated sub-slab sample or split sample is desired, a stainless steel tee (e.g., Swagelok SS-400-3-4TMT, SS-400-3-4TTM or equivalent) may be used in place of the male connector.
6. Attach a length of ¼-inch OD Teflon tubing to the male connector with a nut. The Teflon tubing is then connected to the sampling container or system to be used for the sample collection.
7. After sample collection, remove the male connector from the probe and reinstall the hex socket plug. It is recommended that the hex socket plug be wrapped with Teflon thread tap prior to re-installation. **Do not over tighten** the hex socket plug. If excessive force is required to remove the plug during the next sampling event the probe may break loose from the anchoring cement.

7.2.3 Repairing a Loose Probe

1. If the probe breaks loose from the anchoring cement while removing or installing the hex head plug or the male connector (e.g., Swagelok SS-400-14, or equivalent), lift the probe slightly above the surface of the concrete slab.

2. Hold the female connector (e.g., Swagelok SS-400-7-4, or equivalent) with the $\frac{3}{4}$ -inch open wrench.
3. Complete the step being taken during which the probe broke loose, following the relevant instructions above, remembering not to overtighten the connections.
4. Push the probe back down into place and reapply the anchoring cement.
5. Modeling clay may be used as a temporary patch to seal around the probe until the anchoring cement can be reapplied.

7.3 Tedlar Bag Sampling

1. Sampling will take place at least 2 hours after construction to allow for equilibration, preferably 24 hours or more.
2. An amount of air equivalent to three times the volume of the soil gas well must be evacuated prior to sampling (Purge volume = $3\pi r^2 h$, where r is the radius of the inner probe and connecting tubing, and h is the entire length of the sampling train). Connect a vacuum pump, hand pump or soil gas syringe to the sample probe using a section of Teflon tubing. If using a vacuum pump, calculate the required length of time to purge the required volume, turn on the pump and adjust the flow rate to 3.0 L/minute. The calculated volume of air is evacuated from the hole for the specified length of time, or extracted for the equivalent volume using a hand pump or soil gas syringe.
3. A leak test should also be performed by placing a shroud around the sample train and using a tracer gas (99.999% laboratory grade helium) to enrich the atmosphere within the shrouded sampling train. A vacuum should then be drawn on the sampling tubing at 150-160 mL/min rate and the vacuum exhaust monitored for helium using a helium detector that has been factory calibrated within the past year. Any leaks showing >10% of the ambient helium reading should be located and sealed before proceeding with sampling.
4. After evacuation and leak test, a PID/FID monitoring instrument is connected to the probe using a Teflon connector. Upon stabilization, the reading is recorded on soil gas data sheets.
5. Use the vacuum box and sampling train to collect the sample. The sampling train is designed to minimize the introduction or loss of contaminants due to adsorption and other factors. All parts used are either Teflon or stainless steel, and a vacuum is drawn directly to avoid contamination from the pumps.
6. Place the Tedlar bag inside the vacuum box, attach it to the sampling port and open the valve. The sample probe should be attached to the sampling port with Teflon tubing and a "Quick Connect" fitting.
7. Draw a vacuum around the outside of the bag, using a pump connected to the vacuum box evacuation port with Tygon tubing and a "Quick Connect" fitting. The negative pressure inside the box causes the bag to inflate, drawing the sample into the bag.
8. Break the vacuum by removing the Tygon line from the pump. Remove the bagged sample from the box and close the valve. Record the date, time,

sample location ID, name of sampler and any other pertinent information on the sample bag label and on data sheets or in logbooks.

9. Bags should not be labeled directly with a marker or pen, nor should adhesive labels be affixed directly to the bags. Inks and adhesive may diffuse through the bag material and contaminate the sample. Labels should be tied to the metal eyelets provided on the bags.
10. Chain-of-custody sheets must accompany the samples to the laboratory.

7.4 Summa Canister Sampling

1. Sampling will take place at least 2 hours after construction to allow for equilibration, preferably 24 hours or more.
2. An amount of air equivalent to three times the volume of the soil gas well must be evacuated prior to sampling (Purge volume = $3\pi r^2 h$, where r is the radius of the inner probe and connecting tubing, and h is the entire length of the sampling train). Connect a vacuum pump to the sample probe using a section of Teflon tubing. Turn on the pump and adjust the flow rate to 3.0 L/minute. The calculated volume of air is evacuated from the hole by pulling a vacuum through the probe for the specified length of time.
3. A leak test should also be performed by placing a shroud around the sample train and using a tracer gas (99.999% laboratory grade helium) to enrich the atmosphere within the shrouded sampling train. A vacuum should then be drawn on the sampling tubing at 150-160 mL/min rate and the vacuum exhaust monitored for helium using a helium detector that has been factory calibrated within the past year. Any leaks showing >10% of the ambient helium reading should be located and sealed before proceeding with sampling.
4. After evacuation and leak test, a PID/FID monitoring instrument is connected to the probe using a Teflon connector. Upon stabilization, the reading is recorded on soil gas data sheets.
5. Attach a certified clean, evacuated 6-L Summa canister via the ¼-inch Teflon tubing.
6. Open the valve on the Summa canister. The soil gas sample is drawn into the canister by pressure equilibration. The approximate sampling time for a 6-L canister is 20 minutes.
7. Sample number, sample location, date collected, sampler name and any other pertinent sample information must be recorded on a chain-of-custody form and on a blank tag attached to the canister.
8. Chain-of-custody sheets must accompany the samples to the laboratory.

8.0 CALCULATIONS

Calculations used to determine concentrations of individual components are beyond the scope of this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

9.1 Sample Probe Contamination

Sample probe contamination is checked between each sample by drawing ambient air through the probe using a vacuum pump and checking the response with a PID/FID. If readings are higher than background, replacement or decontamination is necessary. Sample probes may be decontaminated simply by drawing ambient air through the probe until the PID/FID reading is at background. Contamination can also be removed by decontaminating with alconox and deionized water, then air drying. For persistent contamination, use of a portable propane torch may be needed. Using a pair of pliers to hold the probe, run the torch up and down the length of the sample probe for approximately 1-2 minutes. Let the probe cool before handling. When using this method, make sure to wear gloves to prevent burns. Having more than one probe per sample team will reduce lag times between sample stations while probes are decontaminated.

9.2 Sample Train Contamination

The Teflon line forming the sample train from the probe to the Tedlar bag should be changed on a daily basis. If visible contamination (soil or water) is drawn into the sampling train, it must be changed immediately. When sampling in highly contaminated areas, the sampling train should be purged with ambient air, via a vacuum pump, for approximately 30 seconds between each sample. After purging, the sample train can be checked using a PID/FID to establish the cleanliness of the Teflon line.

9.3 PID/FID Calibration

The PID and/or FID must be calibrated at least once a day using appropriate calibration gases.

9.4 Trip Blanks

A trip blank detects any sample contamination during shipping and storage. With the exception of Summa canisters, the trip blank is prepared and added to the site samples after sampling has been completed and prior to shipment.

9.4.1 Tedlar Bags

Each cooler containing Tedlar bag samples must contain one Tedlar bag of ultra-zero grade air, acting as a trip blank for samples shipped to a laboratory. Chain-of-custody records must accompany each cooler of samples and should include the blank that is dedicated to that cooler.

9.4.2 Summa Canisters

Canister trip blanks are evacuated containers that are shipped to and from the site with the canisters used for air sampling.

9.5 Field Blanks

Field blanks detect sample contamination during the handling and shipping process associated with a specific sampling event.

9.5.1 Tedlar Bags

For each day of sampling, a Tedlar bag is filled with ultra-zero air at the beginning of the day. This field blank is handled in the same manner as the samples.

9.5.2 Summa Canisters

For each day of sampling, a Summa canister is filled with ultra-zero air at the beginning of the day. This field blank is handled in the same manner as the samples, including .

9.6 Trip Standards

If Tedlar bags are used for sampling, each cooler containing samples should contain a Tedlar bag of standard gas to calibrate the analytical instruments. This trip standard will be used to determine any changes in concentrations of the target compounds during the course of the sampling day (e.g., migration through the sample bag, degradation, or adsorption). A fresh trip standard must be provided and placed in each cooler pending additional sample collection. Chain-of-custody records must accompany each cooler of samples and should include the trip standard that is dedicated to that cooler.

9.7 Lot Blanks

9.7.1 Tedlar Bags

Prior to use, one bag is removed from each lot of Tedlar bags to be used for sampling and checked for possible contamination as follows: Fill the test bag with ultra-zero grade air; withdraw a sample from the bag and analyze using a field portable GC or other field instrument to ensure sample container cleanliness prior to the start of the sampling effort.

9.7.2 Summa Canister Check

From each lot of four cleaned Summa canisters, one is used for a GC/MS certification check. If the canister passes certification, it is re-evacuated and all four canisters from that lot are available for sampling. If the chosen canister is contaminated, the entire lot of four Summa canisters

must be re-cleaned and a single canister is re-analyzed by GC/MS for certification.

9.8 Duplicate Samples

A minimum of 5% of all samples should be collected in duplicate. The Project Manager will choose which samples to duplicate, typically in areas of highest concern. However, a duplicate may be taken only if after filling the first Tedlar bag and evacuating the well for 15 seconds, the second field monitoring device is within 20% of the first reading.

9.9 Spikes

A Tedlar bag spike and sorbent tube spike may be desirable in situations where high concentrations of contaminants other than the target compounds are found to exist (e.g., landfills). The additional level of QA/QC attained by this practice can be useful in determining the effects of interferences caused by these non-target compounds. Summa canisters containing samples are not spiked.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or Quality Assurance Program Plan (*QAPrP*) shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*. However, for each target compound to be considered valid, the concentration found in the sample must be greater than three times the level of that compound found in the appropriate blank (lot, field and trip) that accompanied that sample. Additional data to be verified/validated include but is not limited to location information, GPS coordinates, digital photographs and area sketches.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with well sampling:

- Exposure to unknown contaminants
- Lifting injuries associated with moving equipment, coolers with samples.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE
- Slips, trips, and fall hazards

- Biological hazards such as insects, snakes, spiders and poison ivy
- Below surface pipes and rebar

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known site contaminants of potential concern, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derived waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

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Indoor Air Sampling

SOP OER-0131

Prepared for:
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Division of Land Restoration
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INDOOR AIR SAMPLING

SOP OER-0131

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List of Acronyms and Abbreviations

DL	Detection Limit
FID	Flame Ionization Detector
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HPLC	High Performance Liquid Chromatography
IDW	Investigation Derived Wasted
L	Liter
OER	Office of Environmental Remediation
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
RL	Reporting Limit
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound
USEPA	United States Environmental Protection Agency
WVDEP	West Virginia Department of Environmental Protection

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1.0 SCOPE AND APPLICATION

Vapor intrusion of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and some vapor-phase metals (e.g., mercury) is often a leading risk pathway for contaminated sites, especially those with petroleum and/or halogenated compounds. Methods for identifying and tracing the movement of underground vapor-phase contaminants is critical to protecting human health. The purpose of this standard operating procedure (SOP) is to outline the methods and equipment used to sample ambient or indoor air. These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. Experience, objectives, site characteristics and chemical characteristics will dictate sampling strategy. Thus, alternate methods of collecting samples may be proposed for the site and the West Virginia Department of Environmental Protection (WVDEP) Office of Environmental Remediation (OER) will review the merits of such alternatives for potential approval. The procedures utilized at a site should be documented and included in the site investigation report.

2.0 SUMMARY OF METHOD

Air monitoring utilizes direct-reading instruments that provide instantaneous data on the levels of airborne contaminants. By comparison, air sampling is the combination of sampling and analytical techniques that require laboratory analysis and are therefore not immediate results. This air sampling will typically occur after some sort of screening determines the list of contaminants of potential concern in the air. Risks associated with airborne contaminants can be determined by comparing the air sampling results to health-based benchmarks, such as the USEPA Vapor Intrusion Screening Levels (VISL).

Generally, indoor air is sampled to assess the potential of vapor intrusion issues in existing buildings. However, indoor air should only be sampled after screening via groundwater or soil gas samples to determine if the indoor air might be contaminated because other spurious sources of indoor air contamination (e.g., aerosol sprays, gas cans, etc.) make it difficult to determine the sources of indoor air contamination. Additionally, indoor air samples of existing buildings do not effectively screen out future buildings on the site. Only groundwater and soil gas samples can screen potential future buildings for vapor intrusion. Ambient air samples are taken simultaneously with indoor air samples to assess the potential for other sources contributing to the indoor air contamination and, to a lesser degree, to determine if the subsurface sources of vapors may be contributing to ambient air contamination. The samples may be collected via Summa Canisters or Tedlar Bags. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Tedlar Bags

Indoor air samples can be collected in 1.0 L Tedlar bags, which should be stored in the dark (e.g., opaque containers) and protected from damage during transit to

the laboratory. However, Summa canisters are recommended for indoor air samples because Tedlar bags must be kept at ambient temperatures out of direct sunlight and analyzed within 48 hours of sample collection.

3.2 Summa Canisters

Summa canisters have a range of capacities, but 1.0 L and 6.0 L are the most common and they are certified clean by GC/MS before collecting samples in the field. The size of canister used depends on the predetermined sampling time-frame (e.g., 1 hour vs. 24 hour). Canisters are stored and shipped in travel cases and should be analyzed within 30 days of sample collection. The canister should be fitted with a regulator valve properly calibrated by the laboratory to allow a maximum flow rate of 200 mL/min.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Upwind sources can contribute to sample concentrations and natural sources can produce hydrogen sulfide and methane that contribute to air contamination. Additional sources from burning fossil fuels, vehicular traffic, petrochemical facilities, and emissions from smokestacks may also contribute to contaminant levels. Importantly, it has been found that lighter SVOCs, particularly Naphthalene, may have significant sample losses in cool conditions (Hayes et al. 2005), and differences in soil temperatures in the upper profile can lead to variations in soil gas concentrations by a factor of two for all VOCs (Luo et al. 2009, USEPA 2010, Hers et al. 2014, Johnson and Deeb 2014). Indoor air concentrations are often biased low due to indoor positive pressure during the cold months while heating a home and during the hot months while cooling a home (USEPA 2015). Accordingly, WVDEP recommends that vapors be sampled when the ambient temperature is at least 21°C (70°F). WVDEP may require additional samples be collected at a time when ambient temperature is at least 21°C to verify the data if indoor air is collected during periods of relatively low soil and ambient air temperatures, especially when concentrations are greater than one-half of benchmark values. Photoreactivity or reactions with non-related compounds of concern may be an issue. Some samples should not be exposed to light, particularly PAHs. Humidity, temperature and pressure also impact the air sampling methodology, collection efficiency and detection limit. The collection procedure thus becomes an integral part of the analytical method.

5.0 EQUIPMENT APPARATUS

The following sources of analytical methods are used for most environmental air sampling applications: Manual of Analytical Methods (NIOSH 2016), American Society for Testing and Materials (ASTM) Methods, USEPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air (USEPA 1999), OSHA Methods (OSHA 1990, 1991), and Air Sampling Instruments for Evaluation of Atmospheric Contaminants (ACGIH 2001). No single reference or method is best for all applications. The following equipment and materials may be required to conduct air sampling:

- Site logbook
- Clipboard
- Chain of custody forms
- Custody seals
- Air sampling worksheets
- Sample labels
- Small screwdriver set
- Aluminum foil
- Extension cords
- Multiple plug outlet
- Whirl-pak™ bags or culture tubes
- Teflon tape
- Calibration devices
- Tygon and/or Teflon tubing
- Nitrile or non-powdered latex gloves
- Lint-free gloves
- Sampler container
- Camera
- Scribe printer with paper
- Protective equipment (e.g., splash goggles, etc.)
- Paper towels
- Five-gallon bucket
- Scrub brushes and bottle brushes
- Summa canisters and/or Tedlar bags
- Flow regulators properly calibrated for the specific sample collection duration, request at least one extra as a backup
- In-line filters, if needed
- PID/FID

6.0 REAGENTS

Refer to the site-specific SAWP for the preservatives required for the specified analysis to be performed. The following reagents are generally used for air sampling:

- Calibration and spike gases
- Deionized water
- Methanol, High Performance Liquid Chromatography (HPLC) grade
- Ultra-zero grade compressed air

7.0 PROCEDURES

7.1 Air Sampling Strategy

The goal of air sampling is to accurately assess the impact of a contaminant source(s) in ambient indoor or outdoor air. This impact is expressed in terms of overall average and/or maximum air concentrations for the time period of concern and may be affected by the transport and release of pollutants from both on- and off-site sources. The location of these sources must be taken into account as they impact the selection of sampling locations. Unlike soil and groundwater concentrations, air concentrations at points of interest can easily vary by orders of magnitude over the period of concern and should be accounted for when designing the air sampling strategy.

Downwind outdoor air concentration is determined by the amount of material being released from the site into the air (the emission rate) and by the degree that the contamination is diluted as it is transported. Local meteorology and topography govern downwind dilution. Contaminant emission rates can also be heavily influenced by on-site meteorology and on-site activities. For indoor air sampling, the concentrations are generally governed by the emission rates into the room/building and the air exchange rate, which are impacted by HVAC systems, the type of subflooring, cracks in subflooring, meteorological conditions, soil porosity and the presence/absence of preferential pathways. All of these concerns must be incorporated into an air sampling strategy.

A sampling strategy can be simple or complex, depending on the sampling program objectives. Programs involving characterization of the pollutant contribution from a single point source tend to be simple, whereas sampling programs investigating fate and transport characteristics of components from diverse sources require a more complex sampling strategy. In addition, resource constraints may affect the complexity of the sampling design.

An optimal sampling strategy accounts for the following site parameters:

- Location of sources
- Analytes of concern
- Analytical Reporting Limit (RL) to be achieved
- Rate of release and transport of pollutants from sources
- Availability of space and utilities for operating sampling equipment
- Meteorological monitoring data
- Meteorological conditions in which sampling is to be conducted

The sampling strategy typically requires that the concentration of contaminants at the source or area of concern, as well as background contributions, be quantified. It is important to establish background levels of contaminants in order to develop a reference point from which to evaluate the source data. Field blanks and lot

blanks, as well as various other types of quality assurance/quality control (QA/QC) samples, can be utilized to determine other sources. The impact of extraneous sources on sampling results can frequently be accounted for by placing an outdoor ambient air sampler upwind of the building being assessed. Indoor air samples may need to be placed in various lower level rooms to account for potentially different points of entry, and in various levels to account for air circulation.

7.2 Sampling Objectives

The objectives of the sampling must be determined prior to developing the *QAPrP*. In addition, the assumptions associated with the sampling program must be defined. These assumptions include whether the sampling is to take place under "typical," "worst case," or "one-time" conditions. If the conditions present at the time of sampling are different from those assumed during the development of the sampling plan, the quality of the data collected may be affected. WVDEP generally recommends air sampling under the worst case scenario to avoid costly frequent sampling over long time periods (typical scenario) or the potential for false negatives (one-time scenario). The following definitions have been established:

- Typical: routine daily sampling or routine scheduled sampling at pre-established locations.
- Worst case: sampling conducted during meteorological and/or site conditions that have the greatest potential to result in elevated air concentrations. To meet this definition the sampling must occur:
 - with negative pressure in the building
 - with low outdoor atmospheric pressure
 - with temperatures greater than 70°F on the sampling train
 - over an 8-hour period for commercial/industrial buildings
 - over a 24-hour period for residential or sensitive receptor (e.g., daycare and nursing homes) buildings
- One-time: only one chance is given to collect a sample without regard to time or conditions. Qualitative data acquired under these conditions are usually applicable only to the time period during which the data were collected and may not provide accurate information to be used in estimating the magnitude of an air impact during other periods or over a long time interval.

The volume of sample to be collected is dependent upon an estimate of the contaminant concentration in the air, the sensitivity of the analytical method, and the standard or desired detection limit (DL) or RL. A sufficient amount of sample must be collected to achieve the desired DL without interference from other

contaminants. Most importantly, the selected method must be able to detect the target compound(s).

7.3 Location and Number of Individual Sampling Points

Choose the number and location of sampling points according to the variability, or sensitivity, of the sampling and analytical methods being utilized, the variability of contaminant concentrations over time at the site (if known), the level of precision required, and cost limitations. In addition, determine the number of locations and placement of samplers by considering the local terrain, meteorological conditions, location of the site (with respect to other conflicting background sources), size of the site, and the number, size, and relative proximity of separate on-site emission sources and upwind sources. The following are several considerations for air sampler placement:

- Location of potential on-site emission sources, as identified from the review of site background information or from preliminary on-site inspections.
- Location of potential off-site emission sources upwind of the sampling location(s). Review local wind patterns to determine the location of off-site sources relative to wind direction.
- Vegetation, such as trees and shrubs, which stabilizes soil and hinders subsurface contaminants from becoming airborne. Indoor plants also scrub some contaminants from the air.
- Look for cracks in basements and floors, and points of utility entry (e.g., water and natural gas) as potential pathways of vapor entry into the building. If all of the points of entry and cracks are in one room, then that may be the only room to sample, depending on air circulation patterns. Dirt basements and crawl spaces are especially likely points of entry to evaluate.
- HVAC systems can circulate contaminated air throughout the building. Determine the number of self-contained HVAC systems and prioritize sampling them based on proximity to vapor source areas, number of cracks and points of entry, and the location of human receptors.
- Extreme care should be taken to remove all potential sources of VOCs from a building before air sampling in order to prevent false positive results, such as indicating a vapor intrusion problem that was actually caused by an aerosol spray or cleaning agent. Sources of VOCs include gasoline cans, aerosol spray cans, paint, solvents, etc. Even empty cans can still be a source of VOCs and should be removed from the building. The building should be screened with a PID/FID to determine the location of any potential spurious sources. Once the potentially spurious sources have been removed, the building should be allowed to equilibrate for at least 48 hours before sampling, longer (~72 hours) if the air exchange rate

is low (<0.3 ACH). This care includes conducting indoor air sampling before the installation of sub-slab probes.

- Do not place sample canisters near primary-use doors or open windows.
- Sample locations should avoid fans and ask the occupants not to use any fans during sampling activities.
- The rooms to be sampled should also be kept predominantly closed for at least 24 hours prior to sampling to minimize dilution of the air contaminants.

The number of samples is variable, but each HVAC system and/or each room with a point of entry or obvious cracking should be sampled for indoor air quality, particularly in rooms with high occupancy or where people spend at least 8 hours of time.

7.4 Time, Duration and Frequency of Sampling Events

The time of day, duration and frequency of sampling events is governed by the effects of site activities and meteorology on emission and dispersion of the contaminants, the variable impacts of off-site sources, costs and logistical considerations. Generally, samples for OER may be collected as one-time and/or worst case grab samples, but longer sampling periods are preferential to integrate a more accurate average concentration and dose. Integrated samples should be collected over at least a 2-hour period, preferentially 8-hours for commercial buildings and 24-hours for residents to meet the worst case scenario definition. Outdoor ambient air samples will be collected at the same time as the indoor air samples and upwind of the building being sampled. If conditions during the time of indoor air sampling are shown to be under worst case conditions (e.g., negative pressure in the building, low atmospheric pressure, temperatures greater than 70°F on the sampling train) then only one round of samples may be necessary, but more rounds of samples may be necessary to fully assess vapor intrusion if the sampling did not occur under worst case conditions.

7.5 Chemical Considerations

The chemical characteristics of a contaminant (e.g., molecular weight, physical state, vapor pressure, aerodynamic size, temperature, reactive compounds and photodegradation) affect its behavior and can influence the method used to sample and analyze it.

7.6 Summa Canisters

Canisters at least 6.0-L in size should be used for integrated air samples. The canisters will need to be fitted with a calibrated flow controller to collect air at a fixed rate (e.g., 40 cc/min over 2 hours for a 6.0-L canister). The canister should be left under some vacuum at the end of the sampling period to ensure sufficient driving force collecting air at a steady rate. Samples collected under vacuum may

need to be pressurized with the addition of inert gas prior to analysis. Alternately, equipment exists to actively pump air into a pressurized canister (up to 2 atmospheres) to collect a higher volume than the previous method. However, special care must be taken with pressurized equipment to make sure none of the components that contact the air sample prior to the canister become contaminated and compromise subsequent samples. Samplers should be flushed with zero air or clean nitrogen between samples.

1. Place the sampling canisters at the breathing-zone height and be sure to photograph the canister in place. If canisters cannot be placed so that the intake is at the breathing-zone height, Summa Canister cane-shaped rain guards must be used so that the intake would be at the approximate breathing-zone height.
2. Remove the brass plug from the canister and connect the flow regulator (with in-line particulate filter and vacuum gauge, if needed) to the canister.
3. Tighten the flow regulator and canister connection using a wrench.
4. Open the valve on the Summa canister. The sample is drawn into the canister by pressure equilibration. The appropriate sampling time for a canister is dependent on the unit of investigation. Generally, 20-60 minutes for a grab sample but 8 to 24 hours are more representative in integrated commercial and residential samples, respectively.
5. Return to the sample location ~15 minutes before the end of the sample collection timeframe. Examine the flow regulator to ensure that some vacuum is left on the gauge (preferably 5 inches, but 2 to 10 inches of Hg on the regulator dial is acceptable).
6. Record the pressure and stop the sample collection by closing the flow regulator.
7. Remove the flow regulator using a wrench and re-install the brass plug on the canister, tightening the plug with a wrench.
8. Package the canister and flow regulator into the shipping container provided by the lab.
9. Sample number, sample location, date collected, sampler name and any other pertinent sample information must be recorded on a chain-of-custody form and on a blank tag attached to the canister.
10. Chain-of-custody sheets must accompany the samples to the laboratory.

7.7 Tedlar Bags

The use of Tedlar Bags is recommended only when the samples can be analyzed within a few hours, such as having a portable GC in the field. It has been shown that high concentrations of contaminants in contact with the Tedlar bag for more than 12 hours may react with the bag and be unrecoverable for analysis. If Tedlar bags are used, the results should be accompanied with documentation that the samples were analyzed within recommended holding times, and percent recovery data as an indication of matrix effects. The percent recovery can be determined by charging the Tedlar bag with a known gas (e.g., a calibration standard or

Standard Reference Material), holding it for a similar time as samples and then analyzing it. For samples taken under extreme humidity or oily mist conditions, a partially filled Tedlar bag with known volume could be spiked with a known concentration and volume of a calibration standard or Standard Reference Material and analyzed along with an unspiked sample to calculate the percent recovery.

1. Assemble the sampling train (e.g, vacuum box).
2. A leak test should be performed by placing a shroud around the sample train and using a tracer gas (99.999% laboratory grade helium) to enrich the atmosphere within the shrouded sampling train. A vacuum should then be drawn on the sampling tubing at 150-160 mL/min rate and the vacuum exhaust monitored for helium using a helium leak detector that has been factory calibrated within the past year. Any leaks showing >10% of the ambient helium reading should be located and sealed before proceeding with sampling.
3. Use the vacuum box and sampling train to collect the sample. The sampling train is designed to minimize the introduction or loss of contaminants due to adsorption and other factors. All parts used are either Teflon or stainless steel, and a vacuum is drawn directly to avoid contamination from the pumps.
4. Place the Tedlar bag inside the vacuum box, attach it to the sampling port and open the valve. The sample probe should be attached to the sampling port with Teflon tubing and a “Quick Connect” fitting.
5. Draw a vacuum around the outside of the bag, using a pump connected to the vacuum box evacuation port with Tygon tubing and a “Quick Connect” fitting. The negative pressure inside the box causes the bag to inflate, drawing the sample into the bag.
6. Break the vacuum by removing the Tygon line from the pump. Remove the bagged sample from the box and close the valve. Record the date, time, sample location ID, name of sampler and any other pertinent information on the sample bag label and on data sheets or in logbooks.
7. Bags should not be labeled directly with a marker or pen, nor should adhesive labels be affixed directly to the bags. Inks and adhesive may diffuse through the bag material and contaminate the sample. Labels should be tied to the metal eyelets provided on the bags.
8. Chain-of-custody sheets must accompany the samples to the laboratory.

8.0 CALCULATIONS

Volume is obtained by multiplying the sample time by the average flow rate, making sure to use similar time units. Adjustments for temperature and pressure differences may be required. Results are usually provided in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

9.1 General

Refer to the site-specific *QAPrP* for details on the QA/QC requirements. All data must be documented in approved field data sheets, in a logbook and/or recorded electronically. All instrumentation must be operated in accordance with operation instructions as supplied by the manufacturer, unless otherwise specified in the *QAPrP*. A training record indicating the level of competency for each field employee will be documented and maintained on file. A chain of custody record must be maintained from the time a sample is taken to the final deposition of the sample.

9.2 Sample Train Contamination

The Teflon line forming the sample train to the Tedlar bag or Summa canister should be changed on a daily basis. If visible contamination (soil or water) is drawn into the sampling train, it must be changed immediately. When sampling in highly contaminated areas, the sampling train should be purged with ambient air, via a vacuum pump, for approximately 30 seconds between each sample. After purging, the sample train can be checked using a PID/FID to establish the cleanliness of the Teflon line.

9.3 PID/FID Calibration

The PID and/or FID must be calibrated at least once a day using appropriate calibration gases.

9.4 Trip Blanks

A trip blank detects any sample contamination during shipping and storage. With the exception of Summa canisters, the trip blank is prepared and added to the site samples after sampling has been completed and prior to shipment.

9.4.1 Tedlar Bags

Each cooler containing Tedlar bag samples must contain one Tedlar bag of ultra-zero grade air, acting as a trip blank for samples shipped to a laboratory. Chain-of-custody records must accompany each cooler of samples and should include the blank that is dedicated to that cooler.

9.4.2 Summa Canisters

Canister trip blanks are evacuated containers that are shipped to and from the site with the canisters used for air sampling.

9.5 Field Blanks

Field blanks detect sample contamination during the handling and shipping process associated with a specific sampling event.

9.5.1 *Tedlar Bags*

For each day of sampling, a Tedlar bag is filled with ultra-zero air at the beginning of the day. This field blank is handled in the same manner as the samples.

9.5.2 *Summa Canisters*

For each day of sampling, a Summa canister is filled with ultra-zero air at the beginning of the day. This field blank is handled in the same manner as the samples.

9.6 Trip Standards

If Tedlar bags are used for sampling, each cooler containing samples should contain a Tedlar bag of standard gas to calibrate the analytical instruments. This trip standard will be used to determine any changes in concentrations of the target compounds during the course of the sampling day (e.g., migration through the sample bag, degradation, or adsorption). A fresh trip standard must be provided and placed in each cooler pending additional sample collection. Chain-of-custody records must accompany each cooler of samples and should include the trip standard that is dedicated to that cooler.

9.7 Lot Blanks

9.7.1 *Tedlar Bags*

Prior to use, one bag is removed from each lot of Tedlar bags to be used for sampling and checked for possible contamination as follows: Fill the test bag with ultra-zero grade air; withdraw a sample from the bag and analyze using a field portable GC or other field instrument to ensure sample container cleanliness prior to the start of the sampling effort.

9.7.2 *Summa Canister*

From each lot of four cleaned Summa canisters, one is used for a GC/MS certification check. If the canister passes certification, it is re-evacuated and all four canisters from that lot are available for sampling. If the chosen canister is contaminated, the entire lot of four Summa canisters must be re-cleaned and a single canister is re-analyzed by GC/MS for certification.

9.8 Duplicate Samples

A minimum of 5% of all indoor samples should be collected in duplicate. In choosing which samples to duplicate when using Tedlar bags, a duplicate may be

taken only if after filling the first Tedlar bag and evacuating the well for 15 seconds, the second field monitoring device is within 20% of the first reading.

9.9 Spikes

A Tedlar bag spike may be desirable in situations where high concentrations of contaminants other than the target compounds are found to exist (e.g., landfills). The additional level of QA/QC attained by this practice can be useful in determining the effects of interferences caused by these non-target compounds. Summa canisters containing samples are not spiked.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*. However, for each target compound to be considered valid, the concentration found in the sample must be greater than three times the level of that compound found in the appropriate blank (lot, field and trip) that accompanied that sample. Additional data to be verified/validated include but is not limited to location information, GPS coordinates, digital photographs and area sketches.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASp). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with well sampling:

- Exposure to unknown contaminants, with particular attention to potentially explosive or flammable atmospheres.
- Lifting injuries associated with moving equipment, coolers with samples, etc.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE
- Slips, trips, and fall hazards
- Biohazards, such as snakes, biting insects and poison ivy

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated

from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

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Sediment Sampling

SOP OER-0132

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ross Brittain	0.0	1/10/2021	Created new SOP and SOP ID#	Editorial, Technical

SEDIMENT SAMPLING
SOP OER-0132

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List of Acronyms and Abbreviations

DI	Deionized Water
FID	Flame Ionization Detector
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HPLC	High Performance Liquid Chromatography
ID	Identification
IDW	Investigation Derived Waste
OER	Office of Environmental Remediation
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
RL	Reporting Limit
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compounds
PPE	Personal Protection Equipment
QA/QC	Quality Assurance/Quality Control
QAPrP	Quality Assurance Program Plans
VOC	Volatile Organic Compound
WVDEP	West Virginia Department of Environmental Protection

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1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to outline the methods and equipment used to collect representative sediment samples. Sediment is defined as organic and/or inorganic material that is broken down by the processes of weathering and erosion and deposited/transported by the action of water/air/ice. Some examples include weathered rock, naturally occurring organic material (e.g., peat) and secretions from organisms (e.g., calcite). These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. Experience, objectives, site characteristics and chemical characteristics will dictate sampling strategy. Thus, alternate methods of collecting samples may be proposed for the site and the West Virginia Department of Environmental Protection (WVDEP) will review the merits of such alternatives for potential approval. The procedures utilized at a site should be documented and included in the site investigation report.

2.0 SUMMARY OF METHOD

The use of the various sediment sampling techniques and equipment is dependent on project goals (e.g., receptors of concern) and site conditions, such as depth of the aqueous layer, sediment profile required, type of sample required, contaminants, sediment type and analyses required. Sediment can be collected using a hand-held device such as a scoop, trowel or auger, or using remotely activated devices such as an Ekman or Ponar dredge. Once collected, sediment is transferred from the sampling device to sample containers of appropriate size and construction for the analyses. Composite sampling can be used to analyze for inorganic compounds in sediments but should not be used for VOCs and SVOCs due to potential loss of vapors. Composite techniques should have multiple grabs placed into a container constructed of an inert material (e.g., stainless steel bowl or aluminum pan), homogenized and transferred to the sample container(s) appropriate for the analyses requested. VOC and SVOC samples should be transferred directly from the sampling device to the sample container(s). Cores may also be collected directly into an acetate or polyvinyl chloride (PVC) sleeve that serves as the sample container for undisturbed samples. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is generally not recommended, except for VOC samples. Preservation with sodium bisulfate for VOCs creates low pH conditions that may deteriorate certain target compounds, whereas samples preserved with methanol can only be analyzed with the medium-level method and thereby have elevated reporting limits (RLs). Cooling to less than or equal to 6°C but withing freezing is usually the best approach, supplemented by the appropriate holding time for the analyses requested. Wide-mouth glass containers with Teflon lined caps are utilized for sediment samples. The sample volume depends on the analytical requirements and should be specified in the site *QAPrP*.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Sediments occur in a variety of environments such as streams, wetlands, rivers and lakes. It is common to find material that is too large to sample, such as cobble and gravel, in addition to clay, silt and organic material. The appropriate sampling equipment will be necessary for the type of sediment encountered at the site. A vessel will be required for areas deeper than wading depth, with appropriate safety measures taken while using the vessel. The material that sample containers are made of can interfere with the contaminants that a sample will be analyzed for (i.e., plastics absorb pesticides, metal devices may corrode, etc.). Contaminants are more likely to be concentrated in areas of fine particle size and high organic matter compared to coarse sediments with low organic matter. Thus, selection of sample location is important and should generally be located in zones of deposition where the fine particles will settle. Efforts must also be made to prevent the loss of light sediments during sampling due to current, agitation or other disturbances.

5.0 EQUIPMENT APPARATUS

The equipment required for sediment sampling is largely dependent on the type of contaminants and sediments to be sampled. The following equipment and materials may be required to conduct sediment sampling:

- Maps/navigational charts
- Personal protective equipment (PPE)
- Compass
- Global positioning system (GPS) receiver
- Tape measure
- Survey stakes, flags, buoys and anchors
- Digital camera
- Bucket, plastic or stainless steel
- Sample bottles
- Zip-locking baggies of various sizes
- Logbook/data sheets
- Sample labels
- Chain of custody records
- Custody seals
- Cooler(s)
- Ice
- Decontamination equipment and supplies
- Scoops (plastic or stainless steel)
- Trowels (plastic or stainless steel)
- Bucket auger, with T-handle and extensions
- Tube auger, with T-handle and extensions
- Pipe wrenches
- En Core® or Terra Core™ samplers for VOCs
- Ekman™ dredge

- Ponar™ dredge
- Van Veen Sampler or Young-Modified Van Veen Sampler
- Rope or steel cable
- Winch
- Power drill
- PID/FID
- Vessel
- Hacksaw
- Trash bags
- Coring device
- Acetate/polycarbonate/PVC sleeves
- Hook blade razor knife
- Hip and chest waders
- Over boots
- Stainless steel bowls for homogenizing
- Personal floatation device

6.0 REAGENTS

Refer to the site-specific SAWP for the preservatives required for the specified analysis to be performed. The following reagents are generally used for sampling:

- Calibration and spike gases
- Deionized water
- Methanol, High Performance Liquid Chromatography (HPLC) grade

7.0 PROCEDURES

7.1 Sample Collection

1. Determine the project objectives and extent of sampling area, and the type of equipment necessary to complete the sampling. Confirm that all equipment is in proper working order. Identify and mark all potential sampling locations with flags, stakes and/or buoys.
2. The selection of sampling device is dependent upon the physical characteristics of the sediment, the type of sample needed, analytical parameters required, amount of sediment, contaminants, depth of water above the sediment, and possible interferences introduced by the sampling device.
3. If analysis of sediment from a discrete depth or location is desired, sediment is transferred directly from the sampling device to a labeled sample container(s) of appropriate size and construction for the analyses requested. Transfer is accomplished with a stainless steel or plastic lab spoon or equivalent, or En Core/Terra Core sampler for VOCs.

4. If composite sampling techniques or multiple grabs are employed, equal portions of sediment from each location or collocation are deposited into a decontaminated stainless steel, plastic, aluminum pan or other appropriate container (e.g., Teflon). The sediment is homogenized thoroughly to obtain a mixture representative of the area sampled. The composite sediment sample is transferred to a labeled container(s) of appropriate size and construction for the analysis (es) requested. Transfer of sediment is accomplished with a stainless steel or plastic lab spoon or equivalent. Samples for VOC or SVOC analysis must be transferred directly from the sample collection device or pooled from multiple areas in the homogenization container prior to mixing. This is done to minimize the loss of contaminant due to volatilization during homogenization.
5. All non-dedicated sampling devices should be decontaminated prior to use, then wrapped in aluminum foil. The sampling device should remain wrapped until needed. Dedicated sampling devices should be used for each sample. Disposable sampling devices for sediment are generally impractical due to cost and the large number of sediment samples which may be required.
6. Once samples have been collected, follow these procedures:
 - a. Transfer the sample(s) into suitable, labeled sample containers specific for the analysis to be performed.
 - b. Preserve the sample, if appropriate, or use pre-preserved sample bottles. Do not overfill the sample bottles if they are pre-preserved.
 - c. Cap the container securely, place in a resealable plastic bag, and cool to $<6^{\circ}\text{C}$ but without freezing, if required by the analytical method.
 - d. Record all pertinent data in the logbook and/or field data sheets
 - e. Generate a chain of custody record, place inside a plastic sleeve and tape to the top of the inside of the cooler.
 - f. Attach custody seals to the cooler prior to shipment.

7.2 Sediment Sampling

Several techniques have been developed to sample sediment material, including scoops, bucket/tube augers, coring devices and mechanical grabs. Scoops cause the greatest degree of sediment disturbance. Cores and mechanical grabs cause the least disturbance. The main sampling procedures are discussed below.

7.2.1 *Sampling Surface Sediment with a Scoop/Trowel*

In shallow, slow moving water, representative surficial sediment samples may be collected with plastic or stainless steel scoops or trowels. Focus the study area in zones of deposition that are downgradient of observed or likely contaminant migration pathways.

1. Collect the desired thickness and volume of sediment from the marked sampling location causing minimal disturbance of the water-sediment interface with a scoop.

2. Place the sample into a homogenization container or a specified sampling bottle. (If sampling for VOCs/SVOCs, do not homogenize; transfer the sample directly into the container).
3. Label the sample bottle and store in a cooler with ice at $\leq 6^{\circ}\text{C}$ but without freezing.

7.2.2 *Sampling Surface Sediment with a Bucket/Tube Auger*

In shallow water, representative surficial sediment samples may be collected with a bucket or tube auger. Focus the study area in zones of deposition that are downgradient of observed or likely contaminant migration pathways. Bucket and tube augers are sampling devices that consist of a bucket or tube with a series of extensions and a handle in the shape of the letter "T" (commonly known as "T" handle).

1. Attach the bucket/tube auger to the required length of extensions and attach the "T" handle to the upper extension.
2. If the study objectives and characteristics of the sediment or water body warrant, an acetate sleeve may be inserted into the tube auger prior to sampling.
3. Insert the bucket/tube auger onto the sediment at a 90° vertical angle.
4. Begin sampling by rotating the auger into the sediment with downward pressure until the desired depth is reached.
5. Slowly retrieve the auger containing the sample. The auger should be examined to determine if significant amounts of sediment are lost due to the thin, wet nature of some sediments. If significant losses have occurred, an alternate method of sampling should be performed, such as coring.
6. Carefully decant the surface water contained in the auger.
7. Collect VOC/SVOC samples directly from the bucket/tube auger using methods discussed below.
8. Place the sediment sample in a container to homogenize, and then transfer the sediment sample into the appropriate sample bottle.
9. Label the sample bottle and store in a cooler with ice at $\leq 6^{\circ}\text{C}$ but without freezing.

7.2.3 *Sampling Deep Sediment with a Bucket/Tube Auger*

In some instances, Bucket/Tube Augers may also be used to collect subsurface sediment samples in a dry creek bed. Typically, this method is not practical due to difficulties keeping boreholes open to desired depth.

1. Attach the auger bucket/tube to the required length of extensions and attach the "T" handle to the upper extension.
2. If using a tube auger, insert an acetate sleeve prior to sampling.
3. Insert the bucket/tube auger into the sediment at a 90° vertical angle.

4. Rotate the auger into the sediment with downward pressure until the desired depth is reached.
5. Begin augering while periodically removing any accumulated sediment (i.e. cuttings) from the auger bucket/tube. The cuttings should be temporarily stored on plastic sheeting at a distance of at least two (2) feet from the sampling area, to prevent cross-contamination.
6. After reaching the upper range of the desired depth, carefully retrieve the bucket/tube auger from the boring.
7. Advance the auger down the borehole carefully avoiding contact with the borehole sides to prevent cross-contamination. Gradually push down the auger into the sediment sampling location to reach the desired depth.
8. Retrieve the auger from the borehole.
9. Carefully decant the surface water contained in the auger.
10. Collect VOC/SVOC samples directly from the bucket/tube auger using methods discussed below.
11. Place the sediment sample in a homogenization container, homogenize, and then transfer into the appropriate sample bottle.
12. Label the sample bottle and store in a cooler with ice at $\leq 6^{\circ}\text{C}$ but without freezing.
13. Dispose the cuttings in accordance with the site-specific *QAPrP*.

7.2.4 *Surface Sediment Sampling with a Mechanical Dredge*

The Ekman, Van Veen, and the Ponar™ dredges are recommended for sampling in deeper water (water that is too deep to use scoops or augers) or for when relatively large amounts of sediments are required. In general, dredges are devices with jaws that are forced shut by weights, level arms, springs, cables or cords. The Ekman™ dredge is mainly used to sample fine sediments (e.g. mud, silt, and other soft and unconsolidated materials) whereas the Ponar™ dredges can be used to sample a wider range of grain sizes (clay to small gravel). Listed below are the assembly and operation instructions for both devices.

Sampling using an Ekman™ Dredge

1. Attach a dredge head to the bracket on the base of the extension pole with machine bolts.
2. Engage the jaws in a way that they are in the open position by placing trip cables over the release studs. Ensure that the hinged doors on the top of the dredge open freely to grab a sample.
3. Lower the dredge above the sampling location and hold.
4. Using the extension pole, push the dredge head into the sediments to the desired depth.
5. Trigger the jaw by depressing the button on the upper end of the extension pole.

6. Raise the sampler and slowly decant the water contained in the device through the top opening of the sampler.
7. Open the dredge jaws and place the sediment into a container for homogenization or directly into appropriate sample containers.
8. Label the sample bottle and store in a cooler with ice at $\leq 6^{\circ}\text{C}$ but without freezing.

Sampling using a Ponar™ or Van Veen Dredge

NOTE: Special care should be taken when using these types of dredges. The steel arms act in such a way as to cause significant pinch hazards.

1. Attach a nylon rope (at least $\frac{1}{4}$ ") or a steel cable (at least $\frac{1}{8}$ ") to the ring located on top of the dredge.
2. Arrange the dredge with the jaws in the open position, setting the trip bar or spring pin so the sampler remains open when lifted from the top.
3. Slowly lower the sampler to just above the sediment surface and drop the sampler into the sediment.
4. Raise the dredge to the surface and slowly decant the water through the screens on top of the dredge.
5. Open the dredge jaws and place the sediment into a container for homogenization or directly into appropriate sample containers.
6. Label the sample container and store in a cooler with ice at $\leq 6^{\circ}\text{C}$ but without freezing.

7.2.5 *Sampling Sediment with a Coring Device*

This method is ideal for collecting intact sediment core samples. By utilizing this technique, the original layering of the sediment deposited will be preserved. In general, core samplers are elongated tubes composed of an acetate sleeve, a "T" handle, a core catcher, drive hammer and a cutting shoe.

1. Assemble the coring device and insert an acetate sleeve into the sampling tube.
2. Insert the core catcher, if needed, into the lower end of the sampling tube with the convex surface positioned inside the acetate sleeve.
3. Screw the cutting shoe onto the lower end of the sampling tube, securing the acetate sleeve and core catcher.
4. Attach the sampling device to the required length of extensions; then attach the "T" handle or the drive hammer onto the upper extension.
5. Place the sampler 90° over the location to be sampled.
6. If the "T" handle is used, place downward pressure on the device until the desired depth is reached. After the desired depth is reached, slowly retrieve the sampler from the sediment. Some samplers may be equipped with a ball valve at the top of the core to aid in retrieving

wetter samples. This valve should be closed before retrieving the sampler from the bottom.

7. Carefully remove the coring device from the water sampling location.
8. Unscrew the cutting shoe and remove the core catcher.
9. Slide the PVC sleeve out of the bottom of the sampler tube. Decant surface water, using care to retain the fine sediment fraction. The sample may be left in the PVC sleeve, collected directly from the sleeve, or placed in a container for homogenization prior to transferring to sample containers. Cores should always be stored in an upright position until the overlying water has been drained, the PVC cores cut to remove any overlying air spaces and capped on both ends. To drain the overlying water, the PVC core should cut at various levels starting near the top of the core and proceeding to just above the top of the sediments. Water should be drained at a rate slow enough to minimize turbulence and disturbance to the sediment. Indicate on the PVC tube the orientation of the sediment core using a waterproof marker.
10. Label the sample and store in a cooler with ice at $\leq 6^{\circ}\text{C}$ but without freezing.

7.2.6 *Vibracore Sampling*

When sampling in deep water or where significant sample volume or depth are required, Vibracoring techniques may be used. Use of the Vibracore obtains sediment samples by vibrating a metal core barrel into the sediment. Penetration success is dependent upon the lithology of the formation. Vibracores are generally composed of a stainless steel tube, detachable metal-cutting nose, stainless steel core catcher and the Vibracore drilling head. In general, Vibracores are operated by a team of two or more people from a vessel or on a structure extending over the water surface. Vibracoring should be conducted in accordance with subcontractor's SOPs and industry methodology standards. Vibracoring uses vibration to achieve penetration into the sediments. If undisturbed cores are required, alternate sampling methods should be evaluated.

1. After allowing the sediments in the core to settle, all standing water should be drained from the core by cutting small holes above the sediment line. Water should be drained slowly so as not to re-entrain fine sediments.
2. Put the core sleeve on the soil identification table.
3. Use a Vibracore™ sleeve cutting tool (electric sheet metal cutter) and cut the full length of the sleeve. Then position the cutting tool roughly 4 inches to the left or right of the first cut and cut the entire length of the sleeve again.
4. Separate the sample core into the pre-determined sampling intervals.

5. Collect VOC/SVOC samples first using a technique outlined in Soil Sampling Using Direct-Push Drilling SOP OER-0121. Screen the sample core with the appropriate air monitoring device using the techniques outlined in the PID/FID Field Screening SOP OER-0101 and record all readings in a site logbook. Then, transfer the remainder of the interval to a mixing bowl and homogenize.
6. Perform soil identification/description activities.
7. Transfer the samples into the appropriately labeled sample containers and then store in a cooler with ice to maintain a temperature of $\leq 6^{\circ}\text{C}$ but without freezing.

7.2.7 Volatile Organic Compound Sampling

En Core® Sampling Method

The En Core® sampler is designed to collect sediment samples to be analyzed for VOC's. The En Core® sampler is comprised of an inert composite polymer (coring body) and a stainless steel "T" handle. This method reduces the open-air handling of soil samples in the field, minimizing the loss of VOCs. The following procedures are used for collecting sediment samples using an En Core® sampler.

1. Assemble the coring body, plunger rod and "T" handle.
2. Turn the "T" handle with the T-up and the coring body down and push the sampler into the sediment until the coring body is completely full (o-ring on sampler seen in the bottom hole of the sampler for 5 grams, and the top hole of the sampler for 25 grams) with minimal disturbance of the sample. Remove the sampler from the sediment.
3. Cap the coring body while it is still on the "T" handle. Push the cap over the flat area of the ridge. Ensure that the cap is seated properly to seal the sampler. Push cap to lock arm in place. Rotate the cap 90 degrees ensuring the cap is locked.
4. Remove the capped sampler by depressing the locking lever on the "T" handle while twisting and pulling the sampler from the "T" handle.
5. Using the hole located on the En Core® "T" handle, insert the core plunger, twist and lock the plunger of the core body.
6. Attach the label to the coring body cap, place it back into the En Core® sample bag and seal the bag.
7. This process will be conducted a total of three times for each field sample, six times for a sample and a field duplicate and nine times for a sample that has been chosen for the Matrix Spike/Matrix Spike Duplicate (MS/MSD) as outlined in the *QAPrP*.
8. Store the sample in a cooler with ice at $\leq 6^{\circ}\text{C}$ but without freezing.

Terra Core® Sampler Method

A Terra Core® sampler is a single-use device designed to collect sediment samples to be analyzed for VOCs. The Terra Core® sampler is made of an inert composite polymer and reduces the open-air handling of sediment samples in the field. The following procedures are used for collecting sediment samples using a Terra Core® sampler.

1. Assemble the Terra Core® sampler by inserting the plunger portion into the “T” handle. Snap the plunger into the sampler.
2. Push the Terra Core® sampler into the sediment, ensuring that the Terra Core® sampler is completely full with sediment. Remove sampler from the sediment.
3. Unclip the plunger, rotate 90° and push the sample out of the sampler into a pre-weighted 40-milliliter (mL) vial containing a stirring bar. Refer to the analytical method if preservation is required. Label sample and store on ice at $\leq 6^{\circ}\text{C}$ but without freezing.
4. This process will be conducted 3 times for the collection of a sample, 6 times for a duplicate and 9 times for an MS/MSD as outlined in the *QAPrP*.

8.0 CALCULATIONS

This section is not applicable to the SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer’s instructions unless specified otherwise in the site-specific SAWP.
- The collection of an equipment rinsate blank is recommended to evaluate potential for cross-contamination.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAWP and/or *QAPrP* for further information on collection of duplicate samples.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAWP and/or *QAPrP* for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants.

This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASp). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with sediment sampling:

- Exposure to unknown contaminants, with particular attention to potentially explosive or flammable atmospheres.
- Lifting injuries associated with moving equipment, coolers with samples, and retrieving sampling devices.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slips, trips, and fall hazards.
- Water hazards, such as drowning.
- Biohazards, such as snakes, biting insects and poison ivy.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derived waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

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Surface Water Sampling

SOP OER-0133

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ross Brittain	0.0	1/10/2021	Created new SOP and SOP ID#	Editorial, Technical

SURFACE WATER SAMPLING
SOP OER-0133

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List of Acronyms and Abbreviations

DO	Dissolved Oxygen
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDPE	High Density Polyethylene
HPLC	High Performance Liquid Chromatography
IDW	Investigation Derived Waste
LDPE	Low Density Polyethylene
OER	Office of Environmental Remediation
ORP	Oxidization Reduction Potential
OSHA	Occupational Safety and Health Administration
PE	Polyethylene
PTFE	Polytetrafluoroethylene
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
PPE	Personal Protection Equipment
QA/QC	Quality Assurance/Quality Control
QAPrP	Quality Assurance Program Plans
VOC	Volatile Organic Compound
WVDEP	West Virginia Department of Environmental Protection

Disclaimer: Any mention in this SOP of any products or services does not constitute or imply the endorsement, recommendation or favoring by WVDEP or any of its employees or contractors acting on its behalf.

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to outline the methods and equipment used to collect representative surface water samples from streams, rivers, lakes, ponds, lagoons and surface impoundments, including from depth and the surface of the water. These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. Experience, objectives, site characteristics and chemical characteristics will dictate sampling strategy. Thus, alternate methods of collecting samples may be proposed for the site and the West Virginia Department of Environmental Protection (WVDEP) will review the merits of such alternatives for potential approval. The procedures utilized at a site should be documented and included in the site investigation report.

2.0 SUMMARY OF METHOD

The conditions for sampling surface water will vary widely due to water depths, velocity, sampling intervals, etc.; therefore, there is no universal sampling procedure. Collecting representative surface water samples can generally be accomplished by using either a Kemmerer bottle, a dip sampler or sampling directly into the container. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The amount of sample collected, chemical preservation, storage requirements and the proper sample container type (i.e., glass or plastic) are dependent upon the matrix sampled and analysis performed. Refer to the relevant WVDEP *QAPrP* for details of the appropriate sample containers, amounts, etc. based on the analysis performed. Whenever possible, dedicated sampling devices should be used. However, if re-usable (non-dedicated) equipment is used, it will need to be decontaminated between samples following SOP OER-0100. The sample volume depends on the analytical requirements and should be specified in the site *QAPrP*. Additional QA/QC samples will need to be collected as specified in the site *QAPrP*. Once samples have been collected the following general procedures should be followed:

- Transfer the sample(s) into suitable, labeled sample containers specific for the analysis to be performed.
- If appropriate, preserve the sample, or use pre-preserved sample bottles. Do not overfill bottles if they are pre-preserved.
- Cap the container securely, place in a resealable plastic bag, and cool to <6°C.
- Record all pertinent data in the site logbook and/or on field data sheets.
- Complete the chain of custody record.
- Attach custody seals to cooler prior to shipment
- Decontaminate all non-dedicated sampling equipment prior to the collection of additional samples.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Cross contamination can be eliminated or minimized through the use of dedicated or disposable sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Selection of samplers constructed of glass, stainless steel, HDPE, LDPE, PVC or PTFE should be based upon the suspected contaminants and the analyses to be performed (refer to the relevant WVDEP *QAPrP*). Improper sample collection can involve using contaminated equipment, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed or non-representative area. Following proper decontamination procedures, minimizing disturbance of the sample site (e.g., working from downstream to upstream sample locations), and careful selection of sampling location will eliminate most problems. Proper timing for the collection of samples must be taken into consideration for low or fast-flowing streams or rivers (e.g., drought vs. flood conditions). Dip samplers may collect floating debris which may skew sample results.

5.0 EQUIPMENT APPARATUS

The following equipment and materials may be required to conduct surface water sampling, depending on the sampling and analytical methods:

- Kemmerer bottles
- Line and messengers
- Dip sampler
- Peristaltic pump
- Tygon tubing
- Polyethylene (PE) or PTFE tubing
- 0.45 micron (μm) filters
- Sample bottles
- Preservation reagents
- pH paper
- Resealable plastic bags (e.g., ziplock-ing baggies)
- Ice
- Coolers
- Inert packing material
- Sample labels
- Printer
- Chain of custody records
- Custody seals
- Field data sheets
- Decontamination equipment/supplies
- Maps/plot plan
- Personal protective equipment (PPE)
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors

- Vessel
- Global Positioning System (GPS) unit
- Camera
- Logbook/waterproof pen
- Paper towels
- Water quality meter (e.g., pH, DO, conductivity, salinity, temperature)

6.0 REAGENTS

Refer to the site-specific SAWP for the preservatives required for the specified analysis to be performed. The following reagents are generally used for sampling:

- Calibration and spike gases
- Deionized water
- Methanol, High Performance Liquid Chromatography (HPLC) grade

7.0 PROCEDURES

7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the type and amount of equipment and supplies needed.
2. Obtain the necessary sampling and monitoring equipment.
3. Decontaminate or pre-clean equipment and ensure that it is in working order.
4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.
5. Use stakes, flags, or buoys to identify and mark all sampling locations identified by GPS data. If required, the proposed locations may be adjusted based on site access, property boundaries, and obstructions.
6. Field Rinsing - Once field work has begun, and before samples are collected, the sample wetted portions of most of the collection and processing equipment require a field rinse with native water. Field rinsing helps to condition, or equilibrate, sampling equipment to the sample environment. Rinsing also serves to ensure that all cleaning-solution residues have been removed. Note – Do not field rinse pre-preserved bottles or when collecting volatile organic compounds (VOCs).

7.2 Representative Sampling Considerations

In order to collect a representative sample, the hydrology and characteristics of a stream, river, pond, lake or impoundment should be determined prior to sampling. This will aid in determining the presence of separate phases or layers in lagoons or impoundments, flow patterns in streams, and appropriate sample locations and depths. Location of sampling will depend on project goals and conditions. For example, in a stream or river the sample should be collected at a location where

the velocity is sufficient to prevent deposition of solids and should have relatively uniform flow. In moving water, the sampler must always stand downstream of the collected sample. Care must be taken to avoid introducing re-suspended sediment into the sample, particularly in small stagnant ponds. Recent storm events may dilute contamination or bring contaminants from upstream sources and should be taken into consideration when collecting samples. In addition, present or recent storm events will alter water quality data. Storm event data should be recorded in logbooks to help evaluate the data.

In-stream Monitoring Procedures:

All samples will be collected for the specific pollutants of concern and using accepted QA/QC procedures. Surface water samples will be collected during low to normal flow conditions as follows:

Transect Locations:

One transect 25' from the upstream property line and one transect located 25' from the downstream property line. The number and location of transects along the reach of stream adjacent to the site is site-specific, depending upon information gleaned during the site characterization process and the site conceptual model, with regard to groundwater delineation and flow direction. At a minimum, one transect will be located in the reach of stream where groundwater is projected to discharge for each 75' of plume width. Individual samples are to be collected from mid-depth in streams less than 1.5-feet deep, and in the lower 1' of the water column for all streams deeper than 1.5-feet. During development of the stream characterization component of the SAWP, refer to the VRP Guidance Manual for specific requirements, and coordination with the OER Project Manager is encouraged.

Sample Locations per Transect:

1. For a stream less than 30' in width, one sample collected at the approximate mid-channel location.
2. For streams between 30' and 60' in width, two samples collected at locations equally spaced between mid-channel and the shoreline.
3. For streams between 60' and 100' in width, 3 samples collected at locations equally spaced between mid-channel and the shoreline.
4. For streams greater than 100' in width, 4 samples at locations equally spaced between the lesser of 75' from the shoreline, or mid-channel and the shoreline.

In-pond/impoundment Monitoring Procedures:

All samples will be collected for the specific pollutants of concern and using accepted QA/QC procedures. Surface water samples will be collected during low to normal pool conditions. The number and location of samples in any pond/impoundment is dependent on the size of the impoundment and potential

number of hotspots. At a minimum, one sample will be located in the pond/impoundment for every 500 ft², and in known/likely hotspots for conservative risk estimates. Ponds less than 500 ft² in size should have at least two samples. Recall that a minimum of eight (8) samples must be collected per medium to calculate an Exposure Point Concentration using a 95% UCL. Ponds/impoundments with more than eight samples may locate their samples randomly for good representation. Individual samples are to be collected from mid-depth in ponds/impoundments less than 1.5-feet deep, and in the lower 1' of the water column for all ponds/impoundments deeper than 1.5-feet. During development of the pond/impoundment characterization component of the SAWP, coordination with the OER Project Manager is encouraged.

7.2.1 Water Quality Data

Water quality data, including pH, conductivity, oxidation reduction potential (ORP), salinity and dissolved oxygen (DO) may be collected in ponds, lakes and impoundments to determine if stratification is present. Measurement intervals will depend on many factors (i.e. total depth, location access, site conditions, etc.). A determination will be made prior to collecting any water quality data as to depth(s) and frequency of measurements. These measurement intervals should be as consistent as possible throughout the sampling event. Depth intervals should be documented in the site *QAPrP*; any changes should be documented in a field logbook.

7.2.2 Sampling Methods

Factors that contribute to the selection of a sampling method are:

- Width, depth, flow and accessibility of the location being sampled
- Whether the sample will be collected onshore or offshore

Kemmerer bottles may be used in most situations where site access is from a boat or structure, such as a bridge or pier, and where samples at specific depths are required.

Dip samplers are useful in situations where a sample is to be recovered from an outfall pipe or along a lagoon bank where direct access to the sample point is not feasible.

The **direct method** may be utilized to collect water samples from streams, rivers, lakes, and other surface waters directly into the sample container(s).

Note that all VOC samples must completely fill their sample containers with no headspace.

7.3 Sample Collection

7.3.1 *Kemmerer Bottle*

Sampling procedures for a Kemmerer Bottle are as follows:

1. Use a properly decontaminated Kemmerer bottle. Set the sampling device so that the upper and lower stoppers are pulled away from the body, allowing the surface water to enter tube.
2. Lower the pre-set sampling device to the predetermined depth. Avoid disturbance of the bottom.
3. When the Kemmerer bottle is at the required depth, send the weighted messenger down the suspension line to close the sampling device.
4. Retrieve the sampler and discharge the first 10-20 milliliters (mL) from the drain to clear potential contamination from the valve. Fill sample containers for VOC samples first as these samples should not be composited. This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited or transferred directly to appropriate sample containers.

7.3.2 *Dip Sampler*

Sampling procedures for a Dip Sampler are as follows:

1. If necessary, assemble the device in accordance with the manufacturer's instructions.
2. Extend the device to the sample location and collect the sample by dipping the sampler into the water.
3. Retrieve the sampler and transfer the sample to the appropriate sample container(s).

7.3.3 *Direct Method*

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples directly into the sample container(s). Health and safety considerations must be addressed when sampling lagoons or other impoundments where specific conditions may exist that warrant the use of additional safety equipment. These issues must be addressed in the site-specific Health and Safety Plan (HASP). Using adequate protective clothing for wading or boats, access the sampling station from a downstream location, walking upstream so as to not disturb sediments and suspending them into the water column. Collect water quality information for the sampling location and record in the site logbook or field data sheets. For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the

sample under the water surface while avoiding surface debris and boat wake. Pre-preserved sample bottles cannot be used for this sampling method. Surface water samples may also be collected directly by using a peristaltic pump with PE or PTFE lined tubing. This method is also used when collecting filtered samples.

8.0 CALCULATIONS

This section is not applicable to the SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

There are no specific QA/QC activities that apply to just surface water, but the following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAWP.
- The collection of an equipment rinsate blank is recommended to evaluate potential for cross-contamination.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAWP and/or *QAPrP* for further information on collection of duplicate samples.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAWP and/or *QAPrP* for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASp). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with surface water sampling:

- Exposure to unknown contaminants, with particular attention to potentially explosive or flammable atmospheres.
- Lifting injuries associated with moving equipment, coolers with samples.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slips, trips, and fall hazards.
- When sampling lagoons or surface impoundments containing known or suspected hazardous substances, adequate health and safety and boating precautions must be taken to ensure personnel safety.
- Biohazards, such as snakes, biting insects and poison ivy.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derive waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

U.S. Environmental Protection Agency. 1984. *Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods*, Second Edition. EPA/600/4-84-076.

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SPLP and TCLP Sampling

SOP OER-0134

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
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SPLP AND TCLP SAMPLING
SOP OER-0134

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List of Acronyms and Abbreviations

FID	Flame Ionization Detector
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	Investigation Derived Waste
OER	Office of Environmental Remediation
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semi-Volatile Organic Compounds
PPE	Personal Protection Equipment
QA/QC	Quality Assurance/Quality Control
QAPrP	Quality Assurance Program Plans
TCLP	Toxicity Characteristic Leaching Procedure
VOC	Volatile Organic Compound
WVDEP	West Virginia Department of Environmental Protection

Disclaimer: Any mention in this SOP of any products or services does not constitute or imply the endorsement, recommendation or favoring by WVDEP or any of its employees or contractors acting on its behalf.

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to outline the methods and equipment used to collect representative soil samples that will be used to measure the potential for leaching to groundwater via either the Synthetic Precipitation Leaching Procedure (SPLP) or the Toxicity Characteristic Leaching Procedure (TCLP). SPLP determines the mobility of both organic and inorganic analytes present in leachate from soils that are exposed to acidic rainfall (pH = 5). TCLP is designed to determine the mobility of both organic and inorganic analytes in leachate as water passes through landfill waste but can also be used to determine leachability from soil in more acidic conditions. This SOP only discusses the collection of samples to be analyzed using SPLP and/or TCLP laboratory methods. The laboratory procedures for SPLP/TCLP analyses are determined by the SOPs within the respective laboratories and outside the scope of this SOP. These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. Experience, objectives, site characteristics and chemical characteristics will dictate sampling strategy. Thus, alternate methods of collecting samples may be proposed for the site and the West Virginia Department of Environmental Management (WVDEP) will review the merits of such alternatives for potential approval. The procedures utilized at a site should be documented and included in the site investigation report.

2.0 SUMMARY OF METHOD

SPLP and TCLP are both used as a way to screen contaminated soils for the potential of leaching into groundwater. These methods can be used in place of screening via Migration to Groundwater screening levels, such as those in the VRP Guidance Manual, or collecting groundwater samples. However, if the results of SPLP or TCLP indicate the potential exceedance of groundwater standards, such as the Groundwater De Minimis Standards, then groundwater wells will need to be installed to verify the contamination of the groundwater. Generally, SPLP should be used to determine the leaching capability of contaminated soils. TCLP should only be used where more acidic conditions are known or expected to exist, such as a landfill or abandoned mine land. For both the SPLP and TCLP analyses, a soil sample is collected and then extracted with an amount of extraction fluid equal to 20 times the weight of the solid phase. The extraction fluid used in SPLP is a function of the region of the country where the sample site is located. In WV the extraction fluid has been pre-determined for the SPLP method to be SPLP Extraction Fluid #1 for sites east of the Mississippi River, in which 60:40 H₂SO₄/HNO₃ is added to reagent water until the pH is 4.20±0.05. The extraction fluid used in TCLP is a function of the alkalinity of the soil/waste. If the pH is <5.0, TCLP Extraction Fluid #1 is used. TCLP Extraction Fluid #1 is created by adding 5.7 mL of glacial acetic acid to 500 mL of reagent water, then adding 64.3 mL of 1N NaOH and diluting the mixture to a volume of 1L with the resulting TCLP Extraction Fluid having a pH of 4.93±0.05. If the pH is >5.0, 3.5 mL 1N HCl is added but if the pH goes below 5.0 TCLP Extraction Fluid #1 is added. If the pH remains >5.0, then TCLP Extraction Fluid #2 is used to get the pH below 5.0. TCLP Extraction Fluid #2 is created by diluting 5.7 mL of glacial acetic acid with reagent water to a volume of 1L with a resulting pH of 2.88±0.05. Following extraction, the

liquid extract is separated from the solid phase by filtration through a 0.6 to 0.8 μm glass fiber filter. The liquid extract is then analyzed using appropriate aqueous methods for the analytes of interest to determine the concentrations of potential contaminants in the leachate. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Soil samples should be collected in wide-mouth glass containers with Teflon-lined caps and refrigerated at $\leq 6^{\circ}\text{C}$ but without freezing. If precipitation occurs, the entire sample, including precipitate, should be extracted. All extracts must be stored at $\leq 6^{\circ}\text{C}$ until analyzed within the proper holding times for the analytes. Extracts for metallic analytes must be acidified with nitric acid to a pH less than 2.0, unless precipitation occurs.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Potential interferences that may be encountered are inherent to the analytical methods used for the extracts.

5.0 EQUIPMENT APPARATUS

The following equipment and materials may be required to conduct soil sampling for either SPLP or TCLP analysis, depending on the sampling and analytical methods. Refer to the SAWP to determine specific needs for any given project:

- Photoionization detector (PID) and/or flame ionization detector (FID)
- Logbook
- Field data sheets and samples labels
- Chain of custody records and seals
- Sample and shipping containers
- Pails, tubs, or buckets
- Plastic sheeting
- Packing materials and Ziploc plastic bags
- Decontamination solutions (i.e., tap water, non-phosphate soap, distilled water)
- Brushes
- Stakes and flagging
- Sampling gloves
- Shovel
- Spatula, scoops, and/or trowels
- Continuous flight (screw) auger
- Bucket auger
- Post hole auger
- Split spoons
- Drilling rig equipment (points, drive head, drop hammer, puller jack and grip, extension rods, T-handle, thin wall tube sampler, etc.)

- Backhoe
- Drums for storage of investigation derived waste
- Personal protective equipment (PPE)

6.0 REAGENTS

Refer to the site-specific SAWP for the preservatives required for the specified analysis to be performed. The following reagents are generally used for sampling:

- Calibration and spike gases
- Deionized water

7.0 PROCEDURES

7.1 SPLP vs TCLP

First determine if the samples will be analyzed using SPLP or TCLP procedures in the SAWP. SPLP should be used to determine the leaching capability of the majority of contaminated soils. TCLP should only be used where more acidic conditions are known or expected to exist, such as a landfill.

7.2 Sampling Considerations

In order to screen the potential of groundwater contamination via leaching from contaminated soils, potential source areas should be identified at the site, with SPLP/TCLP analyses of soils from each of the potential source areas. The soil samples should come from these hotspots to screen the worst-case scenario for leaching to groundwater. These source areas can either be identified beforehand with historical soil data, they can be determined in the field while collecting soil samples for conventional soil analytical methods, or they can be determined in the laboratory.

Option 1: Using Historical Soil Data

If adequate historical soil data exists to determine the contamination hot spots, then select at least one sample location for each hotspot. There should be a minimum of three SPLP/TCLP sample locations to adequately assess the potential for contaminant leaching to groundwater. However, more than three samples may be needed, depending on the number of hotspots, number of contaminants of concern and the size of the site/hotspots. The depth of the soil samples for SPLP/TCLP should be based on the depth of the highest concentrations of the contaminants of concern. If multiple contaminants of concern are present in the soils, then choose locations/depths that capture the greatest range of high concentrations of as many contaminants as possible to assess potential interactive effects. Additional sample locations may need to be determined in order to assess the maximum concentrations of different contaminants. The determination of the

sample locations and depths should be discussed with the WVDEP Project Manager in the development stages of the SAWP to expedite the process.

Option 2: Using Real-time Soil Data

In this case, since the concentrations of contaminants are not known ahead of time, a SPLP/TCLP sample will need to be collected from each soil boring and sent to the laboratory for analysis. While collecting soils for conventional analytical analyses, the soils can be screened in the field following the procedures outlined in *Soil Sampling SOP OER-0120*, *Soil Sampling Using Direct-Push Drilling SOP OER-0121*, *PID/FID Field Screening SOP OER-0101*, and *XRF Field Screening SOP OER-0102* to determine the likely hotspots within each soil boring. Then a sample(s) will be collected from the depth(s) of the boring where there is obvious staining, odors, relatively high XRF readings for the metals of potential concern and/or the highest PID/FID readings.

Option 3: Using Laboratory Data

This option requires collecting extra surface and subsurface soil samples for SPLP/TCLP analyses from each boring while in the process of collecting conventional soil samples following the procedures outlined in *Soil Sampling SOP OER-0120*, *Soil Sampling Using Direct-Push Drilling SOP OER-0121*, *PID/FID Field Screening SOP OER-0101*, and *XRF Field Screening SOP OER-0102*. Once the conventional soil analyses have been completed in the laboratory, the choice of which samples to run for SPLP/TCLP analysis can be made based on where the known hotspots are located as in Option 1 above. The remaining soils that will not be used for SPLP/TCLP analysis will need to be disposed of as Investigation Derived Waste. This option requires collecting far more soil samples than necessary but allows for determining a more limited set of soil samples to analyze for SPLP/TCLP than Option 2 when there is no historical soil data.

7.3 Sample Collection

Once the sample locations have been determined, the soil samples should be collected following the procedures outlined in *Soil Sampling SOP OER-0120* according to the requirements of the analytes to be processed. Note that SPLP/TCLP can also be run on sediments, in which case the sediments should be collected following the procedures outlined in *Sediment Sampling SOP OER-132*. The specific requirements for collecting SPLP/TCLP soil samples should be found in the SAWP, but the following are the general requirements for different analytes:

- **VOCs:** At least 25 g of soil (preferably 50 g) with no headspace in an amber glass jar, cooled to $\leq 6^{\circ}\text{C}$ but without freezing and extracted within 14 days

- **SVOCs:** At least 300 g of soil (preferably 500 g) with no headspace in a glass jar, cooled to $\leq 6^{\circ}\text{C}$ but without freezing and extracted within 14 days
- **Pesticides:** At least 300 g of soil (preferably 500 g) in a glass jar, cooled to $\leq 6^{\circ}\text{C}$ but without freezing and extracted within 14 days
- **Metals:** At least 100 g in a glass jar, cooled to $\leq 6^{\circ}\text{C}$ but without freezing and extracted within 180 days
- **Mercury:** At least 100g in a glass jar, cooled to $\leq 6^{\circ}\text{C}$ extracted within 28 days.

7.4 Interpreting SPLP/TCLP results

If the SPLP/TCLP sample results are below the relevant groundwater standards, then no further assessment of groundwater is needed due to the releases in question. However, if the SPLP/TCLP sample results are above the relevant groundwater standards then further assessment of groundwater will be required. The further assessment can take one of two paths:

1. Consult your WVDEP Project Manager about determining a site-specific dilution factor from the leachate to the groundwater and rescreen the results.
2. Collect groundwater samples for analyses and screen the concentrations against the relevant groundwater standards.

8.0 CALCULATIONS

This section is not applicable to the SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

There are no specific QA/QC activities that apply to collecting SPLP/TCLP samples in the field, but the following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAWP.
- The collection of an equipment rinsate blank is recommended to evaluate potential for cross-contamination.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAWP and/or *QAPrP* for further information on collection of duplicate samples.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis.

Refer to the site-specific SAWP and/or *QAPrP* for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered to when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with soil sampling:

- Exposure to unknown contaminants, with particular attention to potentially explosive or flammable atmospheres.
- Lifting injuries associated with moving equipment and lifting coolers with samples.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slips, trips, and fall hazards.
- Biohazards, such as snakes, biting insects and poison ivy.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions, as well as known contaminants, as required by the Hazard Communication Standard requirements set forth in the OSHA regulations. Investigation derived waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

American Society of Testing and Materials (ASTM). 1995. *Annual Book of ASTM Standards, Designation D4972 - 95a: Standard Test Method for pH of Soils.*

United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. 1996. *Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Method 1311: Toxicity Characteristic Leaching Procedure, Revision 0, July 1992*

United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. 1996. *Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Method 1312.*

Passive Diffusion Bag (PDB) Sampling

SOP OER-0135

Prepared for:
West Virginia Department of Environmental Protection
Division of Land Restoration
Office of Environmental Remediation

Author	Revision No.	Effective Date	Description of Changes	Type of Change
Ross Brittain	0.0	1/10/2021	Created new SOP and SOP ID#	Editorial, Technical

PASSIVE DIFFUSION BAG (PDB) SAMPLING
SOP OER-0135

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List of Acronyms and Abbreviations

bTOC	below Top of Casing
CoC	Contaminants of Concern
DI	Deionized Water
DQO	Data Quality Objectives
ft	Feet/foot
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
ID	Identification
IDW	Investigation Derived Waste
ITRC	Interstate Technology and Regulatory Council
MTBE	Methyl Tert-Butyl Ether
OER	Office of Environmental Remediation
OSHA	Occupational Safety and Health Administration
SAP	Sampling and Analysis Plan
SAWP	Site Assessment Work Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
TOC	Top of Casing
PDB	Passive Diffusion Bag
PPE	Personal Protection Equipment
QA/QC	Quality Assurance/Quality Control
QAPrP	Quality Assurance Program Plans
VOC	Volatile Organic Compound
WVDEP	West Virginia Department of Environmental Protection

Disclaimer: Any mention in this SOP of any products or services does not constitute or imply the endorsement, recommendation or favoring by WVDEP or any of its employees or contractors acting on its behalf.

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to outline the methods and equipment used to collect representative groundwater samples using Passive Diffusion Bags (PDB). This SOP should be used in conjunction with the *Groundwater Well Sampling Procedures* SOP OER-0110. The laboratory procedures for specific analyses are determined by the SOPs within the respective laboratories and outside the scope of this SOP. These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations and/or limitations imposed by the procedure. Experience, objectives, site characteristics and chemical characteristics will dictate sampling strategy. Thus, alternate methods of collecting samples may be proposed for the site and the West Virginia Department of Environmental Protection (WVDEP) Office of Environmental Remediation (OER) will review the merits of such alternatives for potential approval. The procedures utilized at a site should be documented and included in the site assessment report.

2.0 SUMMARY OF METHOD

Diffusion sampling is based on the underlying principle that there is constant, mostly horizontal flow from the aquifer through the saturated screened interval and that this flow, along with molecular diffusion, causes water within the saturated well screen to have the equivalent contaminants and concentrations as the surrounding aquifer. Diffusion sampling devices consist of one or more semipermeable membranes formed into a tubular shape, sealed at the bottom and filled with laboratory-grade deionized (DI) water. The top is typically manufactured with a nozzle for filling the sampler with the DI water. However, some diffusion samples are pre-filled with DI water by the manufacturer and sealed at both ends. The PDB sample is then suspended in the saturated screen zone of the monitoring well using a suspension tether assembly and left in place for chemical equilibration to occur. When the PDB is installed, a concentration gradient will exist between the contaminants outside the PDB and the DI water inside. The semipermeable membrane will allow certain molecules to pass through the membrane without restriction, so that during the residence time, the concentration gradient causes molecules to flow in or out of the sampler until equilibrium is achieved. The PDB is removed from the well after enough time to achieve equilibrium and the water within the sampler is transferred to the appropriate laboratory container and analyzed by standard laboratory methods. Consult the manufacturer to determine the appropriate sampler membranes suitable for the compounds of interest as well as recommended equilibration time. Specific details for sampling at any location should be found in the Sampling and Analysis Plan (SAP) or Site Assessment Work Plan (SAWP, hereafter both are referred to as SAWP).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The type of sample container, the preservative, holding time, and filtering requirements are all dependent upon the type of analysis to be performed. This information should be clearly set forth in the SAWP for the site. The sampler should consult the SAWP for all pertinent information relating to the proper sample preservation, type of containers, handling, and storage procedures for their project. A pair of clean, new, non-powdered disposable gloves shall be worn each time a different location is sampled to prevent cross-contamination. Samples should be collected directly from the PDB into appropriate laboratory cleaned containers, without

making contact with the sampling device. Samples shall be appropriately preserved, labeled, and placed in a cooler to be maintained at $\leq 6^{\circ}\text{C}$, but without freezing the sample, in accordance with the SAWP requirements. The samples should be shipped with adequate packing and cooling to ensure that they arrive at the laboratory intact and still cold. Refer to Table 2 of the WVDEP OER Quality Assurance Program Plan (*QAPrP*) for information on sample containers, preservation, and holding times for common contaminants

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The goal is to obtain a representative sample of the groundwater. Proper field sampling techniques need to be utilized in order to ensure that a representative sample is collected and the sampler does not compromise the sample through their actions. Analysis can be compromised by field personnel in three primary ways; taking an unrepresentative sample, by incorrectly handling the sample, or by improperly labeling the sample. There are a variety of ways to introduce contaminants into a sample; that is why it is very important to follow sampling protocols. Potential interferences that may be encountered are inherent to the analytical methods used for the extracts.

5.0 EQUIPMENT APPARATUS

The following equipment and materials may be required to conduct PDB groundwater sampling, depending on the sampling and analytical methods. Refer to the SAWP to determine specific needs for any given project:

- Field data sheets and samples labels;
- Chain of custody records and seals;
- Sample and shipping containers;
- Pails, tubs, or buckets;
- Personal protective equipment (PPE);
- Site-Specific Health and Safety Plan (HASP);
- Job Hazard Assessment;
- Air monitoring equipment, if required in the HASP;
- Site Access: agreements, photo identification, property owner contacts, keys, tools, etc.;
- Site Documentation: Site map with sampling locations, list of wells to be sampled, field;
- Logbook, Monitoring Well Sampling Forms, Well Construction Diagrams, etc.;
- Water level indicator and other instrumentation as required to meet site Data Quality Objectives (DQOs);
- Decontamination supplies;
- Laboratory-supplied containers with proper preservation;
- Coolers/shipping containers, ice and packing media;
- Deionized water travel blanks provided in sampler membrane materials when pre-filled samplers are used.

6.0 REAGENTS

Refer to the site-specific SAWP for the preservatives required for the specified analysis to be performed. The following reagents may be used for PDB sampling:

- Deionized water

7.0 PROCEDURES

7.1 PDB Sampler Depth

One or more passive diffusion samplers are suspended at predetermined depths in the saturated screen to intercept groundwater flow and produce a representative sample of the contaminants and their concentrations at that depth. If it is known that the aquifer adjacent to the saturated screen is somewhat homogeneous and the contaminants are not stratified, then a single sampler can be used to represent the entire saturated screen length. In the absence of those conditions or other knowledge about the well and contaminants, a single sampler should not be used to represent a vertical interval of more than about five feet. Wells having longer saturated screens or unknown stratification may be profiled using several samplers at intervals across the screen length for sampling specific intervals or to determine future placement of one or more samplers. Diffusion sampler depth setting is typically referred to by the mid-point of the sampler. This ability to characterize aquifer stratification is a key advantage of the PDB method in assessing site contamination and potential risks and remedies.

7.2 Considerations

- A. Select the sampler type for sampling the contaminants of concern (COC). Single membrane passive diffusion bag samplers are only viable for volatile organic compounds (VOCs). Multi-membrane samplers will provide reliable samples for virtually any COC however, verify specific COCs with the manufacturer.
- B. Select the sampler size to fit the well diameter, saturated screen and sample volume requirements. If adequate sample volume may be difficult to acquire, ask the laboratory for the Minimum Volume Requirements to meet the site Data Quality Objectives. In most cases the laboratory will be able to perform the analyses with significantly reduced sample volume.
- C. If there is any question regarding the integrity of the sample when collected, a new PDB should be deployed at that time so that a new sample could be provided to the laboratory two or three weeks later if the laboratory data are questionable.

7.3 PDB Samplers filled with Deionized Water

Some laboratories provide laboratory-grade water for the user to fill empty samplers before deployment and some laboratories may provide PDBs pre-filled with laboratory-grade water. If samplers are purchased empty, consult the manufacturer's filling instructions. A Fill Water Travel blank, constructed from the sampler membrane materials and the same lot of DI water used to fill the samplers, should be ordered or produced and accompany the samplers from the point of filling to the project site. A spare sampler may also be used to contain a travel blank.

Because diffusion samplers will equilibrate with the surrounding groundwater, low concentrations of diffusible compounds that may be in the sampler or fill water prior to installation will equilibrate with the surrounding groundwater. There are several compounds, including acetone, methyl tert-butyl ether (MTBE) and butanone compounds, that may not equilibrate when using a single membrane polyethylene diffusion sampler for VOCs. In these cases, and for general data quality reporting, a certificate of analysis of the lot of water used to fill the samplers and a fill/travel blank representing any compounds that enter the sampler during transportation and storage and are in the sampler at the time of deployment is required. Travel blanks should be sampled at the project site during the deployment process. Typically, one sampler per site per round of deployment is used.

7.4 PDB Sampler Residence Time Requirements

The required sampler residence time requirement is dependent on two phases; the well must first stabilize and return to its natural flow conditions after being disrupted by the installation of the sampler, followed by the sampler contents coming into chemical equilibrium with the surrounding groundwater. It is generally accepted that two weeks is the minimum residence time to cover installation and equilibration when sampling for VOCs and three weeks when sampling for metals, inorganics and other compounds. There has not been shown a maximum residence time, as the diffusion process maintains a dynamic equilibrium, keeping the sampler at the same concentrations as the surrounding groundwater even as changes in the aquifer occur. However, extended sampler residence time can lead to a loss in sampler bag integrity that should be considered when designing any sampling strategies.

For cost savings and logistics, samplers can be installed during one event and left in place until the next sampling event and then removed, sampled and replaced for the next event. EonProduct Samplers have been used successfully in this manner with sampling intervals longer than one year, but the Interstate Technology and Regulatory Council (ITRC) indicates potential losses of bag integrity as residence times approach one year. Sample strategies with residence times greater than three months should be prepared for potential losses and are not recommended. Because the diffusion process requires some time and occurs at differing rates for

each compound, the acquired sample will represent the chemistry of the past few days in residence, to about one week prior to removal of the sampler from the well. If significant seasonal effects are potential at your site, the PDB sampler removal timing will need to be adjusted accordingly.

7.5 PDB Sampler Installation Assembly

Dedicated sampler suspension tether assemblies can be made to order by the PDB supplier, are re-usable, and reduce the time and effort required to measure and construct these cleanly in the field. Because the assemblies are a one-time investment, with only the disposable samplers requiring replacement, it is recommended that dedicated PDB assemblies (tethers, reels, and weights) be purchased ready-made from the supplier to ensure compatibility.

- A. To ensure that project deadlines are met, contact the sampler and tether-assemblies supplier as far in advance as possible, preferably at least two weeks before the planned PDB deployment date. If this is the first use of diffusion samplers in any well, deploy the samplers in the wells at least two to three weeks (depending on sampler type and contaminants of interest) before the planned sampling date.
- B. To order pre-made PDB assemblies, provide the supplier with the following information:
 - a. Well identification (ID)
 - b. Well diameter
 - c. Total depth of well at the time of installment (feet below top of casing (ft bTOC))
 - d. Screened interval (ft bTOC)
 - e. Number of samplers per well and desired sampling depths of each
 - f. Ship-to address and purchase order number (project number)
- C. Each standard dedicated diffusion sampling assembly, as provided by the supplier, should include the following:
 - a. Diffusion sampler bag (disposable)
 - i. select prefilled with Lab grade DI water by manufacturer, or
 - ii. unfilled for filling by the lab or
 - iii. for filling by the sampling team
 - b. Stainless steel weights with split ring connectors
 - c. Tether made of braided polypropylene rope on a plastic reel
 - d. Embedded stainless steel connection rings at sampler depths-2 per sampler
 - e. Aluminum tag with well ID inscribed
 - f. Snap connectors
 - g. Cable ties
 - h. Well caps (optional: prepared with rings from which to suspend tethers in the well)
 - i. Discharge tubes (disposable)
 - j. DI water (for unfilled samplers)

- k. DI water travel-blank (for prefilled samplers, minimum one per shipment)
- l. DI water certificate of analysis for water used to fill the samplers

7.6 Filling and Transporting PDB Samplers

- A. All sampler bags should be filled at a single time to save time and minimize the potential for contamination, before mobilizing to the various wells for deployment. Care should also be taken to prevent contamination of the water inside the bag by placing and storing the bags on/in clean surfaces, such as clean plastic sheeting. However, if phthalates are part of the contaminants of potential concern at the site, then plastic sheeting may cross-contaminate the PDB sample and should not be used for bags intended to sample phthalates. In that case, a clean stainless steel surface would be appropriate.
- B. Wear disposable, powder-free latex or nitrile gloves to prevent cross-contamination.
- C. If the samplers are not pre-filled, fill the sampler with laboratory-grade DI water and follow the manufacturer's instructions for filling the samplers so that the sample bag is expanded to its maximum capacity. Remove visible air pockets.
- D. Filled sample bags should be placed in a clean poly bag and the poly bags placed in a clean cooler with a tight-fitting lid, for transportation to and on the site to reduce potential contamination.
- E. From the point the samplers are filled with DI Water, the travel blank should travel with the samplers at all times. The project manager should decide at which location on-site the blank should be placed during sampling activities.

7.7 Installing Suspension Tethers and PDB Samplers

If the suspension tether has already been installed and is in use in the well, go to Section 7.8. *Retrieving and Sampling PDB Samplers* for information on removing installed samplers before installing new samplers. If the suspension tether is new and hasn't been previously installed, follow the manufacturer's directions to;

- A. Unpackage the spooled tether. The weights should be attached to the ring on the leading end of the rope. If not, find the correct weight and attach.
- B. Find the Well ID Tag located on the spooled tether. Match the ID tag to the well ID.
- C. Place the weighted leading end of the suspension tether into the well and slowly lower until a small diameter (~0.50-in) stainless steel ring is located on the tether. A second ring should be located further up the rope at a distance slightly more than the length of the sampler.
- D. Use a Zip-Tie to attach the bottom ring or loop on the sampler to the lower of the two rings embedded in the tether. Use a Zip-Tie to attach the loop near the top of the sampler to the upper stainless-steel ring on the tether. Repeat the sampler attachment process for each set of rings on the tether if more than one sampler is used in the well. Optionally trim the excess Zip-Tie. (Do NOT

hold the sampler over the well before attaching zip-ties to prevent accidental loss down the well.)

- E. Once all the samplers are securely attached to the tether rings continue to lower the tether into the well until the black snap connector is located on the tether. It is usually clipped to the spool.
- F. Hold the tether or otherwise secure it so that it cannot slip free down the well and move the snap connector from the spool to the ring on the underside of the well cap.
- G. If there is extra tether rope past the snap connector, place the rope in the well so it hangs alongside the tether. The excess can be zip-tied to the tether if preferred. The extra length allows for field lowering the assembly if the well depth or sampler location is deeper than reported. When the well cap is installed the stainless-steel weight will typically be resting on the well bottom and the sampler will be in the desired position within the screened interval.
- H. More than one sample bag may be deployed in-line along a single tether assembly to allow samples to be collected from discrete depths within the screened interval. In wells larger than two inches, samplers may be placed side by side to obtain more volume if duplicates are needed and the volume of the selected sampler is not adequate. A heavier weight will be needed to hold multiple sample bags in place.
- I. If the well has become silted such that the actual total depth is less than the total depth when the well was installed, the portion of the pre-made tether between the weight and the sample bag can be shortened by creating several small loops and securing them with a cable tie. DO NOT cut the tether to shorten it, because the full length will be needed if the well is redeveloped and restored to its original depth.
- J. Record the water level and the date, time, and depth of sampler installations in the field notebook. Note any occurrences during deployment.

7.8 Retrieving and Sampling PDB Samplers

- A. To avoid loss of analytes, do not retrieve the PDB unless you are ready to sample it immediately. Samples should be decanted into laboratory containers immediately upon retrieval.
- B. Remove the sample bag from the well by reeling the tether onto the dedicated reel. Secure the rope and/or reel so that the weighted tether and samplers do not spool back down the well. This can be done by tying off the rope to the casing or hanging some types of spools on the top of the casing or using a tripod assembly over the well. Small leaks do not interfere with the results provided there is adequate sample volume. Users should make efforts to protect themselves from contact with contaminated samples and spray.
- C. Remove the sampler from the tether by carefully using a small snipping tool to cut the zip-ties that hold the sampler to the rings on the tether. Be careful to not let anything touch the area of the sample bag where you intend to insert the discharge tube.

- D. Open one end of the plastic wrapper containing the discharge tube and, leaving this wrapper on the tube, puncture the upper part of the sample bag (similar to inserting a straw into a juice-box). It may help to hold the sampler at the upper nozzle area to reduce squeezing.
- E. Remove the plastic wrapper from the discharge tube and let the straw purge for a second or two and then fill the laboratory-supplied containers in the usual manner, manipulating the sample bag to start and stop flow as needed.
- F. If VOCs and other compounds are collected from the same sampler, fill the VOC containers first, being sure to leave no headspace in the containers.
- G. Collect field duplicates as needed by filling a second set of laboratory-supplied containers immediately after collecting the first set.
- H. Prepare and ship all samples as usual to meet standard lab requirements.
- I. Dispose of the remaining water in the PDB as investigation derived waste (IDW) or as directed by the project manager.
- J. At the project manager's discretion, new sample bags for the next sampling event may be deployed at this time to avoid an additional mobilization.

7.9 Decontamination and Disposal

- A. If new sample bags are not deployed during the sampling event the dedicated suspension tether assemblies may be left in the well or, if the project manager does not want to leave the dedicated tether assemblies in the well, reel the entire assembly onto the dedicated reel (having marked the reel with the well ID using an engraver or marker) and secure the tether with cable ties. At the project manager's discretion, segregate secured assemblies in plastic bags by level of contamination. It may be desirable to rinse the tethers with DI water to prevent potential recontamination of the well water. The potential for carry-over effects of cleaning agents, such as Alconox, has not been explored. Therefore, the use of cleaning agents is discouraged until research shows they have no significant impacts on groundwater contaminant concentrations. ONLY use a tether in the well originally designated for that specific tether.
- B. Dispose of the spent PDB in the same manner as other disposable items such as latex gloves, tubing, etc., or as directed by the project manager.

8.0 CALCULATIONS

This section is not applicable to the SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

There are no specific QA/QC activities that apply to collecting PDB samples in the field, but the following general quality assurance procedures apply:

- All data must be documented on field data sheets and/or within the field logbook.
- All instrumentation should be operated and calibrated in accordance with the manufacturer's instructions unless specified otherwise in the site-specific SAWP.

- The collection of an equipment rinsate blank is recommended to evaluate the potential for cross-contamination by rinsing the dedicated tethers and reels before they are lowered into a well for a new round of sampling.
- The collection of duplicate samples will likely be required for the project. Refer to the site-specific SAWP and/or *QAPrP* for further information on collection of duplicate samples.
- Trip blanks are required for each cooler with samples for volatile organic compounds analysis as well as one trip blank PDB for each day of sampling.

Refer to the site-specific SAWP and/or *QAPrP* for specific quality assurance/quality control measures that may be applicable for the given project.

10.0 DATA VALIDATION

Data validation requirements set forth in the site-specific SAWP or *QAPrP* shall be adhered to for any given project. Results of quality control samples will be evaluated for contaminants. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives as set forth in the site-specific SAWP and/or *QAPrP*.

11.0 HEALTH AND SAFETY

OSHA regulations should be adhered to when working with potentially hazardous materials. Personnel performing environmental work at OER sites should have their 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with 8 Hour refreshers as appropriate. Some level of Personal Protective Equipment (PPE) is generally required for all sampling and decontamination activities. The appropriate level of PPE for these activities may be found in the site-specific SAWP and/or the Site Health and Safety Plan (HASP). Personnel should adhere to the safety requirements outlined in the site-specific plans. The following is a summary of just some of the hazards associated with groundwater sampling:

- Exposure to unknown contaminants, with particular attention to potentially explosive or flammable atmospheres.
- Lifting injuries associated with moving equipment, coolers with samples, and pulling bags out of the monitoring wells.
- Heat/cold stress as a result of exposure to extreme temperatures and the use of PPE.
- Slips, trips, and fall hazards.
- Biological hazards such as insects, snakes, spiders and poison ivy.

Safety data sheets (SDS) should be readily available on-site for all decontamination solvents or solutions as required by the Hazard Communication Standard requirements set forth in the OSHA regulations, as well as each of the contaminants of potential concern that may be in the water samples. Investigation derived waste (IDW) generated from decontamination activities requires proper handling, storage, and disposal. Refer to the site-specific SAWP for IDW procedures.

12.0 REFERENCES

EON Products, Inc. 2019. Standard Operating Procedures for Groundwater Sampling Using Passive Diffusion Samplers 2.0. <https://www.eonpro.com/wp-content/uploads/2019/08/Diffusion-Sampler-PDB-SOP-2.0.pdf>.

Interstate Technology Regulatory Council (ITRC). 2002. *Technical and Regulatory Guidance Document for Using Polyethylene Diffusion Bag Samplers to Monitor Volatile Organic Compounds in Groundwater*. Tech-Reg Document.

Interstate Technology Regulatory Council (ITRC). 2006. *Technology Overview of Passive Sampler Technologies*. Technology Overview.

United State Geological Survey (USGS). 2001. *User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells*.

Attachment 5, Required Documentation





Department of Administration
 Purchasing Division
 2019 Washington Street East
 Post Office Box 50130
 Charleston, WV 25305-0130

State of West Virginia
 Centralized Expression of Interest
 Architect/Engr

Proc Folder: 1736767			Reason for Modification:
Doc Description: OER- EOI SEMS Evaluations			
Proc Type: Central Purchase Order			
Date Issued	Solicitation Closes	Solicitation No	Version
2025-08-19	2025-09-10 13:30	CEOI 0313 DEP2600000002	1

BID RECEIVING LOCATION

BID CLERK
 DEPARTMENT OF ADMINISTRATION
 PURCHASING DIVISION
 2019 WASHINGTON ST E
 CHARLESTON WV 25305
 US

VENDOR Triad Engineering, Inc.

Vendor Customer Code: 000000203587

Vendor Name : Triad Engineering, Inc.

Address : 10541
Street : Teays Valley Road
City : Scott Depot
State : WV **Country :** USA **Zip :** 25560

Principal Contact :

Vendor Contact Phone: (304) 755-0721 **Extension:**

FOR INFORMATION CONTACT THE BUYER
 Joseph (Josh) E Hager III
 (304) 558-2306
 joseph.e.hageriii@wv.gov

Vendor Signature X  **FEIN#** 55-0592364 **DATE** 9/10/25

DESIGNATED CONTACT: Vendor appoints the individual identified in this Section as the Contract Administrator and the initial point of contact for matters relating to this Contract.

(Printed Name and Title) Heather Metz

(Address) 10541 Teays Valley Road Scott Depot, WV 25560

(Phone Number) / (Fax Number) (304)755-0721

(email address) hmetz@triadeng.com

CERTIFICATION AND SIGNATURE: By signing below, or submitting documentation through wvOASIS, I certify that: I have reviewed this Solicitation/Contract in its entirety; that I understand the requirements, terms and conditions, and other information contained herein; that this bid, offer or proposal constitutes an offer to the State that cannot be unilaterally withdrawn; that the product or service proposed meets the mandatory requirements contained in the Solicitation/Contract for that product or service, unless otherwise stated herein; that the Vendor accepts the terms and conditions contained in the Solicitation, unless otherwise stated herein; that I am submitting this bid, offer or proposal for review and consideration; that this bid or offer was made without prior understanding, agreement, or connection with any entity submitting a bid or offer for the same material, supplies, equipment or services; that this bid or offer is in all respects fair and without collusion or fraud; that this Contract is accepted or entered into without any prior understanding, agreement, or connection to any other entity that could be considered a violation of law; that I am authorized by the Vendor to execute and submit this bid, offer, or proposal, or any documents related thereto on Vendor's behalf; that I am authorized to bind the vendor in a contractual relationship; and that to the best of my knowledge, the vendor has properly registered with any State agency that may require registration.

By signing below, I further certify that I understand this Contract is subject to the provisions of West Virginia Code § 5A-3-62, which automatically voids certain contract clauses that violate State law; and that pursuant to W. Va. Code 5A-3-63, the entity entering into this contract is prohibited from engaging in a boycott against Israel.

Triad Engineering, Inc.

(Company) 

(Signature of Authorized Representative)

Tom Chandler, Controller/Treasurer 9/10/2025

(Printed Name and Title of Authorized Representative) (Date)

(304) 755-0721

(Phone Number) (Fax Number)

tchandler@triadeng.com

(Email Address)

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.:

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:

(Check the box next to each addendum received)

- | | |
|---|--|
| <input type="checkbox"/> Addendum No. 1 | <input type="checkbox"/> Addendum No. 6 |
| <input type="checkbox"/> Addendum No. 2 | <input type="checkbox"/> Addendum No. 7 |
| <input type="checkbox"/> Addendum No. 3 | <input type="checkbox"/> Addendum No. 8 |
| <input type="checkbox"/> Addendum No. 4 | <input type="checkbox"/> Addendum No. 9 |
| <input type="checkbox"/> Addendum No. 5 | <input type="checkbox"/> Addendum No. 10 |

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

Triad Engineering, Inc.

Company



Authorized Signature

9/10/2025

Date

NOTE: This addendum acknowledgment should be submitted with the bid to expedite document processing.

Non-Conflict of Interest Statement

(as per 40 CFR 36.6550)

“Triad Engineering, Inc. knows of no actual, apparent, or potential conflict of interest regarding any individual that we propose to have work on this contract assignment or have access to information regarding this contract. This notification includes both organizational conflicts of interest and personal conflicts of interest. If a personal conflict of interest exists, the individual who is affected shall be disqualified from taking part in any way in the performance of the assigned work that created the conflict-of-interest situation.”



9/10/25

Signature

Date

Controller/Treasurer

Title

Triad Engineering, Inc.

Company

Our Services:

- Civil Engineering
- Geotechnical Engineering
- Environmental Services
- Survey and Mapping
- Landscape Architecture
- Construction Monitoring
- Drilling and Sampling
- Laboratory Testing



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WEST VIRGINIA

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